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Coordination and Control of Globally Distributed Software Projects

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Coördinatie en controle van internationaal verspreide software projecten

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PART 1 INTRODUCTION

The first part of this thesis introduces the background and focus of our study. It elaborates on research questions, and outlines the structure of this thesis.

Chapter 1 Context and Focus

In this chapter, we sketch the context of global software projects, and elaborate on challenges reported in literature. The section outlines how our research contributes to understanding these challenges. It elaborates on our focus and research questions.

§ 1.1 Background of the Research

Around early 1990s, firms in countries like the US, Canada, Western Europe and Singapore started to outsource software projects to offshore vendors in India, China, Ireland and the Philippines. In the former countries, an increasing number of IT projects was initiated to streamline international business processes and infrastructures. Enterprise Resource Planning software (ERP) became popular as a tool for standardization and integration across functions and locations. Also, firms were eager to ensure on time readiness for the Y2K problem,[1] and they started to implement new web-based e-commerce solutions. All this boosted demand for IT services beyond supply. Average wages for IT professionals started to soar, pushing IT project costs up.

IT industry in offshore countries - especially India - benefited from this trend. They could source from a considerable pool of local IT professionals who worked at comparatively low wages. Gradually, with local government assistance, high-tech centers emerged around cities like Bangalore and Hyderabad (Heeks, 1996). Vendors based in these centers - Tata, IMR, and Wipro - evolved into huge IT service firms with presence throughout the world. They organized and improved business processes according to international quality standards (ISO, CMM) to built trust with customers in North America and Western Europe. This enabled top-tier vendors from India to shift their strategic focus towards high added value work and long term partnerships (Shekar, 1999). Multinational firms from the US and Europe were eager to tap into these evolving resource centers. They include IT

[1] Many systems in the 70s were coded with only 2 digits for programming a year. For instance, only 80 for 1980. This was done to economize on memory usage. The Y2K - Year 2000 - problem is that in that year 00 could also mean 1900. Therefore, systems that depend on annual dates - like financial systems - could be disrupted and become unstable. Concerns with the consequences of this problem led to huge investments in checking software codes for the annual digits and replacing these with 4 digits (so that e.g. 1990 and 2000 are distinguished). Many firms translated the problem into an opportunity. They implemented new systems like ERP that are Y2K ready.

multinationals (Microsoft,[2] Oracle, SAP, and IBM), and software divisions of companies operating in other industries (GE, Philips, Northern Telecom, KLM Royal Dutch Airlines).[3] These firms have different ways to benefit from India's IT industry: they outsourced ad-hoc projects to Indian vendors, or established their own local presence in India. Or they developed sustainable partnerships with local firms (Offshore Development Centers[4]).

Offshore software projects drew the interest of professional and academic researchers (Krepchin, 1993; Kumar & Willcocks, 1996; Meadows, 1996a; Millar, 1999; Ravichandran & Ahmed, 1993). Early research efforts revealed many issues in these projects, like delays, difficulty with time zones, and quality concerns. For instance, in 1995 K. Kumar (Florida International University, and Erasmus University) and L.P. Willcocks (Warwick Business School) conducted a study at Holiday Inn in Atlanta, GA (Kumar & Willcocks, 1996). They were interested in an Information Technology (IT) project that was partially outsourced to a vendor company in India. Initially, vendor staff worked onsite in Atlanta, together with people from Holiday Inn. A local team of vendor and Holiday Inn staff emerged with its own way of collaborating. This process was interrupted when visas were not renewed for the Indian team members. They returned to Bangalore, India with the intention to continue their participation in the project from offshore. Things turned out differently: collaboration became less predictable and frequent. In India, members of the original team were replaced by novices. Mistakes were made that were unthinkable when the whole team was in Atlanta (Kumar & Willcocks, 1996).

From this initial stream of research, a number of interesting questions emerged: Why was the period of remote collaboration so different from the preceding period on-site? Why was it more difficult and less successful? How does global distributedness of team members impact the effectiveness and success of a project?[5] In order to answer these questions, they decided to start new research. In 1996, K. Kumar setup a 4-year study at the Department of Decision and Information Sciences at Rotterdam School of Management, Erasmus University in the Netherlands. He hired and worked jointly with the author to explore the uniqueness and challenges of globally distributed collaboration. This thesis publication reports on that study.

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[2] Commercial names for products and organizations are used throughout the text, like Oracle, Lotus Notes. The author acknowledges the property rights of the respective organizations.

[3] Some firms started to fly in Indian software professionals, a form of insourcing (Hirschheim & Lacity, 2000). This results in a collocated team of client-vendor staff. Since our focus is on remote collaboration, we do not elaborate on this phenomenon as such.

[4] These centers are owned by Indian vendor firms like Wipro but operate exclusively for customers, sometimes from physically separate locations.

[5] In this thesis, *distributedness* implies that people are located at different sites. *Distributedness* and *dispersion* are used interchangeably. *Global* refers to the earth, so *global distributedness* and *global dispersion* mean two or more sites on this planet.

§ 1.2 Phenomenon

In fact, onshore-offshore collaboration, or more in general globally distributed collaboration is not really new.[6] Remote collaboration, even across the globe, has been around for ages. Rome's political, military, and religious system stretched from Africa's north coast to northern Europe, and from England to Germanic areas. Huge countries like the United States, Canada and China have always required connectivity across vast distances. Commercial examples abound too. Around the 16th and 17th century, representatives from Spain, Portugal, and the Netherlands roamed South American and Pacific coasts to establish local presence and trading connections. Similarly, multinational corporations like the Hudson's Bay Company managed large numbers of dispersed sites (O'Leary, Orlikowski, & Yates, 2002).

Still, today's examples of globally distributed collaboration are different.

Back then, sites were connected, but they did not collaborate on a day-to-day basis. Sustaining cohesion relied more on carefully selected representatives that roamed the network of sites to maintain commitment and standards (Edström & Galbraith, 1977). Rotating these people ensured some consistency and control. In addition, messengers and messages connected sites with infrequent, regular intervals (O'Leary, Orlikowski, & Yates, 2002). These communication means relied on basic transportation technology like walking, animals (camels, horses, the Pony Express), smoke signals (native North Americans), fire signals at night (Middle East), and ships. Later, the invention of engines led to ships, trains and vehicles to transport messengers or messages more frequently.

The invention of electricity and various applied technologies promised a new level of remote 'togetherness'. Subsequent inventions like telegraph, telephone, radio, television, satellite, and computer networks made the suggestion of distant connectivity more realistic and convincing. Each wave of new technologies enhanced the affordability, reliability, interactivity, and richness of remote communication. This changed (1) the nature and scope of remote collaboration, and (2) its role in today's societies.

§ 1.2.1 Nature and Scope of Remote Collaboration

Changes in nature and scope are illustrated with the two dimensions depicted in Table 1. We developed this matrix that shows the intensity of collaboration across the rows.

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[6] *Globally distributed* refers to vast spatial separation of two or more actors on the globe - planet earth. We focus only on distributed collaboration between human beings. Remote interaction between human beings and a system, artifact, or robot is therefore not the principal focus of this study.

Second, the columns depict the scope of collaboration, i.e., geographical dispersion: collocation, regional distance dispersion, and global distance dispersion.[7]

Table 1 - Collaboration and dispersion

(1) Nature of collaboration				
	Intense	Local projects	Regional projects	Global projects
	Loose	Local, loosely coupled collaboration	Regional, loosely coupled collaboration	Global, loosely coupled collaboration
		Collocation	Regional distance dispersion	Global distance dispersion
		(2) Geographical dispersion		

The first dimension includes loose collaboration implies that the work of two or more actors is connected, but only to a limited extent (Orton & Weick, 1990). Intense collaboration, on the other hand, means that tasks are closely intertwined (Van de Ven, Delbecq, & Koenig Jr, 1976). An example of close collaboration is a project - or temporary system[8] - which requires frequent communication and adjustment (Goodman, 1981). Our research focuses on projects as forms of intense collaboration (the first row). The second dimension refers to the level of geographical dispersion, i.e., the number of miles of kilometers between sites on planet earth. This is a continuum: from collocation up to maximally the other end of the globe. We give here as an example three points on that range: collocation, regional distance dispersion, and global distance dispersion.

Collocation implies that two or more actors work mostly on the same site, like a traditional office environment (Davenport & Pearlson, 1998). With regional distance dispersion, people collaborate within a country, or across borders of neighboring countries. Examples include projects within the European Union (Airbus), or the United States (NASA). Finally, global distance dispersion indicates inter-continental collaboration, and situations where people are separated by vast distances and time zones. The earlier mentioned Holiday Inn project is an example of globally dispersed project collaboration. People collaborated from Atlanta, GA and Bangalore, India. This study focuses on the right upper cell (shaded gray in Table 1).

[7] *Global distance dispersion* refers here only to geographical distance. We refer to global dispersion as a broader concept that includes other possible dimensions of dispersed collaboration like cultural and infrastructural differences.
[8] The terms *project* and *temporary systems* are used interchangeably (Bryman, Bresnen, Beardsworth, Ford, & Keil, 1987). Our focus is on civil, non-military projects.

The scope of dispersed projects has been extended beyond two or more sites on the surface of planet earth. Remote collaboration[9] may also include projects with below-surface sites (mining, deep sea exploration). And aerospace projects, like the International Space Station that requires collaboration between multiple spacecraft and ground control sites. With current technologies, people may be located in any of these dimensions. They can collaborate within the same spatial dimension (like two sites on the surface of planet earth, or communication between two aircraft). Or their counterparts can be located in another spatial dimension, e.g., ground control and manned spacecraft, or Air Traffic Control.[10]

§ 1.2.2 Importance of Globally Dispersed Projects

Global projects exemplify the shift towards an international, networked economy (Meyerson, Weick, & Kramer, 1996) and virtual workplace (Davenport & Pearlson, 1998; Nemiro, 2000). Multinational firms have started to connect local operations in a more intense fashion than was common so far (Edström & Galbraith, 1977). International connectivity enables them to leverage knowledge and other local resources on a global scale (Gupta & Govindarajan, 1991). Examples include industries and activities like car manufacturing (Andres, 1992; O'Cinneide, 1993), packaged software development (Carmel & Zettl-Schaffer, 1997), oil (Siddal, Willey, & Tavares, 1992), financial transaction processing (HBS, 1995), new product design (Kunz, Christiansen, Cohen, Jin, & Levitt, 1998), rocket design (Majchrzak, Rice, King, Malhotra, & Ba, 2000a), human resource management (Sparrow & Daniels, 1999), training (Filipczal, 1997), computer design (Hamlin, 1994), implementation of packaged software (Kay, 1998; Markus, Tanis, & van Fenema, 2000), and software development and IT management (Lee & Palvia, 1996; Meadows, 1996a).
These examples of project globalization often include some form of outsourcing. Remote vendor staff participates in and contributes to projects, like the Holiday Inn example shows (Kumar & Willcocks, 1996). Offshore IT outsourcing is a good example, and the focus of this study. Early 1990s, firms started to outsource many services - like IT - to reduce costs and focus on core competencies (Lacity, Willcocks, & Feeny, 1996; Prahalad & Hamel, 1990). On top of that, from mid-1990s onwards, there was a huge shortage of IT professionals in North America, Europe, and some Asian countries like Singapore (Krepchin, 1993). The urgency of Y2K and e-commerce projects encouraged firms to look at developing countries like India, China, and Ireland, where large numbers of IT professionals were willing to contribute at lower costs (Millar, 1999; Smith, Mitra, &

[9] This study focuses only on inter-human collaboration, not between human beings and a robot.
[10] A definition issue emerges here. Usually, geographically distributed projects refer to projects with sites on the surface of planet earth. Globally distributed projects are a subset of these, referring to projects with intercontinental distances, and situations where people are separated by vast distances and time zones (Jarvenpaa & Leidner, 1998; Maznevski & Chudoba, 2000). The term 'global' usually refers to planet earth. New terminology is required for projects with people scattered across different spatial dimensions (like space and planet earth surface), for instance 'spatially dispersed'.

Narasimhan, 1996). These opportunities resulted in rapid growth of software industries in developing countries, especially India (Meadows, 1996b; Nidumolu & Goodman, 1993).

The overall implication is that globally dispersed collaboration in projects has become widespread. Global projects are a vital tool for achieving economies of scale (Chiesa, 1995), and leveraging resources like knowledge and IT (O'Hara & Johansen, 1994). Successful management of global projects is important for reducing cycle times (Eisenhardt & Tabrizi, 1995), and standardize operations (Kay, 1998; Markus et al., 2000). Global projects are also important for attracting and retaining a pool of talented professionals (Sparrow & Daniels, 1999).

§ 1.3 Challenges

As people have started to collaborate in projects across global distances, new challenges have emerged (Rajkumar & Dawley, 1997). Some of these were mentioned in the Holiday Inn case, like less frequent and predictable collaboration. And loss of social contact between the teams in Atlanta, GA and Bangalore, India. Other researchers have also pointed at numerous issues that surfaced in their research on distributed, remote collaboration. We drew from research areas that appeared relevant for understanding globally distributed collaboration, such as offshore outsourcing, teleworking, virtual teams, groupware.

As we further elaborate in the theory section, some of the issues and challenges include:

- Challenges to manage the requirements analysis process with remote sites (Meadows, 1996b)
- Complexity of connecting people across sites, including channeling of communications (Meadows, 1996b)
- Difficulty to ensure deliverables from people at counterpart sites
- Role of on-site visits and liaison (Millar, 1999)
- Lack of informal, direct communications that are more common in collocated work settings
- Working around time zone differences (Meadows, 1996b)
- New skills and attitudes that are required for using electronic media successfully (Jarvenpaa, Knoll, & Leidner, 1998)
- Lack of understanding of counterpart's context (Cramton, 1997)
- Using documents in a multi-site environment
- Delays in distributed collaborative work processes (Jarvenpaa & Leidner, 1998)[11]
- Difficulty to divide work, and manage interdependencies in global projects (Meadows, 1996a)
- Infrastructural challenges

[11] The assumption that global distributedness enables nonstop and therefore faster work cycles - e.g., 3x8 hours - appears not realistic in many cases.

- The role of groupware (Majchrzak et al., 2000a)
- Managing/ leading people in remote locations (Kurland & Egan, 1999)

Starting around mid-1990s, these studies offer a first and fascinating view on geographically distributed collaboration as a new phenomenon for scientific research. At the same time, the initial stage of the present research implies of course many remaining limitations and challenges. Many of the studies are exploratory in nature. They are not clearly rooted in existing literature of the organization sciences. Nor do they expand on the background of the issues listed above. Individual researchers have adopted their own - often grounded - perspective on the new phenomenon, without clearly embedding their view in others' current or past research. Many research projects rely on experiments or student projects instead of 'real-life' distributed projects. Important areas of inter-personal collaboration and project management - like as coordination and control - are not yet thoroughly investigated. Dimensions of global distributedness have not been clearly defined. Most research has focused on geographical dispersion without considering other dimensions of dispersion, like time zone and governance differences. And finally, researchers adopt a unit of analysis in line with traditional mainstream organization science literature, i.e., industrial networks (virtual networks), organizations (virtual organizations), and teams (virtual teams). However, geographical distributedness changes the relevance of these two constructs since many definitional parameters do no longer apply (DeSanctis & Fulk (Eds), 1999; Fulk & DeSanctis, 1995; Meyerson et al., 1996).

The combination of these research challenges and the import role of global projects have motivated our research. We explain in the next section our research focus and contribution.

§ 1.4 Research Focus

This study is focused along the following dimensions.

First, our research concentrates on temporary systems (or projects) as unit of analysis. Goodman (1981: 2) defines temporary systems as "(…) a set of diversely skilled people working jointly on a task of some complexity over a limited time period". Earlier, Bennis (1965) defined projects by contrasting them with bureaucratic organization: "Adaptive, problem-solving temporary systems of diverse specialists, linked together by coordinating and task evaluating specialists in an organic flux - that is the organizational form that will gradually replace bureaucracy as we know it" (Bennis, 1965: 35). In professional project management literature, Lock (1996) defines projects as an interrelated set of activities whose combined performance within a limited period accomplishes certain desired objectives".

Some researchers of distributed collaboration have adopted the team as their unit of analysis. They refer to people involved in the same project from different sites as a 'virtual team', e.g., (Hinds & Bailey, 2000; Jarvenpaa & Leidner, 1998; Majchrzak et al., 2000a). A concern with this unit of analysis is that parameters of the traditional team definition may not apply to a distributed setting. Our research continues a tradition in the organization sciences that is more focused on work or tasks (Barley & Kunda, 2001), particularly here temporary systems (Bryman et al., 1987; Goodman, 1981; Meyerson et al., 1996).

Second, with respect to the temporal dimension, this research focuses on temporary work. Projects are temporary systems with a task-related objective (Goodman, 1981). Furthermore, we look at projects in the late 1990s. Our main viewpoint is people's current experiences in global software projects at the time of our empirical research. As an extension, we take into account what people have learned while working on their current or recently completed global projects (see also Table 2).

Third, our study focuses on geographically dispersed projects. 'Geographical dispersion' refers here to situations where collocated collaboration - under normal conditions - is unfeasible on a frequent basis. People must collaborate from locations on the surface of planet earth that are separated by vast distances. Instead of face-to-face interactions, they rely on other means to coordinate their work like electronic media, procedures and occasional visits.

Geographical dispersion defines the category of projects we focus on. It provides a minimum demarcation of the research object. Our content perspective - the impact of global distributedness - is broader since it includes other dimensions of distributedness, like cultural differences, time zone differences and so on. These other dimensions - we show some of them below - may coincide with geographical dispersion, but not necessarily. They cannot therefore define our research object per se (O'Leary, 2001). Examples of those dimensions and some possible relationships to geographical dispersion include:

- Time zone differences - people can be paired from South Africa and Europe, or South America and North America without any time zone differences, but huge spatial distances.
- Countries - single countries sometimes span vast distances, like USA, Canada, Russia, India, China, and Australia. Our definition would include projects that include multiple sites within such countries, like multiple sites in the US (Majchrzak et al., 2000a). International projects do not capture therefore the quintessence of our focus: geographically distributed over vast distances. Project sites may be located at two sides of a nation's border, making it an international project without significant geographical distance.
- Cultural or functional diversity - while geographical dispersion may make it more likely that people have different cultural backgrounds, and functional expertise, this is not necessarily the case. People in the Apache group for instance share many interests and insights while working from different sites (Fielding, 1999). On the other hand, companies in international urban areas like New York and London may hire a more diverse workforce that works collocated.
- Organizational boundaries - a single multinational corporation operates a network of offices, plants and research labs (Ciborra & Patriotta, 1996), while in the same area companies may outsource business processes and work across organizational boundaries.

- The number of people per site - our definition or geographical dispersion does not refer to the relative distribution of people across sites. Some sites may accommodate more people than others.

Fourth, the object of our investigation is real-life software projects, in a civil context (government and business, not military). We focus on Information Systems (IS) development and/ or implementation projects.

Finally, our main content focus is coordination and control processes in distributed projects. This ties in with a long standing tradition in the organization sciences (Crowston & Kammerer, 1998; Ezzamel & Willmott, 1998; Lawrence & Lorsch, 1967b; Litterer, 1965; Mintzberg, 1979; Van de Ven et al., 1976), and some research on temporary systems (Bryman et al., 1987; Goodman, 1981). A more elaborate motivation for this content focus is found at the start of the theory section.
We focus on the way people coordinate and control their work accomplishments. Technology is viewed here as a supporting tool for coordination and control processes. Thus, our main focus is not on human-computer interaction or the role of technology per se.
Specifically, our primary focus is on remote coordination and control, that is, how people connect their work across sites. Local modes of coordination and control are of interest to the extent that they relate to inter-site practices.

§ 1.5 Research Objective and Questions

With this focus, our objective is to understand the impact of global distributedness on the way people coordinate and control their work. We want to understand the issues and constraints people experience when they collaborate across global distances in a software project. We seek to investigate the background of these issues, and want to know whether and how people must adapt their coordination and control modes.

Our overall research question then becomes:

How does global distributedness impact the way people coordinate and control their work in global software projects?

At the core, this concerns an explanatory relationships between two constructs: geographical distributedness, and coordination and control modes in temporary systems (Hedrick, Bickman, & Rog, 1993; Yin, 1994).

The research question leads to a number of sub questions (see Figure 1). First, a definitional and explanatory question:

1. What are coordination and control modes, and what determines the use of particular modes?

Before investigating the impact of geographical distributedness, it is desirable to understand the different modes of coordination and control. And also, to gain insight in the factors, conditions, and situations that determine usage of particular mechanisms.

Second, a definitional question to understand the concept of global distributedness:

2. What is global distributedness?
We use pointers in existing research to explore the concept of global distributedness. As it appears, other dimensions than spatial separation over vast distances should be included, like time zone differences, and cultural diversity.

Third, from the main research question one can derive a more exploratory and descriptive sub question of the "what" type (Hedrick et al., 1993; Yin, 1994):

3a. What is the impact of global distributedness on the way people coordinate and control their work in global software projects?
This question seeks to explore and describe the effects of global distributedness. It then analyzes and attempts to find generic impacts on coordination and control modes, see Figure 1.

The final and main question is explanatory:

3b. How does global distributedness impact the way people coordinate and control their work in global software projects?
This question goes beyond sub question 3a. It focuses not only on exploring and describing effects an sich, but seeks to understand a more causal pattern of impacts. We seek to build a theory that explains the process of impacting, the impacts themselves (i.e., effects), and how people respond to these impacts (Figure 1). In a sense, global distributedness can be perceived as a new contingency or determinant of coordination and control modes. It may interact with determinants currently recognized in coordination and control theory (Kirsch, 1996; Van de Ven et al., 1976) (Figure 1).

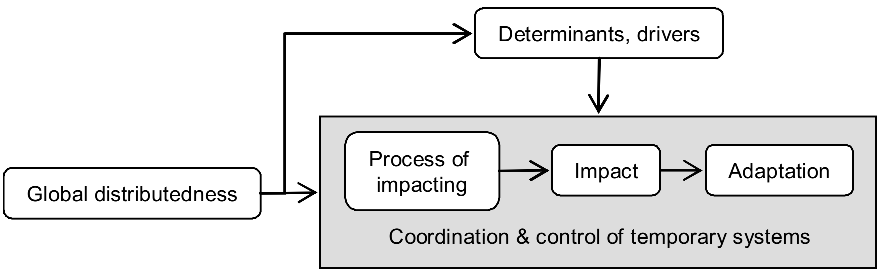


Figure 1 - Explanatory research question

§ 1.6 Nature of Research Questions

The main research question is explanatory in nature as it seeks to understand a pattern of relationships and impacts (Hedrick et al., 1993; Yin, 1994). To support this question, the first two sub questions are definitional, somewhat exploratory. The third sub question (a and b) is exploratory and descriptive, oriented towards making an inventory of effects.

The study is aimed at current projects, i.e., those that are pending during the research process, or just finished. Its main temporal focus is therefore a current situation, shown as a gray column in Table 2.

Table 2 - Research questions: type and temporal orientation

	Temporal orientation of research question		
	Backward looking	Current	Forward looking
Exploratory: Less factual, more oriented towards understanding a trend/ pattern	**Exploratory backward looking:** What could have been done? What would have made this policy more effective? Yin (1994): Exploratory What questions	**Exploratory current:** What could be done in this situation? What is the background of this emerging trend? Yin (1994): Exploratory What questions	**Exploratory forward looking:** What will happen? What will be the impact of this policy? How will people respond? Yin (1994): Exploratory What questions
Descriptive & Predictive: Factual representation or estimation of study object	**Descriptive backward looking:** What were the outcomes of this strategy? How many projects have met expectations? Yin (1994): Inventory What questions Who, What, Where questions	**Descriptive current:** How many firms comply with these standards? Who are currently involved in this project? Yin (1994): Inventory What questions Who, What, Where questions	**Descriptive forward looking (predictive):** What will be the outcome of this policy? How many projects will succeed? Yin (1994): Inventory What questions Who, What, Where questions
Explanatory: Factual, focused on understanding a limited number of events	**Explanatory backward looking:** What happened? Why did it happen? What is the current status? Yin (1994): How, Why questions	**Explanatory current:** What happened? Why did it happen? What is the current status? Yin (1994): How, Why questions	N.A.

Based in part on (Hedrick et al., 1993; Yin, 1994)

§ 1.7 Relevance of the Research

A research project that costs about € 90.000 or US$ 80,000 to tax payers should have clear relevance. Two main groups are targeted with this study: practitioners and academics. First, practitioners have puzzled by the unfamiliarity of global projects. Obviously, a wide range of prescriptive, professional-oriented literature is available for those needing a quick scan and an initial grasp on the new phenomenon. Discerning professionals and consultants, however, may want a more solid understanding of what this new workplace means, and what it requires to be successful. They may want a more comprehensive look at the different strategies for coordinating and controlling global projects in order to build sustainable capabilities in this area. This research is targeted at that group through current and planned publications, collaborative projects, and presentations.

Second, from an academic point of view, globally distributed projects challenge many existing perspectives, theories, and approaches. Areas that are challenged include for instance (1) unit of analysis, (2) empirical research methodologies, and (3) content theories. This study attempts to contribute to some of these challenges through peer networking, journal publications, conference presentations, and research collaboration.
Ad (1) over the 20th century, organization theory has relied on assumptions with respect to the unit of analysis. Research has been built around individuals, groups, organizations, industries, and macro-level phenomena. Distributed collaboration turns many of these assumptions upside down. A more complex object of analysis is emerging where people contribute in temporary configurations that span multiple departments, organizations, industries, and locations (Meyerson et al., 1996). Our research attempts to address these challenges by focusing on temporary systems as a manifestation of work (Barley & Kunda, 2001).
Ad (2) studying distributed collaboration challenges existing methodologies that focus on a fairly homogeneous, collocated object of study. Within resource constraints, researchers must find a way to connect to this more diverse, dispersed environment. Our study offers an example of this environment. We traveled to research sites, contacted interviewees remotely, and worked with people who observed for us at another site.
Finally, ad (3) global distributedness calls for re-assessing many content theories related to the process of organizing and managing work that have assumed collocated of their research object. Our research focuses on a small but important area: coordination and control theory. It provides a starting points for researchers working on these and adjacent areas.

§ 1.8 Thesis Setup

The thesis is structured as follows. In the next chapter, we conclude Part 1 with an explanation of our research approach. Parts 2 and 3 contain the theoretical and empirical body of our study (Figure 2).

Part 2 - the Theory Section - explains the motivation and methodology for our theory building efforts (chapter 3). It continues with theory reviews and integration along two

lines. First, we discuss theories on work coordination and control (chapter 4), and develop an integrated theory of that field (chapter 5). This answers our first research question on coordination and control (see dotted arrow in Figure 2 towards sub question 1).
The second line of inquiry focuses on polycontextual and geographically distributed collaboration. We review contributions on this topic in chapter 6. In the seventh chapter, we use this review to develop our conceptual lens. In the same chapter, we use the lens to analyze and summarize current literature. All this answers sub question 2, and in part also sub question 3 (see dotted lines towards the sub questions in Figure 2).

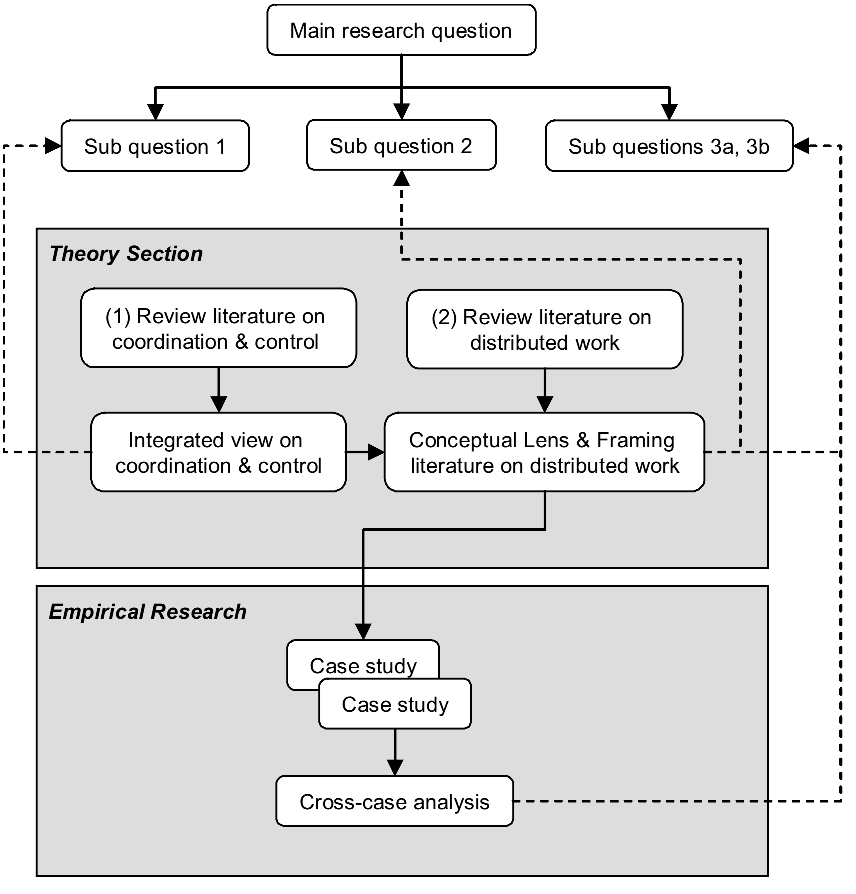


Figure 2 - Thesis setup and research questions

The third Part is devoted to empirical research to answer sub questions 3 and 4. After chapter 8 (empirical research methodology), a number of cases are described and analyzed (chapter 9). Chapter 10 concludes this Part with a meta analysis of the case studies that completes the answers to sub question 3 (Figure 2).
Part 4 concludes the thesis (chapter 11) and identifies contributions, limitations and future research (chapter 12).

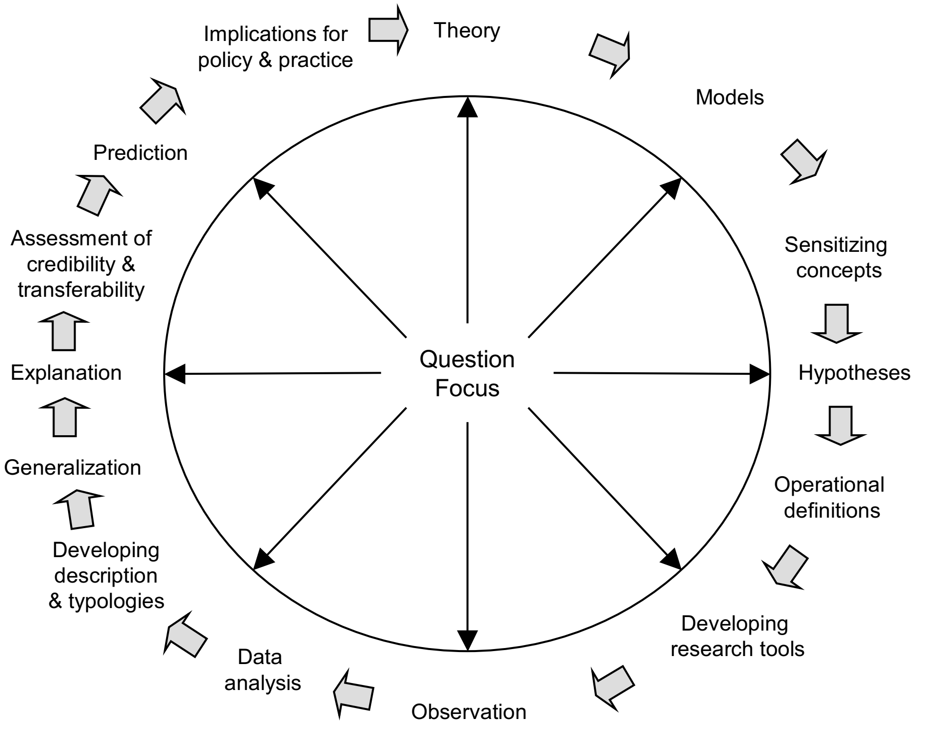
Chapter 2 Research Approach

This study's objective and questions point towards understanding and explaining the impact of global distributedness on project coordination and control. Having established the research content and type of study, our next step is to outline the research approach.

We start with the research cycle (Marshall & Rossman, 1995) to identify major steps and components. Next, we explain the philosophical perspective adopted for conducting the research (Lee, 1991), and our empirical research methodology (Marshall & Rossman, 1995; Yin, 1994). The section is then concluded with a description of the research process, and attention for the quality of this study (Kirk & Miller, 1986). Here, we provide an overview of our research approach. This is extended in the theoretical and empirical section of the thesis. There we discuss motivation for content areas we have focused on, as well as methodological choices.

§ 2.1 Research Design

Research design is concerned with the overall purpose of a research study (Maxwell, 1996). It details components that relate in a logical and efficient manner. One could - in analogy with literature on new product design (Henderson & Clark, 1990) - distinguish between (1) the architectural or system level, and (2) the component level. A well-accepted approach that combines these two levels is the research cycle Figure 3 (Marshall & Rossman, 1995).



Adopted from (Marshall & Rossman, 1995: 17) and modified

Figure 3 - Research cycle

This cycle - also referred to as the “wheel of science” - describes multiple sequential steps. All these related to the research question and focus (see center of Figure 3). According to Marshall and Rossman (1995: 16), a researcher may start at any point of the cycle, for instance with an initial theory (top of cycle) to explain the question (center). Next, following the cycle to the right, models and concepts are developed for guiding empirical research. The development of research tools then precedes empirical observation (bottom of cycle), which leads to analysis and explanation. The final stage translates newly acquired understanding into policies and practice.

What the figure does not clearly show, is the relationships between two dimensions: the empirical, social reality (Kirk & Miller, 1986), and theories. The first dimension consists of people’s physical and social reality, including problems and challenges they experience (Orlikowski & Baroudi, 1991). Researcher may enter and empirically observe this area. The second dimension refers to conceptual analysis and understanding. Researchers develop, test, and modify theories to recognize and explain empirical situations (Yin, 1994). Figure 4 shows the two dimensions - empirical and theoretical.

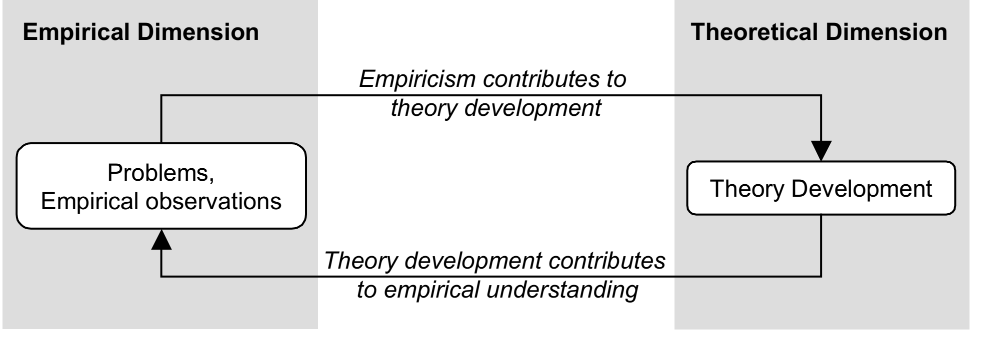


Figure 4 - Research dimensions

The researcher seeks for ways to connect the two levels and enhance their reciprocal added value. On the one hand, he develops familiarity with an empirical setting to fuel theory development (Figure 4 from empirical to theoretical). On the other hand, conceptual development enables him to recognize, understand and perhaps alter an empirical situation.

Connecting the two dimensions is an important challenge for applied social research (Lee, 1991; Schutz, 1973). It requires a philosophical perspective and methodology for conducting empirical and theoretical research (Cooper, 1984; Klein & Myers, 1999). Figure 5 includes such a third layer. The figure combines the research cycle (Figure 3) with the two dimensions (Figure 4), resulting in a grand research design (Maxwell, 1996). The third dimension - Research design and methodology - connects empirical research and theory.

We discuss the grand design for problem-solving in applied social research of which this study is an example. Starting with a problem in the empirical world (top left in Figure 5), the researcher develops research questions and an overall research design. Next, existing theory is investigated and integrated according to a theory development methodology (dotted box). This is followed by a conceptual lens[12] that frames the empirical research. The second dotted box - empirical research methodology - structures from the empirical research design a methodological point of view.

A researcher can enter the empirical dimension and conduct his observations there. His empirical data requires management to ensure accessibility and efficiency in the analysis phase (Miles & Huberman, 1994). Moving back to the theory dimension, the researcher analyzes data based on the conceptual lens while allowing for novel findings (Yin, 1994). His conceptual analysis leads to possible modification of theory (see dotted arrow between theory extension and existing theory). It also translates into understanding of the empirical reality investigated, and possible prescriptions. This leads to a second dotted feedback loop between the 'understanding & prescriptions' box, and the original problem.

[12] A conceptual lens defines the way a researcher enters and looks at an empirical situation. It is less formal than a research model with dependent and independent variables commonly used in quantitatively oriented research (Yin, 1994).

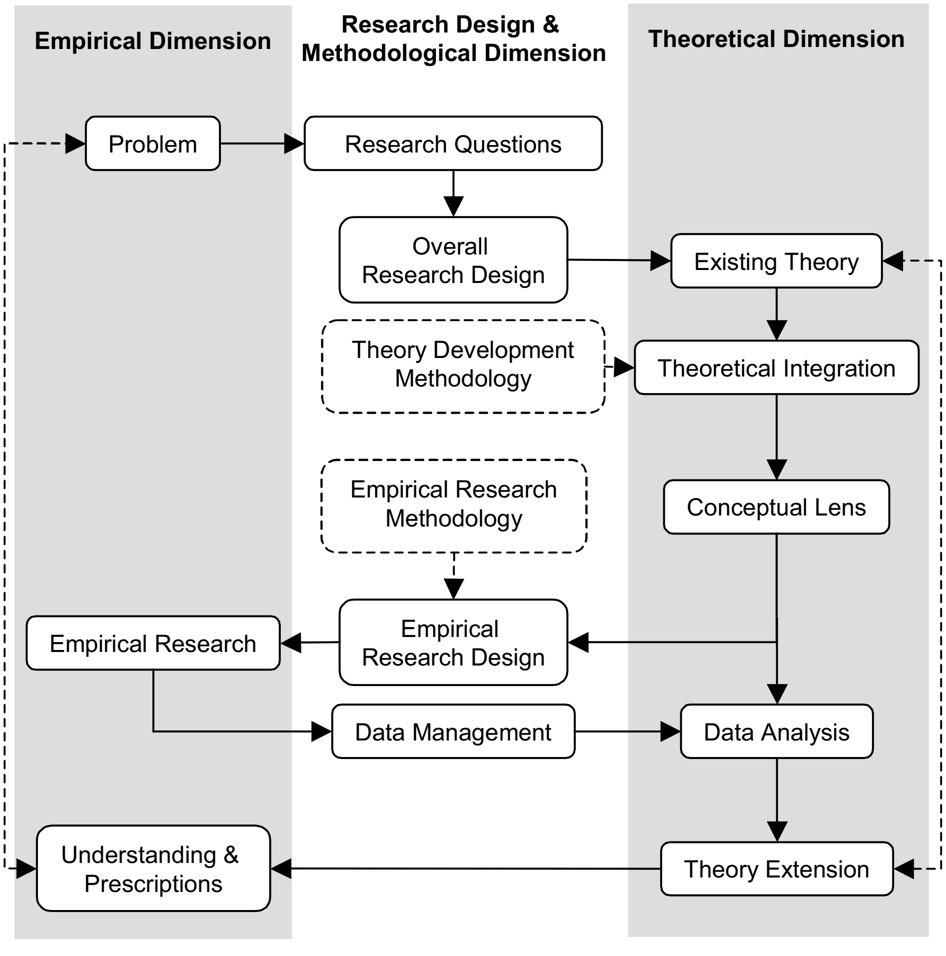


Figure 5 - Grand research design

For our study, methodologies are elaborated in respectively the theory and empirical research sections. We expand in the next section on the philosophical perspective and to some extent on the empirical research methodology.

§ 2.2 Research Philosophy and Empirical Research Methodology

Klein and Myers (1999) and Myers (2001) emphasize the distinction between a researcher's philosophical perspective and his empirical research methodology. For an overview see Table 3. We discuss both dimensions and their relationships in the next two sections.

Table 3 - Philosophical perspective & empirical research methodology

Philosophical perspective & epistemology	Empirical research methodology
Guba and Lincoln (1994): ▪ positivism ▪ post-positivism ▪ critical theory ▪ constructivism Orlikowski and Baroudi (1991): ▪ positivist ▪ interpretive ▪ critical Triangulations, e.g., (Lee, 1991)	Myers (2001): ▪ Quantitative research methods (Examples: survey methods, laboratory experiments, formal methods and numerical methods such as mathematical modeling) - versus - ▪ Qualitative research methods (Examples: action research, case study research, ethnography and grounded theory) Burrell and Morgan, 1979: ▪ Objective - versus - ▪ Subjective research methods Triangulations, e.g., (Markus, 1994)

§ 2.2.1 Research Philosophy

First, the philosophical perspective applies to the research study as a whole. It consists of the researcher's paradigm, assumptions, worldview, as well as his view on knowledge and knowledge acquisition (epistemology) (Myers, 2001). Different philosophical perspectives have been distinguished (Table 1, top row) (Klein & Myers, 1999). Guba and Lincoln (1994) propose positivism, post-positivism, and critical theory. Orlikowski and Baroudi (1991) identify positivist, interpretive and critical perspectives. The latter is commonly used in IS research, and therefore also here.

First, Klein and Myers (1999: 69) refer to research as being positivist "(...) if there is evidence of formal propositions, quantifiable measures of variables, hypothesis testing, and the drawing of inferences about a phenomenon from a representative sample to a stated population". Positivists draw upon logical positivism and the natural science model. With this approach, theory leads to hypotheses that are logically related and empirically tested for falsification (Lee, 1991). Scholars refer to this approach as etic, objective, outside oriented (Burell & Morgan, 1979). Luthans and Davis (1982) describe it as nomothetic, i.e., focused on the discovery of general laws. Stake (1994) refers to instrumental research, that is, empirical research is used as an instrument for e.g. validating theory.

Second, studies are considered interpretive "(…) if it is assumed that our knowledge of reality is gained only through social constructions such a language, consciousness, shared meanings, documents, tools and other artifacts" (Klein & Myers, 1999: 69). Interpretivist researchers acknowledge that people have individual, different experiences, even with inclusion in the same context. These scholars seek to connect closely to diverse actors in a setting to gain a grasp on their perspectives. This is commonly referred to as an emic, subjective, or insider viewpoint (Burell & Morgan, 1979). It is also called idiographic, i.e., looking at the uniqueness of a particular situation, or the specific nature of a context (Klein & Myers, 1999; Luthans & Davis, 1982). Stake (1994, 1995) calls this intrinsic research: an empirical investigation is undertaken for gaining intimate understanding of just that particular setting.

Third and finally, critical research is mainly focused on "(…) social critique, whereby the restrictive and alienating conditions of the status quo are brought to light" (Klein & Myers, 1999: 69).

Since our research objective is not to critique a phenomenon, we further focus on positivist and interpretive views. Some researchers have argued to combine these two philosophical perspectives, i.e., triangulation (Lee, 1991; Myers, 2001). Lee (1991) explains that both perspectives have their own pros and cons. We use Figure 6 to show this dilemma. Individual actors 1 through 4 are involved in a collaborative experience (e.g., a project team), each having their own experience.

First, positivism is strong in terms of theoretical logic and generalizability, but lacks the dense connection to empirical reality. Related to Figure 6, this implies that a general theory is used to develop hypotheses, which are tested on this population. Intersubjective differences or novel insights are not captured.

Second, interpretivism runs the risk of focusing exclusively on individual subjectivity without coming to generalizable, conceptual understanding. Using Figure 6, the interpretive researcher connects extremely well to individual experiences of actors 1 through 4. He may elicit inter-subjective communications and understanding. While he acquires new insight in the uniqueness of this context, his research is weaker in terms of generating generalizable concepts. I.e., those that enable understanding and perhaps improvement of comparable settings and situations.

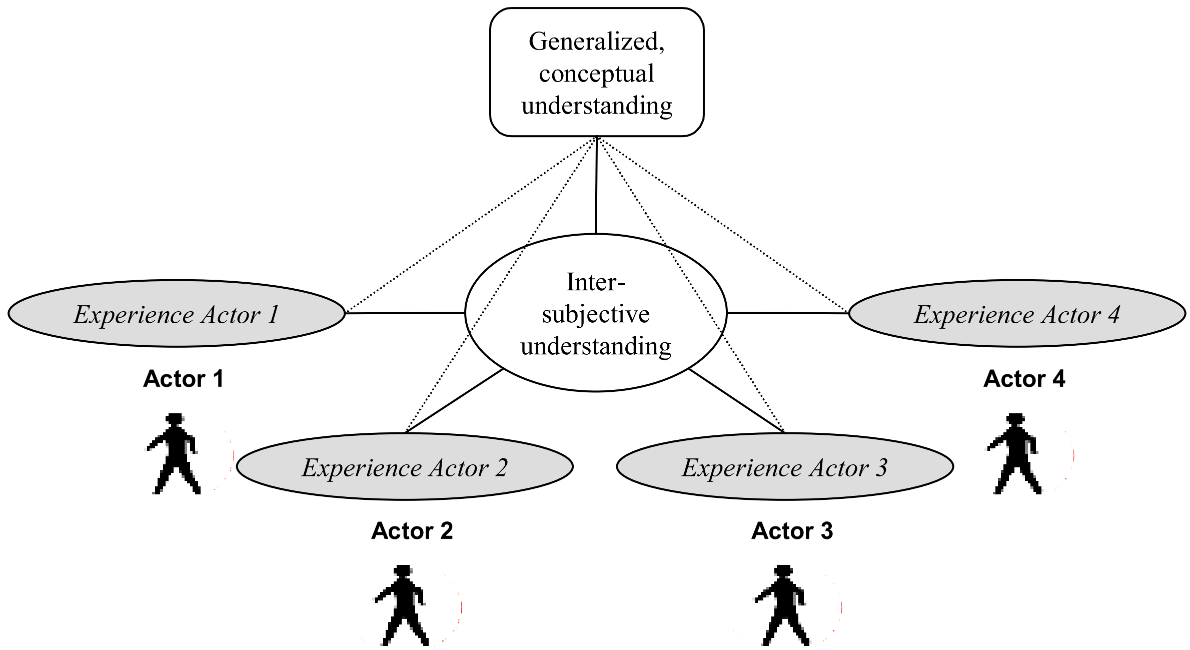


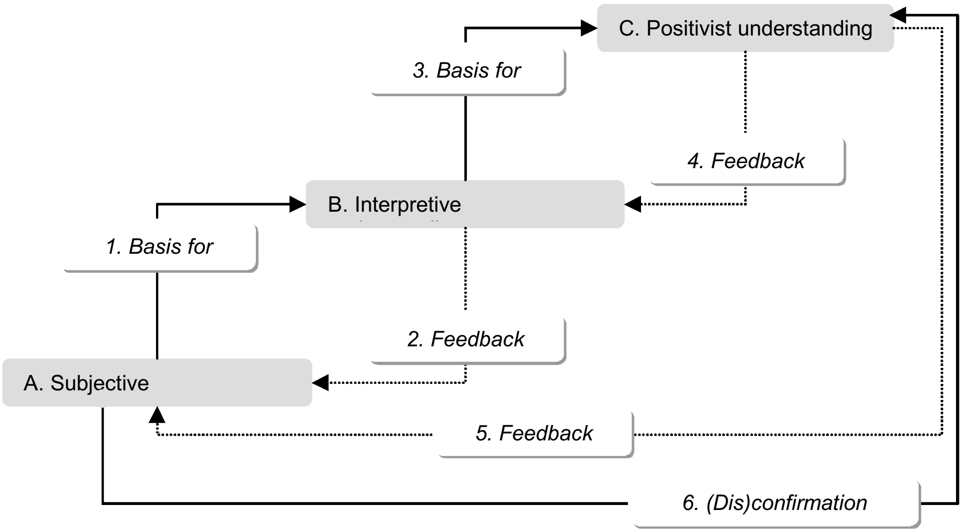
Figure 6 - Positivism and interpretivism

Looking at these two perspectives, what seems to remain is "(…) a continuous dialectical tacking between the most local of local detail and the most global of global structures in such a way as to bring them into simultaneous view" (Geertz, 1983: 69). Lee (1991) - extending earlier work by Schutz (1973) - expresses his concern with perceiving positivism and interpretivism as opposing viewpoints (Guba & Lincoln, 1994). In his mind, they can be used mutually supportive. He proposes three levels of understanding that relate to our earlier distinction of empirical research and theory:

A. Subjective understanding of observed human subjects. This refers to people in the physical and social reality (Kirk & Miller, 1986) that constitutes the researcher's empirical domain.[13]
B. Interpretive understanding of organizational researcher, meaning his initial connection to and perception of people researched.
C. Positivist understanding of organizational researcher, that is, his generalized concepts on a theoretical level.

Lee (1991) outlines steps for connecting the three levels and thus connect interpretivist and positivist approaches to organizational research (Figure 7). Starting point is the Subjective understanding of observed human subjects (A). Connecting to this insight generates the researcher's interpretive understanding (B). A feedback loop ensures quality of this first step. Next, interpretive understanding enables evolution of positivist understanding (C). For instance, analysis of multiple interviews may lead to new theories for positivist research. Feedback again reinforces the quality of that link. Step 5 and 6 then seek to (dis)confirm hypotheses based on positivist research. Dotted lines represent the feedback loops.

[13] As far as we know, inter-subjective understanding amongst observed human subjects is not included in this work, but presumably part of level 1.



Adopted from Lee (1991), and modified

Figure 7 - Positivist and interpretivist approaches to organizational research

Our research objective is to enhance our generalizable understanding of the way global distributedness impacts project coordination and control. Since the research field we work in is in its early stages, we also needed a lot of interpretive understanding, based on subjective understanding. Therefore, we adopted Lee's (1991) approach within feasibility constraints. Usually, it is not possible within a single study to follow the complete scheme, or do all steps elaborate (Eisenhardt, 1989b, 1991). In our study, for instance, we worked for a couple of weeks with the 'observed human subjects', trying to get insight into their subjective understanding. This is less elaborate than an extensive ethnographic study or action research project. But it seemed sufficient for enhancing our interpretive understanding, and translate that into logic theory. In the next section we expand on the empirical research methodology as far as related to the overall research approach. The empirical research section explains in closer detail methodological choices.

§ 2.2.2 Empirical Research Methodology

A study's empirical research methodology is closely related to the researcher's philosophical perspective. Myers (2001) categorizes research methods into quantitative and qualitative ones (see Table 3). Quantitative methods include formal, numerical research modes like surveys and experiments. Examples of qualitative research are action research, case study research, and ethnography. Others refer to objective versus subjective methods (Burrell & Morgan, 1979). Some studies have combined qualitative and quantitative methods, like Markus (1994) study of managerial e-mail usage.

For this study, we adopted a qualitative approach for empirical research, more specifically the case study method. We chose qualitative methods because our main research questions are explanatory in nature (Maxwell, 1996; Yin, 1994). As Miles and Huberman (1984: 132) stress: "(...) much recent research supports a claim that we wish to make here: that field research is far better than solely quantified approaches at developing explanations (...)". Qualitative methods are recommended for investigating complex phenomena when it is desirable to adopt an open conceptual approach and to develop "thick" descriptions (Marshall & Rossman, 1995).

The case study was chosen because our research question is exploratory and a "how" question (Yin, 1994). For reasons of feasibility, action research and ethnography were not adopted. A grounded theory approach would not fit with the theory already available. In the section on empirical research we explain in more detail our empirical design for case study research.

§ 2.3 Research Process

An overview of our research process is depicted in Figure 8.[14] We started in Fall 1996 with an identification of the research problem and questions. We collected and analyzed extensive literature on topics related to our study. An initial integration of literature was completed Winter 1996 - Spring 1997. Around that time, we had the opportunity to work with Ms Amanda Cijntje, a student at that time at the Department of Decision and Information Sciences at Rotterdam School of Management, Erasmus University in the Netherlands. For an internship she participated in a global software project at CarCo.[15] We combined efforts and developed an initial research design to collect data for the CarCo case (Cijntje, 1997). In the process we modified our theory, leading to a refined conceptual lens and empirical research design. A second wave of case studies in Singapore in 1999 complemented the CarCo case (Figure 8). Of these only the DiskCo case is reported here. For the other ones a limited data set was collected. Data of all the case studies was analyzed in 1999/ 2000 and led to a re-assessment and write-up of our earlier theoretical work in 2000. In 2001 the remaining parts of the thesis were completed.

[14] While the process appears sequentially in this figure, the reality of research is obviously more messy. This 'messiness' includes frequent feedback cycles, revisiting parts of the study completed at an earlier stage, and reinterpretations.
[15] All names in our case studies have been disguised to maintain confidentiality.

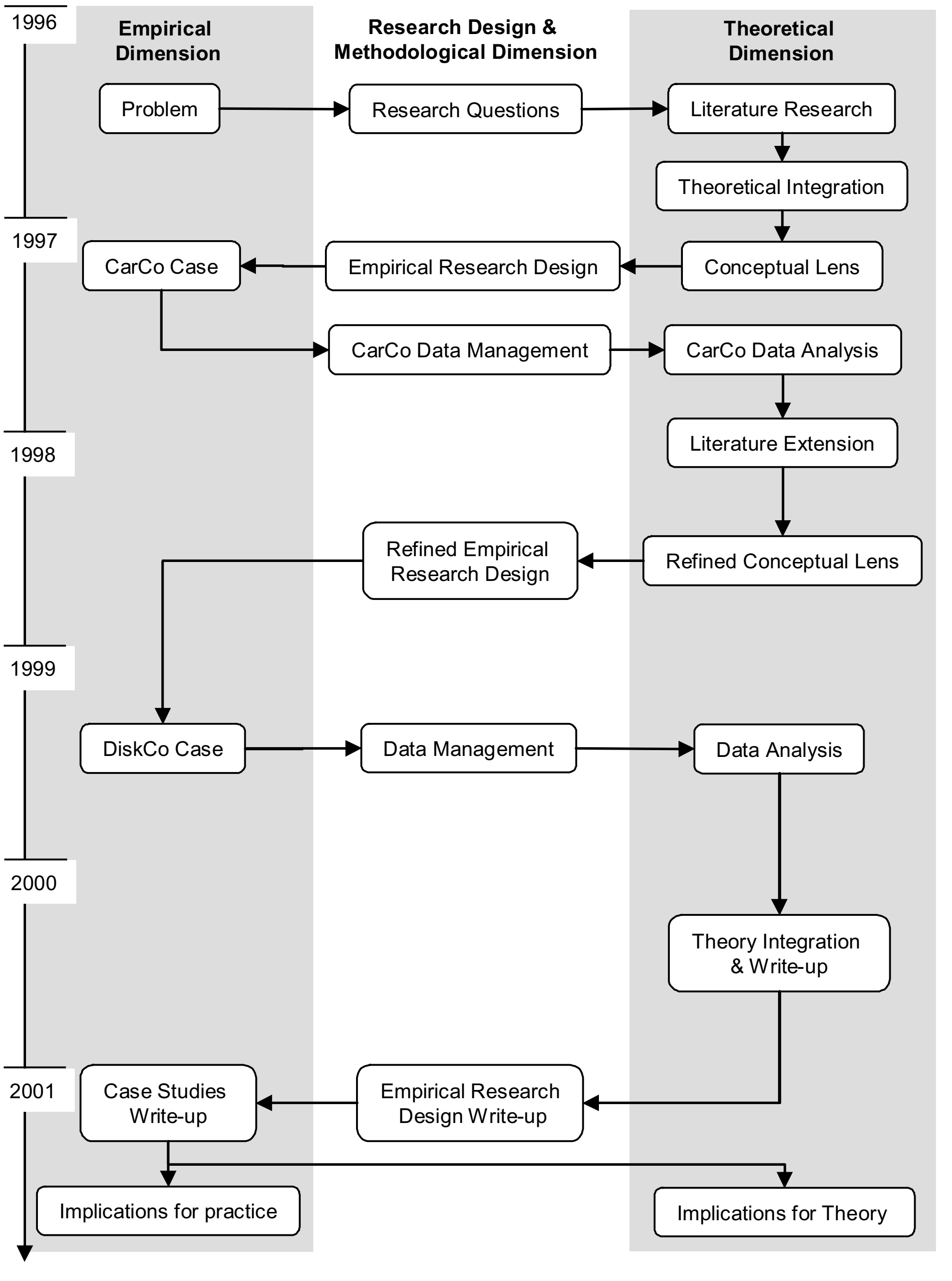


Figure 8 - Research process

§ 2.4 Quality of the Research

> "Quality, according to ISO 8402, is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs" (Zineldin, 1999: 720)

Following this quote and principles of Total Quality Management (TQM), quality is here perceived as something that touches all aspects of a research endeavor. The main objective of quality management is to satisfy customers of a product or service. In our case, this audience consists of professionals, and academic research communities. Specifically, we focus on people in these communities who work - or struggle with - global software projects, virtual teams and similar topics. While we do not know exactly their needs as a population, we can approximate these based on our own research process and existing resources (Cascio, 2000; Pfeffer, 1981; Van de Ven, 1989).
First, Professionals - managers, consultants, team members - look for appealing and relevant concepts to make them successful in their business context - global projects in our case (Cairncross, 2001).
Second, academics look for interesting work that is connected to existing research. It should offer new insights and venues for future research (Sutton & Staw, 1995; Weick, 1989). In our topic domain, this work is related to geographically distributed processes of collaboration, organization and communication (Cramton, 2001; Malhotra, Majchrzak, Carman, & Lott, 2001). For theory development work like our study, Weick (1989) points to a couple of 'quality' criteria:

- That's Interesting - Research should evoke interest by disconfirming assumptions. This challenges academics to move beyond their present-day understanding
- That's Obvious - In social sciences, obviousness refers to the process of making explicit what people assume already (Homans, 1964)
- That's Connected - Research should point at connections between events that evoke scholarly interest
- That's Believable - Conjectures should be likely to scholars, and coherent
- That's Beautiful - Quality research models and conceptual insights may trigger an aesthetic experience
- That's Real - A study should relate closely to 'real-life' phenomena, and should be relevant

We have tried to approximate these criteria as we show here and in two separate sections (theory development and empirical research methodology).

Weick's (1989) criteria can be perceived as quality standards for research output (Figure 9). We can look even broader at research quality by using a cybernetic system as a metaphor (Figure 9). A research study then comprises inputs, processes, outputs, and overall research integration. Quality criteria may apply to all facets of a research endeavor, see black triangles ▼ in Figure 9.

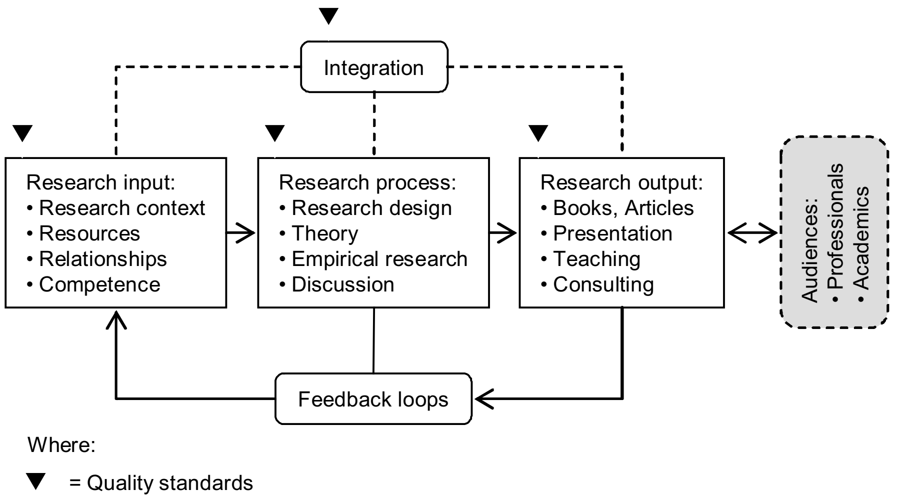


Figure 9 - Research quality

First, inputs consist of the research context in which we operated, as well as resources, and relationships. We have benefited from quality in all these areas. The Rotterdam School of Management is among the top schools in Europe, with extensive resources available for research. Resources include academic networking, IT infrastructure, and financial resources for e.g. visiting conferences and workshops. From a relationship point of view, we have worked on the scope and quality of our network (Zineldin, 1999). Through publications and other activities like participating in conferences, we have connected to researchers and professionals working in relevant areas (see also acknowledgements). In addition to the supervisor K. Kumar, they have contributed in an invaluable manner to the process and outcome.

Second, process refers to the creation and refinement of research design, theory, and empirical research methodology. For theory and empirical research we elaborate on methodologies in the respective sections (e.g., reliability and validity issues). One important process is discussion with academics and professionals. We have worked on opportunities for discussion within and outside the Rotterdam School of Management, and on an international scale.

Third, the output includes books, articles, presentations and the like. We have published a number of articles and book chapters to show intermediate results of our study and receive feedback (see also feedback loops in Figure 9). The seminality of research output depends on a longer term snowball effect where people use and cite research publications.

Finally, there are feedback loops from outputs to process and inputs as well as integration - an overall process of embedding and adjusting components and phases of the study to create a coherent outcome (Maxwell, 1996; Zineldin, 1999). This is in a sense the architectural level of a research undertaking (Henderson & Clark, 1990). Like for a watch or other man-made artifacts, quality depends on the overall design, and the way components fit in this grand picture. The integrative level is important to ensure internal logic and quality of the study, as well as external attractiveness of the outcome for relevant audiences. For the integration level of our study, discussions with professionals and academics (promoter, academic networking) have been of paramount importance. We have also relied on written resources from the social sciences (Marshall & Rossman, 1995; Maxwell, 1996).

PART 2 THEORY SECTION

This part presents the results of our theory review and integration process in two areas of inquiry. First, general coordination and control theory (Part 1); and second, coordination and control of polycontextual, distributed work settings (Part 2). The results are presented after explaining the motivation and theory development methodology.

Chapter 3 Motivation and Methodology for Theory Building

In this chapter we outline our motivation for the literature reviews, and we indicate the methodology used for conducting these.

§ 3.1 Motivation for Literature Reviews and Theory Building

Current studies on distributed (IT project) work are scarce. This applies in particular to those that focus on coordination and control. Most research could be described as including coordination and control as some of the themes. But they do not explicitly refer to these processes, or connect to underlying theories of coordination and control.

In part, this lack of research is due to the novelty of distributed work as an object of inquiry. But it also reveals a more fundamental theoretical problem. Studying coordination and control of distributed work is a specialization and an application of coordination and control theory. Yet as an applied area, it cannot rely on a solid, coherent reference theory. A closer look at coordination and control theory reveals that it consists of multiple streams of thought that have evolved over time. The richness of the field is represented by the streams of thought that have evolved over time. Even though not all contributing theories (as reviewed in the next section) refer explicitly to the twin constructs, the statements from these theories directly connect to coordination and control.

At the same time, however, a lack of integration characterizes the part of organization theory that could be referred to as coordination and control theory. This applies to the theories around each construct. It also concerns the theoretical bridges between the two constructs. Quite recently, coordination theory was defined as the still-developing body of theories about how coordination can occur in diverse kinds of systems (Crowston, 1997; Malone & Crowston, 1994). Apart from Malone and Crowston's (1994) initial steps, Grant (1996b: 113) recently remarked that "[a]lthough widely addressed, organization theory lacks a rigorous integrated, well-developed and widely agreed theory of coordination". Similarly, theories on work control lack an integrated analysis along commonly accepted dimensions (Flamholtz, Das, & Tsui, 1985; Merchant, 1988).

Integration between the twin constructs relies on a few contributions. McCann and Galbraith (1981) proposed a model that summarized research on interdepartmental coordination and control. Eisenhardt (1985) analyzed the relationship between agency theory and organizational approaches to control. Ghoshal and Moran (1996) engaged in a discussion with Williamson (1996) on assumptions and contingencies underlying Transaction-cost Economics. While these contributions initiated exchanges and reflection among theorists on coordination and control theory as a field, more work needs to be done. Larsson and Bowen (1989) express their concern that almost a decade after McCann and Galbraith's (1981) integrative review, "[t]heir call for more research on the selection process of these mechanisms has been left mainly unheeded".

Integrating theories on work coordination and control theory as separate and interlocked entities becomes even timelier for two reasons.
First, new views on coordination and control are emerging, like distributed cognition (Hutchins, 1991), collective mind (Crowston & Kammerer, 1998), semi-structure (Brown & Eisenhardt, 1997) and High Reliability Organizations (Weick, Sutcliffe, & Obstfeld, 1999). Leveraging their intellectual contribution requires both development of these perspectives and an integrative discussion that connects them to more traditional theories.

Second, as firms become more connected in the emerging network economy (Meyerson et al., 1996), they collaborate across organizational (Smith, Caroll, & Ashford, 1995) and geographic (Sanchez & Mahoney, 1996) boundaries. At the same time, the role of technology has changed from basic physical automation to advanced information and communication support (Weick, 1990). In this international and information-intensive environment, coordination and control remain pivotal constructs to make sense of emerging work arrangements (DeSanctis & Fulk (Eds), 1999; Maruca, 1998). But their role has changed in a profound manner that remains ill understood (Armstrong & Cole, 1995).

Addressing this backlog of conceptual integration in coordination and control theory is important since it determines the quality of applied research. This study attempts to contribute to the process of enhancing integration of current and emergent streams of coordination and control theory (chapter 4, 5). It then applies this understanding to polycontextual, distributed collaboration (chapter 6, 7).
Figure 10 depicts our steps (an extension of the theoretical part in Figure 2). We review and analyze contributing theories (chapter 4) in order to build an integrative theory of coordination and control mechanisms as separate fields. The study rounds up the first part of the theory section by proposing an integrated theory of work coordination and control that relies on task contingencies (chapter 5). This first line of inquiry answers sub question 1.
We then develop our second line of inquiry around polycontextual, distributed collaboration. Taking on the integrated coordination and control theory, we select and analyze research on distributed work that emphasizes coordination and control processes (chapter 6). We complete the theory section with the development of the concept of gaps, a conceptual lens, and a structured summary of the literature on polycontextual, distributed collaboration (chapter 7). The gaps concept answers sub question 1. The rest of chapter 7 addresses in part sub questions 3a and 3b. It also provides the basis for empirically investigating coordination and control of distributed work

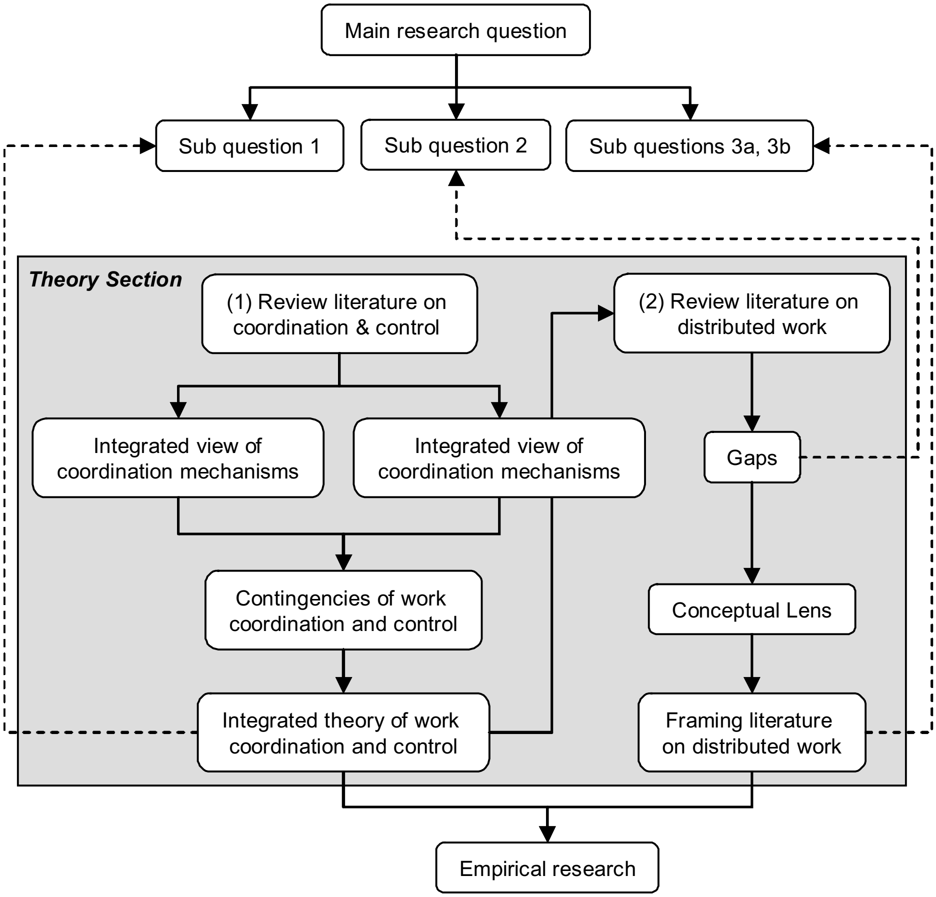


Figure 10 - Overview of theory building process

§ 3.2 Theory Development Methodology

'Theory' suggests a statement of relationships between constructs or variables (Bacharach, 1989: 3). In one of its basic forms, it explains variation of dependent constructs (or variables) in relation to a set of independent constructs (or variables) (Mullins, 1971). Theory is the fruit of an analytical process that thrives on the logic of past conceptual work and/ or empirical observation (Weick, 1989). A debate has evolved on the nature of this process, as epitomized in special issues of Academy of Management Review in 1989 and 1999, and Administrative Science Quarterly in 1995. In the broader literature, some scholars propose a lockstep process that uses matrices to cross-analyze past work (Salipante, Notz, & Bigelow, 1982). This strategy seems to fit homogeneous, bounded research areas with an agreed-upon vocabulary (Cooper, 1984). Other areas in organization theory, coordination and control theory, are more diverse and lack a common jargon. These are still recognizable fields where many scholars have contributed to, but

methodologies for advancing them rely more on typologies (Doty & Glick, 1994), imagination (Weick, 1989), paradoxes (Scott Poole & Van de Ven, 1989), and multi-dimension approaches (Mintzberg, 1998b; Morgan, 1997).
The design of our review of coordination and control theory takes the present level of integration into account. The scarcity of integrative reviews and connections so far made us decide on a four stages.
First, we started cross-analyzing organization theories for definitions of coordination and control. The review traced back to the end of the 19th century covering major organization theory journals and books. It relied on database searches, networking, and snowball effects, and was documented in a chronologically organized table.

For the second part of this review, we used taxonomies as a theory building methodology to surface coordination and control mechanisms from these theories (Doty & Glick, 1994). The mechanisms were analyzed and condensed to taxonomies to be presented in two sections later in this paper.

Third, a variance theory perspective (Mohr, 1982) was adopted to elicit causal structures across the theories we reviewed (Cooper, 1984). That is, the relationship between independent variables and coordination and control mechanisms (Bacharach, 1989). So far, the review concentrated on coordination and control theory as distinct areas.

The fourth stage then uses the previous ones to reveal linkages between coordination and control theory. It assesses definitions of coordination and control to define relationships between the constructs. And it compared the taxonomies of mechanisms and causal structures.

Finally, the emerging structure of coordination and control theory is used for analyzing and framing literature on distributed work. This results in a conceptual lens and insight in the current status of literature on distributed collaboration.

Quality of the overall review and integration effort was ensured by the following means:

- Maintaining a focus on our sub research questions, thus ensuring consistency
- Using quality resources to structure the literature reviews (Cooper, 1984)
- Sharing and discussing our approach and progress with K. Kumar and other academics
- Electronic documenting and interlinking our process, content and deliverables

Chapter 4 Work Coordination and Control: Literature Review

The first part of the theory section focuses on the coordination and control of work. The section starts with a review of theories from organization science and organizational economics. It focuses on (1) the types of coordination and control mechanisms proposed in literature. And (2) the determinants - or contingencies - of these portfolios of mechanisms. Together with chapter 5, we answer here sub question 1.

§ 4.1 Classic Organization Theory

"Nothing is particularly hard if you divide it into small jobs." - Henry Ford

In fact, classic organization theory started with Adam Smith's (1793) discussion of work division as a means to increase efficiency. Using the example of a needle manufacturer, Smith proposed an alternative to traditional work division where each individual actor performs all the steps required to produce an output. Instead, he suggested specialization for each small step in the manufacturing process, to be performed by individual actors. This increases productivity since each actor becomes highly skilled in accomplishing the same task.
While efficiency was Smith's main focus, his ideas change dependence and work coordination as well. Figure 11 shows how work has traditionally been divided, probably used since the medieval guilds or even classics era. Each individual actor is responsible for all the steps required for an output. Sequential dependence between the steps is simply coordinated by the same person.

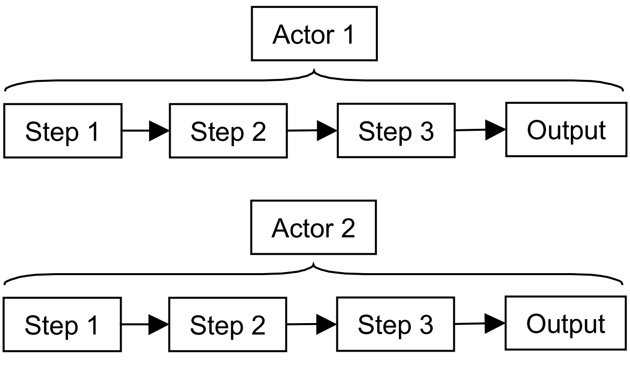


Figure 11 - Traditional division of work

Specialization according to Smith (1793) results in a turnaround as illustrated in Figure 12. Actors concentrate on one specific step and hand their results over to the next person in line.

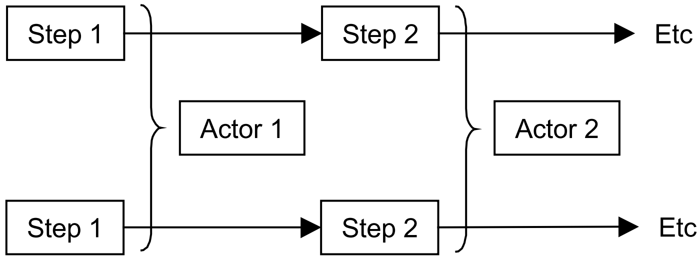


Figure 12 - Work division based on specialization

The assignment of steps to different actors implies that their work becomes interdependent. Their work needs to be coordinated and controlled to yield the same output as before:

> "(…) a piece of work cannot be subdivided into the obvious components without great danger that the central design, the operating relationships, the imprisoned idea, will be lost. When one man builds a house alone he plans as he works; he decides what to do first and what next, that is, he 'co-ordinates the work'. (…) It is self-evident that the more the work is subdivided, the greater is the danger of confusion, and the greater is the need for overall supervision and co-ordination" (Gulick, 1937: 3).

Classic theorists proposed a number of coordination mechanisms. At the basis is a hierarchical design of authority relationships (Barnard, 1938). A set of rules defines formal positions and their interrelationships, independent of the persons enacting the structure (Weber, 1946). Second, managers within that authority structure are supposed to conceive work division and integration in advance. In this process they formulate plans and standards (Barnard, 1938; Fayol, 1949). Planning is connected to managerial authority as Lichtner (1924) claims: "Planning is the managerial function of working out the best combination of procedures through coordinating the requirements with the facilities for carrying out the work of the division." Third, different persons are responsible for planning and executing the work: the plan must be transmitted from the former to the latter. This relies on communication: "(...) Communication relates to the formulation of purpose and the transmission of coordinating prescriptions for action and so rests upon the ability to communicate with those willing to cooperate (Barnard, 1938: 184).
Finally, managers could shape the minds and attitudes of workers such that they can coordinate their own activities. This anchors the coordination process at a work floor level as it is achieved: "(…) by the dominance of an idea, that is, the development of intelligent singleness of purpose in the minds and wills of those who are working together as a group, so that each worker will of his own accord fit his task into the whole with skill and enthusiasm" (Gulick, 1937: 3).

Control follows the coordination process described above. Its purpose is to ensure execution of the plan: "Control is the examination of results. To control is to make sure that all operations at all times are carried out in accordance with the plan adopted - with the orders given and with the principles laid down" (Fayol, 1937). Implicit in this view is a cybernetic view process (to be elaborated in the section on control theory). Actions and results are observed and compared to a priori defined standards; deviations from the plan lead to measures. "For control to be effective, monitoring must be constant, be followed up by corrective actions, and, where appropriate, must carry sanctions" (Fayol, 1949). Moving from coordination to control also means a shift in the manager's role. Having created the plan, he[16] becomes responsible for the control cycle as a controller (Barnard, 1938).

Classic theorists emphasized the linkage between coordination and control. Both dimensions are by definition intertwined: "(...) We get control through coordination" (Parker Follett, 1927: 171). The linkage becomes most apparent with coordination by plan: "Planning is of little value unless there is subsequent control to make certain that the plans are carried out" (Cornell, 1930: 212).

§ 4.2 Contingency and Information Processing Theory

Contingency theorists perceive the organization as an open system that interacts with its environment (Scott, 1992). This interaction implies vulnerability for uncertainty in the environment. Organizations experience uncertainty when they pull inputs from the environment, and face fluctuation in the demand for their outputs (Argote, 1982; Nohria & Gulati, 1994). Galbraith (1973: 5) defines uncertainty as "(…) the difference between the amount of information required to perform the task and the amount of information already possessed by the organization." Contingency theory proposes that uncertainty changes the mechanisms used by an organization for coordinating its operations (Lawrence & Lorsch, 1967b; Thompson, 1967). Information processing theory further clarifies this relationship. In their view, uncertainty increases the need for information processing. Since coordination mechanisms differ in their capacity to process information, the use of them should change to match environmental demands (Tushman & Nadler, 1978). Galbraith (1973) claimed that an increased need for processing information shifts coordination modes from rules and standards, to hierarchical communication and goal setting. More uncertainty requires either reduction of information processing needs by means of slack resources or autonomous work units, or increasing the capability to process information, by investing in information systems or direct lateral contact between work units.
Research on the effects of uncertainty usually employs a distinction made by Perrow (1967). He pointed at two dimensions of the construct: the number of exceptional cases actors face, also referred to as task variability (Van de Ven et al., 1976). And the analyzability of uncertain events, also called information equivocality (Daft & Macintosh, 1981). Task variety determines the amount of information processing. Task analyzability implies that actors lack a more fundamental understanding of cause-effect relationships, and do not know how to respond (Fry & Slocum, 1984).

Apart from uncertainty, contingency theorists have theorized and conducted empirical research on other factors as well. First, Thompson (1967) was among the first to recognize the role of dependencies (McCann and Ferry, 1979). Based on systems theory, he introduced a typology for physical workflows. He used pooled interdependence for

[16] For reading comfort, general references to a person are masculine (he, him, his). This includes, and could equally well be feminine.

describing situations where parts render a discrete contribution to the whole (Thompson, 1967: 54). Sequential dependence exists where one actor passes his work on to another one for continuing the transformation process. And reciprocal interdependence indicates situations in which outputs of each actor become inputs for others (Thompson, 1967: 54). Van de Ven et al (1976) extended the latter form with team interdependence where actors work jointly and simultaneously. These forms of interdependence become increasingly difficult and costly to coordinate (Thompson, 1967). Pooled interdependence does not require extensive coordination behaviors but may rely on a plan to schedules actors demand for a resource. But team interdependence means that people work simultaneously on the same task, like during a surgery. They watch each other closely and interact to blend their efforts. In addition to these commonly recognized dependencies, Galbraith (1973) identified in his case study at Boeing that activities or components require integration at some point in time. Since he did not introduce a dedicated term, we refer to this form as integration interdependence.

A second contingency factor is complexity. It refers to the intricate connectivity among multiple tasks and actors. It means that a "(…) problem is not easily amenable to clearly parceling out individual jobs or discrete tasks" (Goodman, 1981: 3). Complexity is the result of differentiating large tasks and assigning subtasks to multiple interrelated units (McCann & Galbraith, 1981). As a contingency factor, it extends and combines interdependence, uncertainty and work unit size. Complexity refers to the number of elements that are connected, and the number and type of relationships among these (Haeckel & Nolan, 1993). Hence, task complexity always includes an element of interdependence, but not necessarily uncertainty. Even when all the necessary information is available (Galbraith, 1973), tasks can represent a complex problem. Haeckel's (1993) definition clarifies the relationship between complexity and size of a work unit or task (like programming software (Kiesler, Wholey, & Carley, 1994)). As size increases, the number of elements and relationships among these grow as well.

A third factor is functional diversity among people involved in the same process or project. Lawrence and Lorsch (1967: 11) used the term 'differentiation' not to describe work division, but differences "(…) in cognitive and emotional orientation among managers in different functional departments." Functional diversity means that people approach a common problem domain from diverse angles. Dougherty (1992) reports on inter-departmental differences in a firm that develops new products. She describes how each unit has its own 'thought world,' that is "(…) a distinct system of meaning which colors its interpretation of the same information, selectively filters technology-market issues, and produces a qualitatively different understanding of product innovation" (Dougherty, 1990: 195). Functional diversity increases information processing needs. It makes interpersonal coordination mechanisms more important, such as working relationships (Lawrence & Lorsch, 1967b).

A final contingency factor is work unit size, indicating the number of actors involved in or contributing to an aggregated task (Van de Ven et al., 1976). The effect of size is contrary to those triggered by the previously discussed contingencies. Uncertainty, interdependence and complexity imply a shift from programmed coordination (like plans and standards) to inter-personal mechanisms like mutual adjustment (Thompson, 1967) and group meetings (Van de Ven et al., 1976). By contrast, increased size of work units shows a reverse relationship. Actors shift to more formalized mechanisms and information systems as a substitute for interpersonal exchanges that are unfeasible in large scale systems (Pennings & Woiceshyn, 1987; Van de Ven et al., 1976).

§ 4.3 Control Theory

Classic theorists perceived coordination and control as closely intertwined (Parker Follett, 1927). But since that era, control theory has become a somewhat independent stream of research. In the 50s and 60s, systems theory and cybernetics contributed to basic understanding of control cycles (Wiener, 1954). Their perspective on the control of electro-mechanical systems (like a thermostat) became a model for understanding control in human organizations (Litterer, 1981). A starting point for cybernetic control is the definition of a standard as a point of reference for preferred values of system inputs, processes, and outputs. The actual operation of a system is observed, measured and compared to this standard. In case of deviation, corrective measures are undertaken to ensure equilibrium (Beer, 1959; von Bertalanffy, 1968). Figure 13 shows cybernetic control cycles for input, process and outputs of an activity.

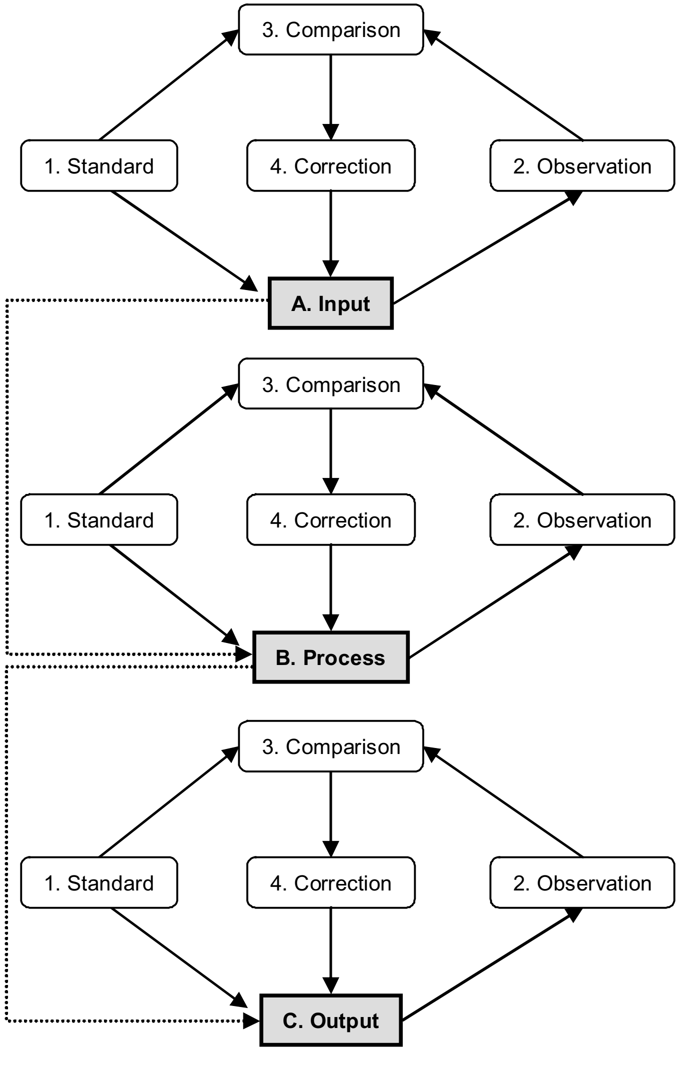


Figure 13 - Cybernetic control cycles

Application of this idea on social systems led to rational control approaches in the tradition of classic organization theory (Anthony, 1965). Managers plan and define desirable performance measures, and they observe behaviors and/ or outputs to make sure their plans are realized (Brech, 1965). Ouchi (1978) remarked that this control mode relies on an understanding of cause-effect relationships (for behavioral control), or outputs (for output control). He further pointed to differences between behavioral control - where a manager observes subordinates' actions-, and output control, where only results are noticed. The former control mode is rich but difficult to transmit across an organization's reporting

structure. Since output control is often quantifiable, exchange of measurements is easier and more comparable across an organization (Ouchi, 1978).
Scholars have proposed alternatives for hierarchical behavior and output control. Organizations that lack complete understanding of their environment and internal task structure can opt for two directions. One is to rely on agents outside a firm's boundary, like customers whose judgments reflect the performance of workers (Smith, 1997). Or professional associations that train and update employees (Stinchcombe, 1990). A second direction is to rely on control modes that focus on workers rather than their work (Kirsch, 1996). An example of this approach is clan control where individual actors are selected, socialized and promoted according to their capacity and internalized commitment to organizational goals (Ouchi, 1979). Individual workers may even control their own efforts, or they contribute to small, self-controlling groups (Barker, 1993; Hage, Aiken, & Marrett, 1971). Self-control implies that observation by someone else than the worker (be it manager or an entity outside the organization) is substituted for non-differentiated, internalized control. The controllee becomes his or her own controller.
Underlying these control modes is the same cybernetic cycle of defining standards, measuring actual work, comparing and effectuating in case of deviations (Manz & Angle, 1986). People-based control modes differ however on a couple of other dimensions. First, the definition of expectations is less formal and explicit. Self-managing groups may develop implicit norms for collaboration and acceptable performance that are enforced in fluid group processes (Barker, 1993; Schein, 1992). Second, programmed control modes are associated with an assumption of goal incongruence between organization and employee. The risk of malperforming actors is overcome by specifying work in advance, and monitoring behaviors or outputs. People-based control modes relax this assumption (Eisenhardt, 1985). Internalized commitment and competence justify (or even require) de-differentiation of control roles where actors define, measure and modify their own actions (Grant, 1996b).

§ 4.4 Transaction Cost Economics

Transaction cost economics (TCE) theorizes on the governance of business transactions. The choice for a particular governance mode intends to minimize the total costs of a transaction. "The overall objective (…) essentially comes down to this: for each abstract description of a transaction, identify the most economical governance structure - where by governance structure I refer to the institutional framework within which the integrity of a transaction is described (Williamson, 1979: 233). The total costs of a transaction are a combination of production costs and transaction costs. The latter consists of "(…) the ex ante costs of drafting, negotiating, and safeguarding an agreement and, more especially, the ex post costs of maladaptation and adjustment that arise when contract execution is misaligned as a result of gaps, errors, omissions, and unanticipated disturbances" (Williamson, 1994: 102). The interplay of environmental and behavioral factors explains variation of transaction costs. Environmental factors include uncertainty in the transaction context, and small numbers exchange (Williamson, 1985). Behavioral factors refer to bounded rationality and an opportunistic attitude. Williamson (1975: chapter 1) emphasizes two combinations of these contingencies. First, small-numbers exchange relations and opportunism: "Opportunism refers to a lack of candor or honesty in transactions, to include self-interest seeking with guile. (...) many transactions that at the outset involve a large number of qualified bidders are transformed in the process of contract execution, so that a small-numbers supply condition effectively obtains at the contract renewal interval". Second, uncertainty and bounded rationality: "The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world (Simon, 1957)".

Drawing from economics (Coase, 1937) and law (Macneil, 1978), Williamson (1975) considers classical contracts as an ideal form for governing transactions. These contracts are "sharp in by clear by agreement; sharp out by clear performance" (Macneil, 1974: 738). Classical transactions are characterized by transparency. Contractual stipulations define mutual dependencies between buyer and seller comprehensively in advance. In its basic form, transactions introduce two dependencies: the buyer depends on the seller for receiving goods or services, and the seller depends on the buyer for receiving value in return. The contract that formalizes these expectations allows actors to check ex post whether commitments have been realized (Williamson, 1985). In sum, coordination of the ideal form of transactions relies on the ex ante specification of work outputs as agreed upon by contractual parties. Control is achieved by a differentiated cybernetic cycle where buyer and seller take on controller and controllee roles. Each compares the counterpart's performance with contractual specifications. An assumption underlying this 'rational' approach to coordination and control is that "(…) it is feasible to measure, with reasonable precision, the performance that is desired" (Ouchi, 1979). This measurement depends, in turn, on perfect understanding of the inputs, behaviors and outputs that constitute the transaction (Williamson, 1991).

The combination of behavioral and environmental factors earlier mentioned undermines this governance process. Uncertainty means that actors - bounded in their rationality - cannot predict and specify reciprocal performances in advance. Small-numbers exchange and opportunisms make behaviors after contract closure unpredictable (Williamson, 1975). Incomplete ex ante understanding translates into incomplete contracts. These leave room for different interpretations and an evolutionary path by which the transaction unfolds (Williamson, 1994). More relevant here, the factors call for a change in the portfolio of coordination and control mechanisms used: "Not every transaction fits comfortably into the classical-contracting scheme. In particular, long-term contracts executed under conditions of uncertainty are ones for which complete presentation is apt to be prohibitively costly if not impossible" (Williamson, 1979: 237).

Relying on contract law (Macneil, 1974, 1978), Williamson (1991) suggested that actors move from classical contract law to neo-classical or relational contract law. With neo-classical contract law, reciprocal performances remain incompletely specified in order to leave room for adaptation during contract execution (Williamson, 1991). Parties engage in a flexible process of mutual adjustment and "(…) require special adaptive mechanisms to effect realignment and restore efficiency when beset by unanticipated disturbances" (Williamson, 1991: 272). Coordination and control of ideal transactions thus change. Reduced comprehensiveness of work specification is complemented with mutual adjustment to coordinate the exchange (Thompson, 1967). Control still relies on the contract, but also on norms for interpreting original intentions that were incompletely outlined in advance (Llewellyn, 1931).

Relational contracts imply a further shift away from classical contracts. Increased uncertainty of the work undertaken makes the identity of both parties and their relationship even more important (Ben-Porath, 1980). MacNeil (1978) emphasized the importance of role integrity, supra-contractual norms, and the reciprocal commitment of parties to preserve the relationship. Ben-Porath (1980: 7) distinguished two types of transactions in which identity and relationship are important: (1) "Transactions in which, because of imperfect information, there is uncertainty about the quality of the object of exchange or the terms of the transaction. The identity of the seller can reduce this uncertainty: a producer's identity can be a signal of the quality of what is produced, and a worker's identity a signal of the quality of his services." And (2) "Transactions that are not consummated instantaneously, and that involve obligations or consequences that extend over time."

As actors move from classical to neoclassical and relational contracts, the nature of their dependence changes. In turn, this alters coordination and control processes. Increased uncertainty implies that specification of work becomes less comprehensive (Williamson, 1994). As a more adaptive form of coordination is required, specifications are complemented with mutual adjustment and, eventually, working relationships (Rousseau & McLean Parks, 1993). Uncertainty also means that control cannot rely on comparison of work with detailed specifications (Ouchi, 1979). Rather, iterative feedback cycles (with neo-classical contracts), and behavioral norms (with relational contracts) ensure that expectations are met in an adaptive manner (Williamson, 1991).

At the outset of TCE, the shift in type of contract has been attached to organizational boundary questions. Williamson (1975, 1985) suggested that increased uncertainty implies a shift from market-based transactions with independent buyers and sellers, to transactions within the boundaries of a firm. Compared to market-based governance, Williamson emphasized the advantages of firms in terms of coordination and control. The coordination advantage of an organization builds on the jargon that is shared within its boundaries and allows for more efficient and informal communications (Williamson, 1975). Moreover, "(…) adaptations to consequential disturbances are less costly within firms because (...) information that is deeply impacted can more easily be accessed and more accurately assessed (...)" (Williamson, 1991: 279). Organizations have also an advantage to control ill-specified transactions. Their appraisal and reward system is more extensive and refined than control in the market place (Williamson, 1975). And within their boundaries, groups can work in what Williamson (1975) calls an atmosphere that is less calculative. Groups of closely collaborating actors develop working relationships and norms that fine-tune and enforce acceptable behaviors. This phenomenon also allows groups to carefully select new members as a form of input control (Williamson, 1975).

TCE has led to discussions among scholars in organization science and sociology. Ghoshal and Moran (1996) debated assumptions underlying TCE such as opportunism. Research has shows that relational governance modes also occur between firms. Networks of small firms in a confined geographic region develop bonds and sustainable patterns of collaboration (Lazerson, 1995). Transactions between these firms do not rely on contractual specifications per se, but mutual orientation: "(…) parties develop knowledge regarding one another and they draw on that knowledge to communicate and resolve problems (Powell & Smith-Doerr, 1994: 384). Other research has further refined the traditional distinction in TCE between market and hierarchy-based governance. Bradach (1989) suggests that price, authority and trust can be combined as independent modes for governing transactions. These combinations do not relate to organizational boundaries in a single way. For example, price-based governance may occur within firm boundaries. Organizations can also combine governance modes, like franchising restaurant chains that have hierarchical relationships with their own restaurants, and relational contracts with franchisees (Bradach, 1997). For coordination and control theory, this implies that multiple types of coordination and control mechanisms may be selected to suit a particular situation. The challenge becomes to define a more comprehensive taxonomy of these mechanisms, and to gain insight in the factors that drive the selection process.

§ 4.5 Inter-firm Coordination and Control

In geographically distributed IS projects, portions of the work are often contracted out or even subcontracted to offshore vendors (Rajkumar & Dawley, 1997). This makes it important to understand coordination and control across organizational boundaries. Yet most literature on coordination and control focuses on collaboration within a single organization, like between departments (McCann & Galbraith, 1981). An exception is Transaction-cost economics that theorizes on the efficient governance of transactions (Williamson, 1979, 1994). This theory proposes contingencies that explain choice for a particular governance mode, like market-based contract, intra-organizational hierarchy, or clan (Ouchi, 1979). TCE and its more recent extensions (Ghoshal & Moran, 1996; Powell, 1990) thus concentrate on a generic decision process. They do not elaborate on the actual coordination and control mechanisms that materialize governance modes (Grandori, 1998). As far as intra-organizational integration is concerned, TCE is complemented with contingency theory as earlier discussed. Coordination and control of inter-firm transactions requires other literature that is introduced in this section.

First, Bryman et al. (1987) investigated inter-firm collaboration in construction projects. His research showed that supervising managers of the main contractor emphasized the need for familiarity in working with both clients and the web of subcontractors they relied upon. "With regard to clients, considerable attention was directed (by contracts managers) to both the level of familiarity with clients' methods and procedures and the personal characteristics of the individuals involved: "You have to get to know the strengths and weaknesses, the likes and dislikes of the particular client if you're to cover their requirements in greater depths"." (Bryman et al., 1987: 263).
In the construction industry, multiple subcontractors are usually involved to take care of the activities that match their particular specialization. This fragments work across multiple firms and makes coordination and control more intricate. In addition, the short time frame of projects leaves the main contractor little room to assess and influence the subcontractor's operations. Hence, in Bryman et al.'s (1987) research, supervising contracts managers "(…) stressed the value of working with a "known" site manager and a

familiar "team" on whom they are able to rely" (Bryman et al., 1987: 262). When firms contract out parts of the project, they create lateral relationships across organizational boundaries. These transactions lack the 'incentive and control machinery' common to an intra-organizational hierarchy (Williamson, 1975). Instead, Bryman et al. (1987) argues, contractors rely on selection and continuous relationships with subcontractors. "Such a focus stems in large part from the lack of time within a temporary system for probation and socialization into the organization. (...) It has been noted elsewhere that the selection of individuals acts as a control device (...). Such a process may be no less relevant, and perhaps even more so, in the context of a temporary system" (Bryman et al., 1987: 263).
As a coordination mechanism, selection of known subcontractors implies leveraging mutual knowledge acquired on prior occasions (Krauss & Fussell, 1990). "Individual subcontractors who depend on one or a few main contracting organizations for the bulk of their work are more readily "tuned in" to the culture, methods, and practices of the main contracting organization" (Bryman et al., 1987: 267).

Second, Bradach (1997) conducted research on restaurant chains which have both company-owned restaurants and franchising contracts. His study compares the way corporate headquarters manages both forms and achieves adaptation across all restaurants. It therefore sheds light on inter-firm coordination and control. First, company-owned restaurants are part of a bureaucratic hierarchy with structured planning and control practices (Williamson, 1975). This is leveraged to ensure consistency and implement adaptation of restaurant operations. "The company arrangement focuses on control: a multitude of structures and systems ensures adherence to the standards and preserves uniformity" (Bradach, 1997: 277).
The company's relationship with franchisees is different since it lacks this authority structure. Instead, it is founded on a relational contract that specifies reciprocal obligations (Bradach, 1997). The contract is complemented with lateral contacts between headquarters and franchisees (Macneil, 1978). Implementing the same adaptation of franchisee operations requires mutual adjustment in the context of these working relationships (Bradach, 1998). As two respondents in Bradach's (1997: 288) research explained: "We have no authority, so we must be able to convince the entrepreneur (...). On the company side, we can put restrictions on people. In contrast, with franchisees we suggest, nurture, and prod to achieve our goals. Relationships are crucial and when they deteriorate it becomes extremely frustrating to try to get the company's goals across."

Third, Grandori and Soda (1995) point at the lack of precision in TCE and network theory in explaining inter-firm coordination modes. This concerns both the absence of a taxonomy of coordination mechanisms, as well as insight in the determinants of these coordination modes. To fill this gap, Grandori and Soda (1995) and Grandori (1997) reviewed organizational economics and contingency theory. They propose a set of inter-firm coordination mechanisms that can be summarized as follows:

- Communication, decision and negotiation mechanisms - firm representatives interact to establish and foster exchange between their organizations.
- Group problem solving - organizations may establish formal or informal committees with representatives from the partners involved to discuss issues concerning the exchange relationship (Grandori, 1997; Van de Ven et al., 1976).

- Social coordination and control - inter-firm collaboration relies on working relationships and collective norms for interaction (Ouchi, 1979)
- Integration and linking-pin roles and units - organization design structures like liaison roles and linking pins were originally proposed for inter-departmental collaboration (Lawrence & Lorsch, 1967a). According to Grandori (1995), firms may establish similar roles for handling inter-organizational exchange.
- Common staff - assigning dedicated staff to coordinate between firms becomes necessary if the scope of inter-firm collaboration becomes wider, or the number of cooperating firms increases (Grandori & Soda, 1995).
- Hierarchy and authority relations - although inter-firm linkages are usually lateral, vertical relationships may emerge, like in case of consortia.
- Planning and control systems - inter-firm collaboration may consist of interrelated workflows that require planning and control, like with franchise organizations.
- Routines, rules and procedures - interaction between firms may rely on formal and informal rules for handling interlocked operations (Grandori, 1997).
- Incentive systems and property rights - aligning interests of two or more firms relies on incentives that are tied to behavioral patterns of the actor involved.
- Selection system - firms develop and apply rules for selecting a partner organization suited for the form of cooperation they want to become engaged in. "In fact, a powerful means of enhancing the likelihood of achieving a coordinated action among firms is the selection of partners on the basis of some good predictors of relevant behaviors for the cooperation" (Grandori & Soda, 1995: 196).
- Information systems - traditionally, information systems have been used within firms to support vertical communications for planning and reporting (Galbraith, 1973). The deployment of IT for inter-firm collaboration facilitates and economizes lateral exchange patterns and may even automate interlocked workflows (Grandori & Soda, 1995).
- Public support and infrastructure - public agencies may increase the feasibility of inter-firm collaboration (like R&D) with infrastructure and incentives.

Grandori and Soda (1995) and Grandori (1997) propose several contingencies that explain selection of coordination mechanisms, like interdependence, complexity, and uncertainty. With respect to interdependence, Grandori (1997) integrates contingency and TCE approaches to distinguish collective action and transaction dependencies. Collective action indicates that firms collaborate and act jointly to capture an opportunity. It includes pooled and intensive[17] interdependence (Thompson, 1967; Van de Ven et al., 1976). Transaction interdependence refers to situations where firms merely exchange resources rather than cooperate. It encompasses sequential and reciprocal dependence (Thompson, 1967). Grandori (1997) theorizes on the linkages between these types of dependence and the coordination mechanisms earlier introduced. She groups the mechanisms as summarized in Table 4.

[17] Since intensive interdependence is characterized by real-time coordination, it closely resembles team interdependence (Van de Ven et al., 1976).

Table 4 - Types of interdependence and effective coordination mechanisms (1)

Pooled: ▪ Communication and decision procedures ▪ Mutual monitoring or supervisory hierarchy	Intensive: ▪ Group decision making ▪ Mutual monitoring or supervisory hierarchy
Sequential: ▪ Programming ▪ Hierarchical decision making for inter-unit adjustment	Reciprocal: ▪ Integration and liaison roles ▪ Authority by exception and residual arbitration

Adopted from Grandori (1997: 909)

Finally, Kumar and Van Dissel's (1996) elaborate on the use of inter-organizational systems (IOS) to support inter-firm coordination. They apply Thompson's (1967) workflow dependencies (pooled, sequential, reciprocal) to inter-organizational collaboration. The resulting taxonomy (Table 5) provides the basis for discussing coordination mechanisms, potential for conflict, and types of IOS.

Table 5 - Types of interdependence and effective coordination mechanisms (2)

Type of Interdependence	Pooled interdependency	Sequential interdependency	Reciprocal interdependency
Coordination mechanisms	Standards & rules	Standards & rules, Schedules & plans	Standards & rules, Schedules & plans, Mutual adjustment
Technologies	Mediating	Long-linked	Intensive
Structurability	High	Medium	Low
Potential for conflict	Low	Medium	High
Type of IOS	Pooled information resource IOS	Value/ supply-chain IOS	Networked IOS
Examples of implementation technologies and applications	Shared databases Networks Applications Electronic markets	EDI applications Voice mail Facsimile	CAD/CASE data interchange Central repositories Desk-top sharing Video-conferencing

Adopted from Kumar and Van Dissel (1996: 287)

Moving from pooled to sequential and reciprocal dependence, the structurability of tasks decreases. Structurability refers to the ability or potential to specify the structure of an inter-organizational relationship (Kumar & van Dissel, 1996: 285). A consequence of more intensively linked workflows and less structurability is that firms will complement standards and rules with schedules, plans and mutual adjustment to coordinate their exchanges (Van de Ven et al., 1976). This requires a corresponding shift in the type of IOS deployed. Pooled information systems (like databases) are extended to EDI and collaboration tools to cater for increased information processing needs.

§ 4.6 Agency Theory

Agency theory is the second major stream of thought in organizational economics, apart from TCE (Barney & Hesterley, 1996). The theory studies "(...) the ubiquitous relationship, in which one party (the principal) delegates work to another (the agent), who performs that work" (Eisenhardt, 1989a: 58). Delegation means that an agent works for his or her principal (Ross, 1973); he or she does not collaborate with him like with the other forms of dependence. While the principal may remain responsible, the actual work is carried out by someone else.

Like any form of interdependence, agency relationships - which could be referred to as delegation interdependence - requires coordination and control. Agency theorists emphasize the control part. Coming from an economic perspective, they assume that both principal and agent are primarily interested in maximizing their own utility (Jensen & Meckling, 1986). Hence, monitoring the agent is important to avoid unsatisfying performance from the principal's point of view (Ross, 1973). This observation complements contractual stipulations that reward or punish an agent's behaviors depending on its utility for the principal (Eisenhardt, 1989a).

The principal's enforcement repertoire is contingent on his ability to observe the agent's work in terms of behaviors or outcomes. If the principal can observe the agent's behavior, he should use a behavior-based contract to enforce performance in his interest. Behavior that is not observable for the principal implies information asymmetry between principal and agent. This may be caused by the fact that principal and agent do not work in the same space (like sales persons on the move). Or because of teamwork, where individual contributions are not easily recognized (Barney & Hesterley, 1996). Assuming self-interest, incomplete observation is an opportunity for the agent to work in his own interests. Yet a behavior based contract could still be used if the principal invests in information systems (Govindarajan & Fisher, 1990). Alternatively, the principal can base the contract on work outcomes and observe these (Eisenhardt, 1985). This occurs only "when the cost of measuring behaviors exceed the cost of transferring risk to their agents" (Govindarajan & Fisher, 1990).

Scholars in organization theory have linked agency theory to control and contingency theory in two ways. First, scholars have suggested conceiving observability and uncertainty -- knowledge of cause-effect relationships (Thompson, 1967) -- as two separate dimensions. Agency theory proposes that uncertain work is by definition hard and costly to observe (Govindarajan & Fisher, 1990). But organization theorists suggest that even if the principal can observe work, he may not be able to understand if he lacks appropriate know-how (Kirsch, 1996). Second, situations may occur where both behaviors and outcomes are unobservable or uncertain. In this case, the principal can attempt to minimize goal divergence, rather than investing in information systems at high costs (Eisenhardt, 1985). By doing so, a clan mode of control emerges that substitutes for external behavior and output control. Internalized values encourage the agent to work in the principal's interest (Eisenhardt, 1989a).

Agency theory is helpful to understand control in distributed work settings. Monitoring behaviors or even outcomes can be difficult if principal and agent are geographically separated. This theme is elaborated in later sections.

§ 4.7 Temporary Systems

Temporary systems is the field of study in organization science that is directed towards projects and the management of projects (both terms are used interchangeably). Even though prescriptive literature intended for professional audiences abounds, few scholars have theorized on the nature and problems of projects (Bryman et al., 1987). Fortunately, their publications have direct relevance for understanding coordination and control of projects.

§ 4.7.1 Organic Perspectives

Early approaches conceived projects as temporary forms of collaboration that involve people who have never worked before nor will work together on afterwards (Bennis, 1965). Temporary systems were characterized as organic systems where members have imprecisely described roles. They rely mainly on mutual adjustment and ad-hoc improvisation, rather than programmed means of coordination (Bennis, 1965; Burns & Stalker, 1961). Goodman and Goodman (1976) confirmed that view. They related the need for adaptive coordination to the complex and interdependent nature of project work: "The members must keep interrelating with one another in trying to arrive at viable solutions" (Goodman & Goodman, 1976: 495). In this spirit, practitioner-oriented writers suggest that project contributors should form a close-knit group (team) to collectively face subsequent challenges (Thamhain, 1988).
In sum, the organic view proposes that temporary systems rely on mutual adjustment between project contributors to shape the project. This is promotes in a lateral, team-based organization design where role definitions are incomplete and overlapping. As participants interact, they control each other's efforts in an implicit manner (Barker, 1993).

§ 4.7.2 Mechanistic Management

Scholars also point at a contrasting, mechanistic view on temporary systems. This perspective emphasizes the formulation of a detailed plan by the apex of the project organization (Burns & Stalker, 1961). Work-breakdown structures define work packages that are assigned to project participants (Globerson, 1994). The plan is vertically communicated to them and clearly demarcates roles: "For instance, in both theatre and construction, one can see an organizational approach in which role clarity is preeminent. (...) Each person knows what he or she can and cannot do" (Goodman, 1981: 5). Detailed planning also facilitates monitoring work progress on a regular and formal basis (Bent, 1988).
The mechanistic approach promotes consistency since actions are shaped in accordance with the master plan. It reduces interaction needs among contributors and thus facilitates the coordination of control of large projects (Brooks, 1975). A key assumption, however, is that project work can be defined in detail in advance.

§ 4.7.3 Beyond the Dichotomy

Since the early 60s, the distinction between mechanistic and organic systems has permeated organization theory (Burns & Stalker, 1961). It provides a clear taxonomy that groups particular coordination and control mechanisms, and relates them to contingencies like task uncertainty. At the same time, however, this perspective does not cater for alternative, hybrid means for organizing (temporary) systems. Currently, an alternative view seems to emerge in organization theory: semi-structure or improvisation.

This alternative concerns the proposition that systems are either structured (mechanistic systems) or unstructured (organic systems). Traditionally, unstructured systems are supposed to thrive in uncertain environments where adaptation is a conditio sine qua non for survival (Burns & Stalker, 1961). But Eisenhardt and Tabrizi (1995: 93) "(…) call into question the traditional link between organic processes and uncertain situations (Burns & Stalker, 1961; Lawrence & Lorsch, 1967b; March, 1988). Burns and Stalker (1961) characterized organic processes as lacking structure. (…) But playful, fluid organic processes fail to capture the importance of focus and structure that emerges here. Fast processes in uncertain situations may not be organic, but they are improvisational in that they combine real-time learning through design iterations and testing with the focus and discipline of milestones and powerful leaders."

According to Eisenhardt and Tabrizi (1995), uncertain work calls for a combination of structure (but not as detailed as with mechanistic systems) and inter-personal coordination. This hybrid form has been referred to as semi-structure. "By semi structures we mean organizations in which some features are prescribed or determined (e.g., responsibilities, project priorities, time intervals between projects), but other aspects are not. Semi structures exhibit partial order, and they lie between the extremes of very rigid and highly chaotic organization (Brown & Eisenhardt, 1997: 28).

A related stream of research draws from literature on improvisation and uses jazz as a metaphor to describe forms of collaboration that are both adaptive and structured (Hatch, 1999; Weick, 1998). As an example of semi-structure, improvisation by a jazz-combo relies on a variety of structured and inter-personal coordination mechanisms. It forges unique collective behaviors from fixed codes of conduct and mutual orientation (Barrett, 1998). "Jazz improvisation involves creating music on the spot without a prescribed score or plan. However, jazz is guided by a non-negotiable framework that constrains what the soloist can play. This structure provides the necessary backdrop to coordinate action and organize choice of notes" (Barrett & Peplowski, 1998: 558).

Semi-structure and improvisation enhance the repertoire for understanding forms of collaboration that lie between mechanistic and organic approaches (Eisenhardt & Tabrizi, 1995; Weick, 1998). It extends the dichotomous choice of structuring predictable projects extensively, and promoting group meetings and mutual adjustment for uncertain ones. In particular the latter type of projects may benefit from structure that defines (minimal) structure for collaboration, and capitalizes on previous experiences and routines (Bryman et al., 1987). This applies especially to geographically distributed temporary systems that cannot rely on the spontaneous, unstructured forms of collaboration possible in a collocated project setting (Cramton, 1997).

§ 4.8 Information Systems Projects

Information systems projects are a subset of temporary systems in general. They are probably among the most challenging project endeavors people engage in. As far as coordination and control are concerned, most literature focuses on IS development projects. The difficulty of managing IS projects is caused by their scale and uncertainty (Kraut & Streeter, 1995). First, the scale of information systems is often large with many subsystems and interconnected routines. This reflects on the project organization as well: work is divided and assigned to multiple specialists. Fred Brooks (1975: 35) in his famous exposé on the development of the IBM System/360, explains that information systems can no longer be the product of one mind. Their size requires architectural design as far as the system is concerned. And organization of the people contributing to the system: "The purpose of organization is to reduce the amount of communication and coordination necessary; hence organization is a radical attack on the communication problems treated above. The means by which communication is obviated are division of labor and specialization of functions" (Brooks, 1975). Second, IS projects are uncertain, not only because their size makes them difficult to grasp. Since they often concern the application of new technologies, project members lack experience and examples to build on (Kraut & Streeter, 1995). In addition, requirements for building the system are difficult to elicit from users, and may change over the course of the project.

What makes IS projects interesting is the fact that these factors - scale and uncertainty - are combined with the need for extreme precision. Numerous lines of codes need to interact appropriately to ensure reliable operation of the eventual system. This led IS scholars to investigate the coordination and control of IS projects (Kiesler et al., 1994; Kirsch, 1997; Nidumolu, 1995). Their research draws mainly on organization theory and organizational economics. Coordination mechanisms used in IS projects include, first of all, the way work is divided. Modularization of the system (object-oriented programming) and project organization simplifies the overall structure and need for coordination (Kraut & Streeter, 1995). Second, selection and training of IS professionals based on commitment and past experience (Kiesler et al., 1994). Third, formalization of project management by means of specifying task decomposition, authority structures, work planning, and standard operating procedures (Kiesler et al., 1994). Fourth, hierarchical and lateral direct communications between interdependent actors (Nidumolu, 1996; Thompson, 1967). These include formal communications to handle routine work demands, and informal communications to address unpredicted events and ad-hoc concerns (Kraut & Streeter, 1995). Finally, technology itself supports the coordination process by facilitating communications among project members, and automating certain aspects of their coordination needs like interface design and testing.

Research on control in IS projects assessed the employment of control mechanisms. Henderson and Lee (1992) made a distinction between managerial (hierarchical) control and team member self control. Both may relate to behaviors or outputs. Incomplete understanding of transformation processes makes it more likely that self-control modes are used (Henderson & Lee, 1992). Kirsch (1996, 1997) studied IS projects adopting Eisenhardt's (1985) integrative review on control theory. She distinguished formal and informal control modes. Formal control indicates explicit specification of desirable behaviors or outcomes. Informal control is based on social or people strategies, and includes clan control (Ouchi, 1980) or self control (Kirsch, 1996; Manz, Mossholder, &

Luthans, 1987). The use of output control depends on the measurability of results; behavior-based control depends on the controller's ability to observe behaviors and understanding these. Finally, technology itself plays a role to support IS projects, like CASE tools, groupware or configuration management tools. These systems ensure performance of individuals, and the consistency of their efforts in the project as a whole (Ciborra et al., 1996; Orlikowski, 1991).

§ 4.9 ISD Methodologies

Developing information systems requires a multiplicity of tasks to be performed by multiple actors (Kraut & Streeter, 1995). The structure of this process usually relies on a guiding set of principles or methodology that defines roles, tasks, and their interrelationships over time (Beath & Orlikowski, 1994). Adoption of a methodology has implications for the way development work is divided and integrated (Kraut & Streeter, 1995). Different methodologies are therefore assessed here from a coordination and control point of view.
Traditionally, ISD projects have been organized according to the waterfall approach, built around separate phases for analyzing, specifying and building the system (Trevor, 1994). This methodology follows a linear pattern and is time-intensive since user requirements must be specified in detail before starting the design and programming work (Hanna, 1995). The increasing complexity of current information systems, combined with the demand for shorter project cycle time has therefore led to alternative approaches (Glen, 1993). First, instead of organizing tasks in a linear sequence, they can be organized in an overlapping mode, or in parallel (Terwiesch & Loch, 1999). A second extension is the emergence of participatory methods that encourage stronger involvement of users in the development process (Hirschheim & Klein, 1994). They also advocate the use of prototypes to build a system in an evolutionary mode, rather than capturing user requirements upfront (Hanna, 1995). Examples of these methodologies include prototyping, Rapid Application Development (RAD), and Joint Application Development (JAD) (Beynon-Davies, Carne, Mackay, & Tudhope, 1999; Glen, 1993).
In the following sections, the waterfall methodology and two extensions are discussed with an emphasis on coordination and control.

§ 4.9.1 Waterfall

> "In that traditional (waterfall) method, system analysts meet with users at the start of a project to determine user needs and agree on a written product requirements specification, and they then work isolated from further user contact until the final product is delivered (...)." (von Hippel, 1994: 435).

The waterfall approach was developed in the 70s to structure ISD projects (Trevor, 1994). It prescribes a series of phases for analysis and design that must be completed in a linear fashion (Glen, 1993). At the start of a project, system analysts work with users to define requirements. These are formally specified and signed off by users. System analysts then elaborate the system design system, and provide programmers with detailed instructions for building the application. Figure 14 illustrates this process, using dimensions proposed by Crowston (1997) except for the 'individuals' dimension. The symbols refer to common practice in structured analysis (Gane & Sarson, 1979). Users A, B, C, and D work with system analysts E and F on the requirements analysis. These result in specifications that are signed off and handed to programmers G, H, I, and J for programming the system.

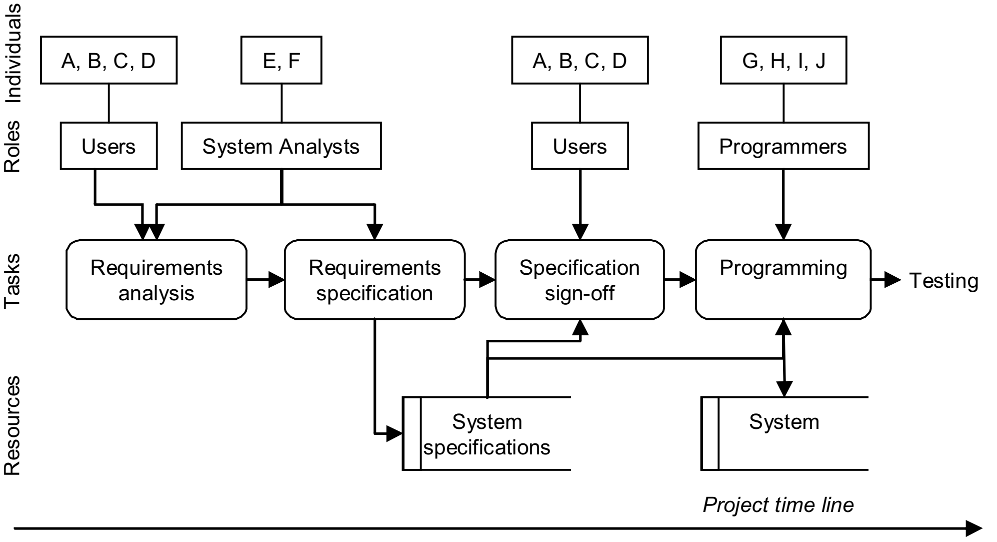


Figure 14 - The waterfall methodology

From a coordination and control theory perspective, the waterfall methodology requires inter-personal coordination mechanisms like mutual adjustment and group meetings in the project's initial phase (Van de Ven et al., 1976). System analysts then translate results in specifications with a number of coordination and control functions. First, users need to sign-off specifications to indicate their satisfaction. To this end, they compare them with their requirements and point at any deviations (Reeves & Woodward, 1970). Once users have signed, the specifications become a means for system analysts and programmers to control further user requests. Second, from the programmers' point of view, specifications are the primary means to coordinate their work with user expectations. Specification is a form of programmed coordination that must reflect the requirements in a comprehensive manner (Perrow, 1967). Third, specifications enable users to compare ex-post the actual system with their initial requirements (Adler & Borys, 1996).

Building comprehensive specifications is challenging when projects become more complex, and requirements are unstable. In fact, these two factors are related. Capturing intricate requirements in a comprehensive manner is time consuming. At the same time, a lengthier analysis phase makes it more likely that requirements have changed (Hanna, 1995).

In a geographically distributed setting, the waterfall method suggests that system analysts and users have a series of - probably collocated - meetings to analyze and document requirements. Then, system analysts prepare specifications and provide these to a - possibly remote - team of programmers.

§ 4.9.2 Parallelization

A first departure from the waterfall approach concerns the sequencing of tasks. The waterfall approach prescribes tasks to be arranged in a linear order. Upon completing a task, results are locked and handed over to actors involved in the next one (Figure 15).

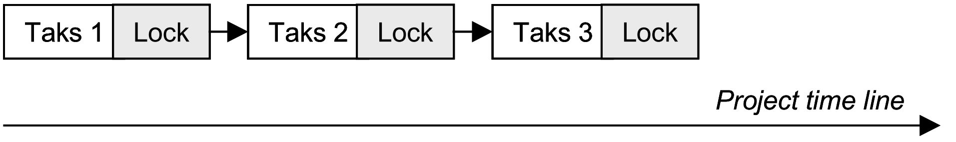


Figure 15 - Task sequencing in the waterfall methodology

As an alternative, parallelization or concurrency implies that tasks overlap to some extent. A subsequent task is already started before the preceding one has been finished (Figure 16). Parallelization is a time-compression strategy that reduces the cycle of development projects (Eisenhardt & Tabrizi, 1995). At the same time, it changes the way sequentially dependent tasks are coordinated and controlled (Kunz et al., 1998).

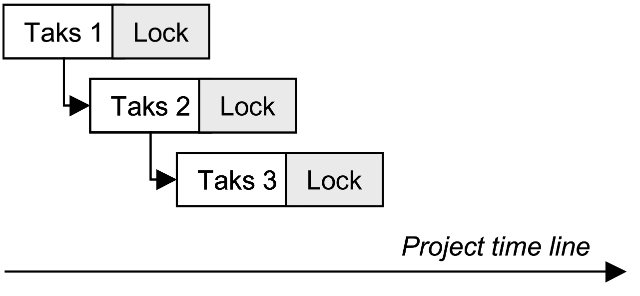


Figure 16 - Task sequencing with parallelization

Tasks use results from preceding ones as input. When they are started before these have been finished, input uncertainty increases (Argote, 1982). Contingency theory predicts that uncertainty implies increased information processing needs, and therefore substitution of work specifications for mutual adjustment (Tushman & Nadler, 1978). Individuals cannot consider output from preceding tasks as fixed inputs. They must interact to keep updated on the completion of that task, and adjust their own work accordingly (Loch & Terwiesch, 1998).

Task overlaps also mean that workers cannot check outputs from preceding tasks and compare these to standards (Melcher, 1976). As a substitute for this form of input control, they become more dependent on internalized competence and commitment of contributors to preceding tasks. While interacting during the final phase of task 1 (respectively task 2) which resembles the initial phase of task 2 (respectively task 3), a type of clan control emerges that is built on mutual confidence (Ouchi, 1979).

Parallelization could also change the way tasks are dependent, another contingency of coordination mechanisms (Van de Ven et al., 1976). The waterfall model resembles a linear, sequential type of task interdependence (Glen, 1993). After pooled dependence, literature suggests that this form is relatively straightforward to coordinate (Thompson, 1967). Says Grant (1996b: 115): "Probably the simplest means by which individuals can integrate their specialist knowledge while minimizing communication and continuous coordination is to organize production activities in time-patterned sequence such that each specialist's input occurs independently through being assigned a separate time slot."

Parallelization potentially complicates the form of dependence if preceding tasks are taking into account they way subsequent tasks are accomplished (Loch & Terwiesch, 1998). Taking task 1 and 2, contributors to task 2 may propose modifications to task 1 since output is not yet fixed. This would imply that contributors to task 1 and 2 pass work back and forth, or even work simultaneously. Literature refers to this as reciprocal and team interdependence (Thompson, 1967; Van de Ven et al., 1976). In turn, this further encourages a shift to mutual adjustment and group meetings as coordination mode (Gupta, Dirsmith, & Fogarty, 1994).

In globally distributed projects, a possibility is that tasks are assigned to teams on different locations. Parallelization implies that coordination between these teams shifts to inter-personal modes in the form of extensive remote communications or visits.

§ 4.9.3 Rapid Application Development

> "The visual tools have had a dramatic effect on how work gets done. They let people see what they need through prototypes, rather than by reading through textual descriptions of the system." (Hanna, 1995: 46)

Rapid Application Development (RAD) is a second, more fundamental change to the waterfall method. It represents a punctuated set of meetings between users and developers around a prototype that evolves in the eventual system (Beynon-Davies et al., 1999). Initial analysis of user requirements - not as comprehensive as with the waterfall method - is used to build a prototype that simulates functionality. Users provide feedback during cross-functional meetings with developers. This is used to improve the prototype for the next meeting. This cycle continues until users are satisfied with the resulting system (von Hippel, 1994). Figure 17 illustrates RAD.

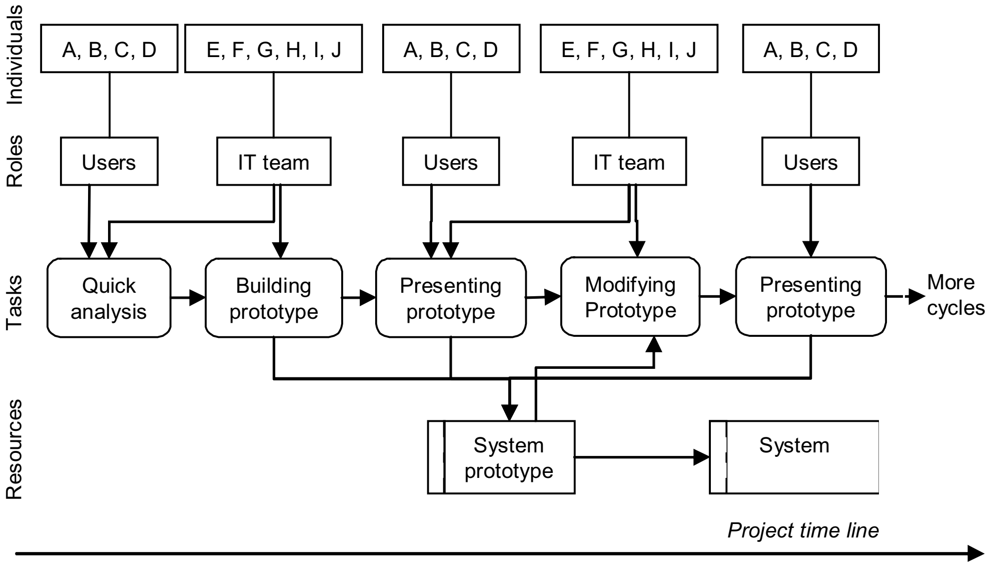


Figure 17 - The RAD methodology

Focusing on coordination and control, RAD differs considerably from the waterfall method. First, the latter defines separate roles for system analysts and programmers. System analysts function as a buffer between users and programmers. They absorb business requirements and translate these into system specifications. With RAD, programmers work with system analysts jointly. They participate in user-IT meetings throughout the project to incorporate feedback in the prototype. Second, the user role changes. The waterfall model prescribes comprehensive involvement upfront in the project to work with system analysts. RAD implies that they remain involved throughout development cycle to provide feedback (Beath & Orlikowski, 1994). Third, the waterfall method depends on comprehensive analysis upfront, resulting in specifications to be used by programmers for building the system (Trevor, 1994). With RAD, results from the initial analysis are used to build a prototype of the system. This becomes a central resource in subsequent meetings to elicit user feedback (von Hippel, 1994).
The combination RAD and global distributedness is interesting to consider. With RAD, system specifications are incomplete. They need to be supplemented with direct and recurrent interactions between users and programmers concerning the prototype. This suggests that RAD implies extensive remote communications or visits for feedback sessions.

§ 4.10 Coordination Theory (MIT's Center for Coordination Science)

The Center for Coordination Science at MIT (http://ccs.mit.edu/ccsmain.html) was founded by Thomas W. Malone in the late 80s. One of its major projects has been the

development of an application to configure organizational processes (Malone, Crowston, Lee, & Pentland, 1999). This software partly relies on coordination theory as developed by Thomas W. Malone and one of his PhD students Kevin Crowston. They define coordination theory as "the still-developing body of theories about how coordination can occur in diverse kinds of systems" (Crowston, 1997; Malone & Crowston, 1994).
Malone and Crowston conducted an extensive, interdisciplinary review of literature relevant to understanding coordination processes (Malone & Crowston, 1994). Their summarizing framework proposes a fine-grained taxonomy of interdependencies. The research distinguishes actors, tasks and resources as main constructs for understanding dependencies. Actors are the people involved in accomplishing work. Tasks include both achieving goals and performing activities. And resources refer to anything used or affected by activities (Crowston, 1997).
The three constructs can be combined in multiple ways to identify dependencies. In their research, Malone and Crowston propose a taxonomy that focuses mainly on task-task and task-resource relationships. For example, a task may use or produce a resource. Or multiple tasks require or produce a resource. (When they produce a resource, a form of interdependence emerges that we called integration interdependence.) Crowston (1997) points out that these dependencies surface coordination problems that need to be resolved. In his own words, "(…) to overcome these coordination problems, actors must perform additional activities, which compose what Malone and Crowston call coordination mechanisms" (Crowston, 1997: 159).
Malone and Crowston point first of all to generic decision making steps to coordinate dependencies (Crowston, 1996). For a task using a resource, this decision process includes: identification of resources needed, identification of available resources, choosing resources, and assigning the resource. The mechanisms chosen for effectuating these steps draw upon three coordination modes: market, hierarchy and network (Crowston, 1996). Crowston (1997) used coordination theory for empirical research on a software bug fixing process. The theory has also been used to develop tools that support the design of interdependencies and business processes (Malone et al., 1999).

§ 4.11 The Role of Technology

Technology has changed the opportunities for coordinating and controlling work. This applies to collocated situations where technology is deployed to communicate between floors of the same building. Or someone leaves a message for a person accidentally not available to respond to a call (Rice & Shook, 1990). But of particular importance here is the role of technology to support projects where time zone differences and distance make real-time and collocated interaction costly in terms of time, costs and effort.
Technology is viewed here in the sense of tools used to accomplish work (Gutek, 1990).[18] It is investigated here in terms of its functions, and how these are connected to the

[18] As Gutek (1990) explains, this perspective is commonly adopted in IS research. It differs from the broader definition adopted by organization theorists that views technology as the entire process of accomplishing work (Pennings, 1992).

coordination and control of work. In the review of literature on distributed collaboration, we expand on the use of electronic media.

§ 4.11.1 Functions of Technology

Traditionally, technology has supported communication between individuals not located in the same location. This started probably with Indians using smoke signals, or the messenger-by-horse in the classics era and Middle Age. With inventions like controlled electricity and wire, the possibility to communicate over larger distances with reduced human involvement became possible. For instance, the telegraph eventually supported coast-to-coast communication in the United States with Morse code. This facilitated the evolution of nationwide railway operations.

In essence, technology as a communication tool combines and links a number of functions. First, it captures individuals' communicative actions by means of input devices. A microphone records a person's voice or other sound, and a camera captures visual phenomena. Other input devices are tied to computers, like a keyboard, mouse, and barcode scanners. Second, if analogue signals are received (e.g., sound or vision), technology transforms these into digital data. This makes it possible to store communicative actions. It also implies, as a third function, that these actions can be transmitted to other spots using telephony, radio, infrared, or satellite communication. Fourth, once received, technology can inform recipients that someone else want to communicate (phone). It can also store data for later retrieval (v(oice) mail, e(lectronic) mail, video mail). Finally, data is transformed into a format that allows recipients to perceive original communications by means of output devices like a speaker, screen, or monitor. This perception makes use of recipients' senses and their insight in the sender's possible intentions (Krauss & Fussell, 1990).

Obviously, the same functions can be fulfilled in reverse order and real-time (phone, audio-conference, video-conference). Asynchronous communication relies on the availability of technology independent of human wake/ sleep cycles. This allows individuals to have their communications sent and stored for retrieval at the recipient's convenience. Traditional technologies like telegraph, telex, and fax support one-to-one communications. This role has been extended by more advanced technologies like radio, TV, and internet that make it possible to transmit the same data to multiple recipients. Email, multi-point audio/ videoconferencing and web broadcasts illustrate this phenomenon.

The invention of the transistor and computer chip has extended the abovementioned repertoire of technology. It has resulted in new technologies that are able to compute according to a pre-programmed set of rules. Communications between humans are complemented with human-computer interaction where human commands trigger computational loops that result in a particular output. In addition, computers can operate independently and process signals from their environment according to their given rule set. The integration between the computer and communication technologies enables remote communication between respectively humans, human and computers, and computers.

§ 4.11.2 Technology for Coordination

Coordination has been defined as additional activities required to integrate tasks performed by multiple actors (Crowston, 1996). These activities rely on coordination mechanisms to link interdependent task accomplishment. From our discussion on contingency theory, at least two types of mechanisms emerged (Van de Ven et al., 1976). First, coordination by programming, which refers to the use of standards, rules, and plans to shape task performance. Second, inter-personal coordination that relies on mutual adjustment, feedback and group meetings to adjust individuals' actions. The way technology supports coordination can be illustrated for both mechanisms.

§ 4.11.2.1 Programmed Coordination

Coordination by program means that actors conceive appropriate inputs, behaviors and outputs in advance. They format expectations in standards, plans, and operating procedures that guide work accomplishment. For example, a project plan conceives which tasks should be performed, how they are interdependent, and when they should be performed.

Technology affects the use of programmed coordination mechanisms in several ways. First, it facilitates the collection, analysis and storage of accumulated know-how and decision rules (Jelinek, 1979; Walsh & Ungson, 1991). In addition to mere textual descriptions of decision rules, it can simulate practices that comply with standards and incorporate accumulated experience (Adler & Borys, 1996). For example, software that shows how a particular action should be performed. Technology may also embed decision rules. Like traffic control systems that warn for conflicting movement patterns. Another example is expert systems that propose actions based on human input (von Hippel, 1994). Or groupware and workflow systems that automatically schedule and route work (Koch, Smalec, Reiner, & Skura, 1999). A final example is configuration management tools that automate coordination of pooled dependence (simultaneous access to the same code) between programmers. When technology embeds decision rules, it takes on a more proactive role than merely representing coordinative rules. It also substitutes for more traditional situations where human decision makers used rules to decide themselves. Second, technology facilitates customization of programs to individual roles and tasks. Login to databases, expert systems or groupware provides a tailor made environment that sorts and presents relevant dimensions of the program.

Finally, technology stores programs in digital format, and makes them accessible through communication infrastructure. Besides remote access through intranet or internet, technology can automatically replicate programs to multiple sites, and update them. Technology enables workers to pull programs independent of their location and time of working. They have access to plans, standards, operating rules, and simulation environments (Adler & Borys, 1996). When they participate in a distributed groupware environment, the system coordinates their actions without the (real-time) involvement of other contributors.

§ 4.11.2.2 Inter-personal Coordination

Technology supports inter-human coordination processes that rely on mutual adjustment and group meetings (DeSanctis & Jackson, 1994; Kraut & Streeter, 1995). It connects a portfolio of devices, network facilities, and software to support inter-personal communication in a number of ways. First, it makes contact information available in a pre-communication phase. Information on people's current role, background, contact modes, and agenda is made accessible through the internet, intranet, and groupware. Software recognizes a communication recipient's profile from prior sessions and automatically configures devices to connect to the same person. Second, in the same preceding phase, technology informs a recipient that someone wants to communicate. Making an audio conference call triggers audio and visual signals; voice mail and email have similar indicators. Third, technology enables actors to transmit communicative actions asynchronously. If working hours or wake/ sleep patterns do not match, people can still leave and receive messages.

Fourth, replication and storage technology makes asynchronous one-to-many communications possible. Email in particular facilitates inclusion of multiple recipients.

Informing them through the same message promotes coordination of large-scale systems. Fifth, technology connects actors remotely in a synchronous mode. This includes - with increasing bandwidth - chatting, phone, audio conference and videoconferencing. These technologies connect two or more sites (e.g., multi-point conferencing). They allow people to send communications and perceive a representation of their recipient's actions (Abel, 1990; Egido, 1990). This process of capturing, transforming and transmitting communications was earlier described in this section. Sixth, advanced technologies combine multiple channels at the same time. In addition to remote audio-visual representation, actors can share application and shift control back and forth. Seventh, technology provides access to resources that relate to a particular communication session. Groupware like Lotus Notes includes links to local or remote at multiple databases. This facilitates coordinated response as actors participate in an environment that links past and current know-how. Finally, technologies may shape and structure inter-personal communication. They can enforce the use of particular rules or jargon (Hutchins, 1991). Group support systems (GSS) facilitate interaction among multiple actors in a decision making process (Ching, Holsapple, & Whinston, 1992). These systems structure, collect, analyze and disseminate participants' inputs according to a pre-specified rules set (Nagasundaram & Bostrom, 1994). They can also be designed to support reflection on diverse interpretations of a situation (Boland, Tenkasi, & Te'eni, 1994).

§ 4.11.3 Technology for Control

Control is the cybernetic process that defines, evaluates and sanctions the accomplishment of work (Edwards, 1981). Task performance is observed and compared with a priori defined expectations to assess its appropriateness and eventual need for correction. (Haberstroh, 1968). Literature points to various roles of technology in this process. First, physical technology may embed control mechanisms (Adler & Borys, 1996; Edwards, 1981). The assembly line is an example of technology that enforces a particular speed of working. And moulds incorporate dimensional standards for achieving consistency.

Second, expectations in the form of rules and standards are programmed in information systems as earlier described for technical coordination. Actors' interaction with the system is configured and confined by the system. For instance, configuration management and CASE tools pre-define the way multiple individuals interact with resources (Orlikowski,

1991). Information systems like in groupware also monitor, store, and report behaviors and outcomes. Work progress thus becomes transparent for executives (Ciborra et al., 1996).
Third, technology supports forms of social control, similar to the inter-personal coordination mechanisms earlier described. Communication technologies enable actors to report work accomplishment remotely. Also more informally, communications allow them to gain some impression of the situation at a remote site.

§ 4.12 High Reliability Organizations, Collective mind and Distributed Cognition

Starting in the 80s, researchers have started to investigate organizations engaged in activities that are potentially dangerous, and require responsive and reliable collaboration among multiple actors. Some research is related to disasters or near disasters with space shuttles (Vaughan, 1990), oil tankers (Roberts & Moore, 1993), nuclear reactors (Perrow, 1984), aircraft (Weick, 1993b), or fire accidents (Weick, 1993a). Some of the research falls under the umbrella of High Reliability Organization (HRO) theory (Roberts & Moore, 1993; Weick et al., 1999). Other work concerned regular collaboration of navigation teams on ships (Hutchins, 1990) or in airlines cockpits (Hutchins & Klausen, 1996). A common theme throughout this research is the relationship between on the one hand the need for unified, reliable and adaptive performance. And on the other hand the realization that this collective task accomplishment is anchored in individual behaviors and the way these are linked (Weick & Roberts, 1993). We discuss here some of the research most relevant to advancing our understanding of coordination and control processes.
Hutchins (1990) explored how navigation staff collaborates on large ships. Their work is first of all defined around six positions that are tied together by procedures for interacting and responding. Hutchins defines a procedure as "a plan of sequential action" where "the task performer is expected to learn the procedure and use it as a guide in organizing his actions" (Hutchins, 1990: 207). The navigation team uses technology to represent problems of calculating current and intended positions of the ship. Yet the design of roles, specification of work and technology are not sufficient to coordinate in fluid circumstances. "When the navigation task is performed by the team, the coordination among the actions of the members of the team is not achieved by following a master procedure. Instead it emerges from the interactions among the members of the team" (Hutchins, 1990: 207). Collective response is the result of connecting distributed, individual awareness (Hutchins, 1991). In turn, this connectivity process is facilitated by overlapping knowledge among role occupants in the navigation team. Job rotation in the past enables actors to identify with the positions of peers in team they currently participate in (Hutchins, 1990: 213).
Weick (1993) investigated the Mann Gulch disaster, an occasion where smoke jumpers got caught in a fire while attempting to extinguish it. In general, the roles of smoke jumpers are interlocked in a form of pooled interdependence. "The job of each one is to clear the adjacent portions of a perimeter area around a blaze so that the fire stops for lack of fuel. Individual efforts to clear away debris are pooled and form a fire line" (Weick, 1993a: 647). Coordination among crewmembers relies on the task at hand, rather than working relationships, also because the composition of crews changes each time. "Simply acting in concert was enough, and there was no need to know each other well in addition" (Weick, 1993a: 647). This form of relating has been called 'nondisclosive intimacy' that is

characterized by "coordination of action over alignment of cognitions, mutual respect over agreement, trust over empathy, diversity over homogeneity, loose over tight coupling, and strategic communication over unrestricted candor" (Eisenberg, 1990: 160).
The Mann Gulch event, however, did not represent a routine fire-fighting event. Its quickly changing nature surprised crewmembers, and required closer forms of social coordination than they were used to. In particular, stronger awareness of the position and needs of other actors, and flexibility in role fulfillment. "Nondisclosive intimacy is a sufficient ground for relating as long as the task stays constant and the environment remains stable" (Weick, 1993a: 647).

Weick and Roberts (1993) investigated collaboration on US Navy aircraft carriers. Their analysis starts with an illustrative quote of the phenomenon under study:

> "Imagine that it's a busy day, and you shrink San Francisco Airport to only one short runway and one ramp and one gate. Make planes take off and land at the same time, at half the present time interval, rock the runway from side to side, and require that everyone who leaves in the morning returns the same day. Make sure the equipment is so close to the edge of the envelope that it's fragile. Then turn off the radar to avoid detection, impose strict controls on radios, fuel the aircraft in place with their engines running, put an enemy in the air, and scatter live bombs and rockets around. Now wet the whole thing down with sea water and oil, and man it with 20-year-olds, half of whom have never seen an airplane close-up. Oh and by the way, try not to kill anyone" (Rochlin, LaPorte, & Roberts, 1987: 78).

Weick and Roberts (1993) research deals with the preparation, release, and return of multiple fighters from aircraft carriers. Their work complements and integrates earlier views on work coordination, like contingency theory (Thompson, 1967), cognitive approaches (Hutchins, 1990, 1991; Ryle, 1949), and social psychology (Asch, 1952). Using 'collective mind' as a metaphor, their research explores the interrelationship between collective, multi-actor performance and role fulfillment by individuals. If one re-builds their argument from the individual level of analysis, collective performance starts with individuals' willingness and skills to interact. These micro-level behaviors enable dense interaction patterns along pre-structured communication channels. This enables individuals to combine observation and analysis of peers with their own insights. Since multiple actors engage in the same process, each one empowers and is empowered to construct a representation of their collective situation beyond what they could achieve as individuals. This is referred to as distributed representation, and resembles mutually shared fields (Asch, 1952), holographic forms of organizing (Morgan, 1997), and knowledge redundancy (Nonaka & Takeuchi, 1995). This phenomenon implies that contributors fuel their individual behaviors and the way they connect with resources from other members. This systemic awareness on a distributed level translates directly into coherence of collective performance:

> "The collective mind that emerges during the interrelating of an activity system is more developed and more capable of intelligent action the more heedfully the interrelating is done" (Weick & Roberts, 1993: 365).

Other studies echoed the importance of communications and heedful relating in HRO. Weick (1993) investigated remote interaction between Air Traffic Control and cockpit

crew in the Tenerife disaster. His analysis revealed the importance of a common jargon for describing positions, events, and positions. This shared language is defined by separate authorities. It provides consistency on a meta-communication level that makes actual exchanges more transparent (Watzlawick, Beavin Bavelas, & Jackson, 1967). In general, Weick (1993: 194) made the following observation on communication: "What our analysis of Tenerife has uncovered is the possibility that with communication a complex system becomes more understandable (you learn some missing pieces that make sense of your experience) and more linear, predictable, controllable".
In their research on the Exxon Valdez disaster, Roberts and Moore (1993) emphasized attentive interaction and feedback loops among crew members on the oil tanker: "Both the ship handling requirements and the nature of the environment prescribed the use of a more tightly coupled system in which players in various organizations recognize their interdependence with one another. (...) Tight interconnections would have been represented by continuous feedback and checking with one another about the meaning of orders, placement of warning lights (...)" (Roberts & Moore, 1993: 245). Eisenhardt (1993) assessed the implications of high velocity environments on the operation of high reliability organizations. High velocity characterizes an environment "in which there is a rapid and discontinuous change in demand, competitors, technology and/or regulation, such that information is often inaccurate, unavailable or obsolete" (Bourgeois & Eisenhardt, 1988: 816). Organizations like nuclear power plants, aircraft carriers, and microcomputer firms that operate in these environments must combine reliability, speed, and flexibility all at the same time. Eisenhardt's (1993) research revealed the importance of establishing direct contact between workers involved in the same task. Moreover, workers should dispose over multiple channels to increase the richness and timeliness of communications. The resulting dense web of communication enables actors to response in an agile, collective manner (Eisenhardt, 1993).

Other scholars - not directly connected to the HRO stream of research - explored work division and integration from a knowledge management point of view. They point out that work division brings about specialization and distributedness of know-how. "The distribution of knowledge in an organization, or in society as a whole, reflects the social division of labor. As Adam Smith insightfully explained, the division of labor is a great source of dynamism and efficiency. (…) From the organizational standpoint, however, this knowledge is as divided as the labor that produced it" (Brown & Duguid, 1998: 98). Grant (1996b) further suggests that specialization is a consequence of bounded rationality. Since humans have limited capacity to acquire and store knowledge and skills, they have to specialize in a particular area (Simon, 1991).

Grant (1996b) continues with the proposition that firms exist to integrate knowledge. "Given the efficiency gains of specialization, the fundamental task of organization is to coordinate the efforts of many specialists" (Grant, 1996b: 113). A central question then becomes how firms integrate distributed knowledge. Clearly, transferring knowledge from actor A to actor B and vice versa is a costly method that contradicts the original advantages of knowledge specialization (Grant, 1996b). This applies in particular to tacit know-how that resides in individuals' brains and remains unformulated (Polanyi, 1967). "Transferring knowledge is not an efficient approach to integrating knowledge. If production requires the integration of many people's specialist knowledge, the key to efficiency is to achieve

effective integration while minimizing knowledge transfer through cross-learning by organizational members" (Grant, 1996b: 114).
Grant proposes four modes for coordinating multiple specialists other than transferring their knowledge. First, impersonal mechanisms like rules, directives, and standardized information and communication systems (Van de Ven et al., 1976). These programs make tacit knowledge explicit and thus accessible to specialists in other domains (Demsetz, 1991). Second, Grant (1996b) proposes that contributions can be sequenced to minimize coordination needs (Thompson, 1967). Third, actors may rely on routines to integrate their efforts. An organizational routines is defined as a "relatively complex pattern of behavior (...) triggered by a relatively small number of initiating signals or choices and functioning as recognizable unit in a relatively automatic fashion" (Winter, 1986: 165). Traditionally, routines were perceived as constituting a fixed set of internalized behaviors (Simon, 1950). But they may also provide flexibility in possible response behaviors in the sense of 'grammars of action' (Pentland & Rueter, 1994). Fourth and finally, specialists mutually adjust their contributions in group meetings (Van de Ven et al., 1976). This integration mode - which is resource intensive compared to the previous three - is reserved for uncertain and complex tasks (Grant, 1996b).

Grant (1996b) then claims that all of the four integration modes depend on common knowledge, the extent to which actors' domains of expertise overlap. Common knowledge enables actors to "integrate aspects of knowledge which are not common between them" (Grant, 1996b: 115). The more actors' knowledge domains overlap, the more efficient integration is supposed to be. Grant (1996b) distinguishes different types of common knowledge. First, language and other forms of symbolic communication as basic enables of interaction between specialists. Second, the extent to which diverse knowledge domains contain similar elements. Third, shared meaning or understanding. Since exchange requires conversion of tacit knowledge into explicit communicative actions, individuals need similar frames of reference to interpret these (Grant, 1996b). A final form to integrate specialized know-how is individuals' awareness of what others know. "Such mutual recognition permits successful coordination even in novel situations" (Grant, 1996b: 116).

§ 4.13 Working Relationships and Trust

Literature considers working relationships and trust important ingredients of a coordination and control portfolio, especially for uncertain tasks.
On a group level, relationships between individuals foster mutual adaptation and improvisational behaviors (Pasmore, 1998). They also increase the reliability of collective performance, and actors' ability to engage in intricately connected work (Weick, 1993a; Weick & Roberts, 1993). According to Schein (1992: 70): "If a group is to accomplish a task that enable it to adapt to its external environment, it must be able to develop and maintain a set of internal relationships among its members."
On an organizational level, 'good' working relationships between departments equips them to take on innovative, cross-disciplinary tasks (Lawrence & Lorsch, 1967b). Dougherty's (1990: 75) analysis of new product development revealed that successful projects relied on inter-departmental relationships that were "creative, interactive, and participatory (…), tightly coupled and well executed, not 'loose.'" To Pennings and Woiceshyn (1987), "trust

in organizations is a mode of control that is inherent in the relationship among interdependent individuals." Trust allows organizations to ensure performance even if task uncertainty makes planning and monitoring less feasible and useful (Ghoshal & Moran, 1996; O'Reilly & Chatman, 1996).
On an inter-firm level, relationships and trust are considered important for dealing with transactions that are uncertain (Ben-Porath, 1980), incompletely specified (Macneil, 1978), or should be accomplished in a short time frame (Bryman et al., 1987).

Most research proposes working relationships and trust as mechanisms for coordinating and controlling work without elaborating on the constructs themselves. This is because they theorize on choosing between alternative mechanisms, rather than exploring the properties of these in detail (Bradach & Eccles, 1989). Yet some researchers have probed for a better understanding of the construct themselves, and their role as coordination and control mechanisms. Grandori and Soda (1995) argue that trust is not a coordination mechanism per se, but rather an outcome of evolving relationships. This implies that a better understanding of trust and its role for coordination and control calls for an exploration of the working relationships construct.
Gabarro (1990: 81) defines working relationships as "(…) an interpersonal relationship that is task-based, non-trivial, and of continuing duration". His review of literature on working relationships revealed a common set of dimensions along which they evolve over time (Altman & Taylor, 1973; Levinger & Snoek, 1972). "Although scholars differ in their definition of a developed relationship, there is a remarkable degree of convergence in the literature on the dimensions that characterize the development of relationships" (Gabarro, 1990: 82). A selection of dimensions relevant to (remote) work coordination and control is listed in Table 6. Gabarro (1990) points out that evolution of working relationships along these dimensions is associated with increased efficiency of collaboration. The development of relationships becomes more desirable when individuals' tasks are highly interdependent.

Table 6 - Working relationships and their evolutionary pattern

Dimensions:	Evolutionary pattern From:	To:
Openness and self-disclosure	▪ limited to "safe," socially acceptable topics	▪ disclosure goes far beyond safe areas to include personal sensitive, private, and controversial topics and aspects of self
Knowledge of each other	▪ surface, "biographic" knowledge; impressionistic in nature	▪ knowledge is multifaceted and extends to core aspects of personality, needs, and style
Predictability of other's reactions and responses	▪ limited to socially expected or role-related responses, and those based on first impressions or repeated surface encounters	▪ predictability of other's reactions extends beyond stereotypical exchange and includes a knowledge of the contingencies affecting the other's reactions
Uniqueness of interaction	▪ exchanges are stereotypical, guided by prevailing social norms or role expectations	▪ exchanges are idiosyncratic to the two people, guided by norms that are unique to the relationship
Multimodality of communication	largely limited to verbal channels of communication and stereotypical or unintended nonverbal channels	includes multiple modalities of communication, including nonverbal and verbal "shorthand" specific to the relationship or the individuals involved
Substitutability of communication	little substitution among alternative modes of communication	possession of and ability to use alternative modes of communication to convey the same message
Capacity for conflict and evaluation	limited capacity for conflict	to readiness and ability to express conflict and make positive or negative evaluations
Synchronization and pacing	except for stereotyped modes of response, limited dyadic synchrony occurs	speech and nonverbal responses become synchronized; flow of interaction is smooth; cues are quickly and accurately interpreted
Efficiency of communication	communication of intended meanings sometimes requires extensive discussion; misunderstandings occur unless statements are qualified or elaborated	intended meanings are transmitted and understood rapidly, accurately, and with sensitivity to nuance

Adopted from Gabarro (1990: 83-84)

For geographically distributed projects, some dimensions seem of particular relevance, assuming that distance and time zone differences increase reliance on electronic media as a substitute for collocated interaction. First, remotely collaborating actors can use knowledge of each other (second dimension in Table 6) to anticipate reciprocal communication needs.

As Krauss (1990: 112) explains, "(…) any communicative act rests on a base of mutual knowledge (...). Mutual knowledge is knowledge that the communicating parties both share and know they share." This knowledge may be derived from previous collaboration and facilitate remote exchanges (Hollingshead, 1998). According to Gabarro (1990: 84), "(…) the more extensive this knowledge base, the easier it is for each party to anticipate the other's responses and reactions correctly." Second, substitutability of communication (sixth dimension in Table 6) facilitates substitution of face-to-face exchange for the use of electronic media. Moreover, they can use different types of electronic media (like email, vmail, phone, videoconferencing) to communicate the same message. Third, stronger working relationships between individuals working remotely increase the efficiency of communication (ninth dimension in Table 6). This implies that the transfer of meaning does not require extensive interaction for clarification. A later section on electronic communication further expands on theories that explain the use of electronic media.

Chapter 5 Work Coordination and Control: Theory Integration

This chapter builds on the theories from the previous chapter. It works towards an integrated theory of work coordination and control. To this end, we take the following steps. First, we integrate coordination mechanism from the various theories and integrate these into a coherent set. Second, a similar approach is adopted for control mechanisms. Third, the relationships between coordination and control is discussed as Siamese twins. Fourth, contingencies of coordination and control mechanisms are discussed and integrated. The chapter concludes with a brief model that integrates the contingencies and coordination and control mechanisms and thus answers sub question 1.

§ 5.1 Coordination mechanisms: An Integrative View

Coordination structures or mechanisms are needed to coordinate differentiated work (Mintzberg, 1979). Nidumolu (1996) defines coordination structures as "the set of mechanisms used to coordinate activities among individuals". From an organization theory perspective, mechanisms "cover all devices or procedures used as stimuli for action in respect of either people or machines." Furthermore, "mechanisms, as opposed to random orders or ad hoc prescriptions, are necessary in any organization that functions as a system and has to cope with repetition of action" (Reeves & Woodward, 1970).
As the literature study revealed, a repertoire of coordination mechanisms exists for achieving concerted action (McCann & Galbraith, 1981; Thompson, 1967). These are grouped in four categories: work-based coordination, coordination by organization design, inter-personal coordination, and technology-based coordination. Figure 18 summarizes the mechanisms for each category. They are used for coordinating activities within and between firms (Grandori, 1997; Kumar & van Dissel, 1996).

§ 5.1.1 Work-based Coordination

As early as 1924, Lichtner (1924: 5-6) proposed planning and procedures as a means for coordinating divided work. The process of conceiving and formalizing interlocked work activities has been referred to as 'programming' (March & Simon, 1958). It may take the form of standards, blueprints, or plans (Van de Ven et al., 1976) that specify work inputs, behaviors, or outputs. Within organizations, role descriptions and reporting structures are formalized (Burns & Stalker, 1961). Between organizations, reciprocal expectations are spelled out in advance in contracts (Ouchi, 1979). Programmed mechanisms result in a form of embedded coordination: actual work that follows the program is automatically integrated (Sanchez & Mahoney, 1996).
Recent advances in system development methodologies and technologies have extended work-based coordination beyond planning and specifications. Prototyping and simulation enables people to visualize the system in preliminary stages (von Hippel, 1994). Work is not specified, but represented in a more accessible format as it evolves over time (Schmitz, 2000).

§ 5.1.2 Coordination by Organization Design

Since work is eventually accomplished by individual actors, programming relates to role descriptions and the relationship between these. Traditionally, hierarchical structures have been proposed to divide and connect work (Simon, 1950). Activities are delegated to subsequent layers of functionally specialized units that report back on the progress of their actions (Burns & Stalker, 1961; Hart & Moore, 1999). Galbraith (1973) proposed that uncertainty overloads hierarchical communications. He suggested that lateral contacts and integrative roles alleviate vertical coordination. Under conditions of extensive coordination needs, he proposed teams with representatives from different departments.

Organizational structure also substantiates transactions between firms: liaison roles at both sides channel intra-firm communications that relate to the counterpart organization (Grandori, 1997).

§ 5.1.3 Inter-personal Coordination

Another extension of programming points to interpersonal mechanisms for coordinating work (Van de Ven et al., 1976). Instead of specifying work upfront, actors mutually adjust their efforts through interactive feedback (Thompson, 1967). More recent literature refines the set of interpersonal coordination mechanisms with three forms: common knowledge, mutual orientation, and working relationships (Grant, 1996b; Krauss & Fussell, 1990). In the order presented, they may be interpreted as forming a Guttman-type scale, where subsequent forms incorporate preceding ones. That is, mutual orientation supposes some level of common knowledge, and working relationships rely on common knowledge and mutual orientation (Gabarro, 1990). First, common knowledge refers to experiential and educational background two or more actors share (Krauss & Fussell, 1990) that becomes apparent when actors meet for the first time, or engage in novel tasks. It depends on the extent to which they have participated in social systems that are the same or similar, including their country, educational institutions, and social categories (Krauss & Fussell, 1990). This results in overlapping backgrounds, taking the form of language and other basic communication frameworks for describing and clarifying the world around us (Grant, 1996b). From an occupational perspective, it includes a common jargon, and set of principles and insights that shape an individual's outlook and social behaviors (Kogut & Zander, 1992). It may result from similar roles and affiliations in the past. Organizations are believed to develop their own internal code and jargon (Arrow, 1974; Williamson, 1975), supported by a socialization and training policies (Hage et al., 1971). This implies that inclusion in the same organizational context equips individuals with commonality that "(…) permits idiosyncratic conditions to be communicated with little difficulty" (Williamson, 1975: 29). Common knowledge brings about efficiency in exchanges since it reduces the need for communication on the communication process itself (Watzlawick et al., 1967). Actors experience limited equivocality in the sense of differences in the way they shape and interpret communicative actions (Daft & Macintosh, 1981). Rather, their exchanges become focused on the coordinative requirements of their tasks (Schein, 1992: 70).

Mutual orientation consists of insight one actor has in the functioning of other actors (Hutchins, 1990). From a behavioral perspective, it relates to the heedfulness of actors vis-à-vis others involved in the same work (Weick & Roberts, 1993). The definition provided here suggests both a cognitive and behavioral side to mutual orientation.[19] The cognitive side refers to knowledge that is distributed (Morgan, 1997), but also to some extent overlapping (Hutchins, 1990), and redundant (Grant, 1996a; Nonaka & Takeuchi, 1995). This happens in particular when jobs are not comprehensively defined and demarcated but interweave with adjacent fields of responsibility (Burns & Stalker, 1961) and induce actors to know more than their individual task and specialization (Grant, 1996b). The behavior side reflects actors' awareness of the way their role is embedded in a larger purposeful system (Weick & Roberts, 1993). Heedfulness achieves flexibility of the system: changes are processed and absorbed through sustainable connectivity among members (Barrett, 1998). Mutual orientation thus enables a group of actors to face unpredictable events and engage in novel activities that require tight interconnections (Nonaka & Takeuchi, 1995; Roberts & Moore, 1993). Lack of it may imply disaster if a group tries to face challenges beyond simply linked activities (Weick, 1993a).

Working relationships are the most intimate form of inter-personal coordination mechanisms. They grow as individuals (Altman & Taylor, 1973), departments (Lawrence & Lorsch, 1967b), or organizations (Bryman et al., 1987) collaborate over an extended period of time. Working relationships thrive on task-related dependencies and collocation (McCann & Galbraith, 1981). They change the way actors interact and coordinate interlocked activities. As earlier reviewed, Gabarro (1990: 81) summarizes literature on the effects of working relationships on a number of dimensions. Evolution of working relationships increases predictability of each actor's performance (Ben-Porath, 1980), thus facilitating coordinative behaviors (Simon, 1950: 124). Past experience translates into trust that substitutes for detailed specification and monitoring of the counterpart's work (Pennings & Woiceshyn, 1987). In a sense, relationships thus economize on coordination expenses (Williamson, 1975). They also seem to promote effectiveness of collaboration across organizational (Powell & Smith-Doerr, 1994) and departmental boundaries (Dougherty, 1990). With respect to working relationships in groups, Simon (1950: 124) describes the natural and flexible way tasks are coordinated:

> "In the behavior of organized human groups we often find a unity and co-ordination of behavior so striking that it has led many social thinkers to draw an analogy between the group and the individual, and even to postulate a "group mind". The mechanism whereby this co-ordination is achieved is not easily perceived (…).
> Coordination then results when the behavior of the individual is guided by his expectations of the behavior of the other members of the group. In the simplest case, as we have seen, this adaptation may be self-induced. (…) The mental processes involved are seldom entirely deliberate or conscious. Most of the behaviors resulting in coordination are in large part habitual and reflexive" (Simon, 1950: 124).

Finally, people may be selected on the basis of the abovementioned inter-personal coordination mechanisms: common knowledge, mutual orientation, and working relationships (Pfeffer, 1997). For instance, people are selected for having similar experiences and proficiency in a language. Or they have collaborated on prior occasions,

[19] The dimensions do not necessarily coincide. Strangers lacking mutual knowledge may act heedfully to understand each other's backgrounds. On the other hand, spies attempt to acquire insight in the operation of other actors without acting heedfully.

which may leverage their mutual knowledge (Krauss & Fussell, 1990). Similarly, for inter-firm coordination, counterparts are selected on the basis of criteria like reliability, competence and prior experience (Grandori & Soda, 1995).

§ 5.1.4 Technology-based Coordination

Finally, coordination is achieved by technology in the form of information systems (Galbraith, 1973), or physical structures (Edwards, 1981). Technology facilitates remote or asynchronous interaction between individuals. It makes work related information available to actors facing similar responsibilities at different locations or moments (Adler & Borys, 1996; Levitt & March, 1988). Information systems may also embed rules for coordinative decision making that allow them to coordinate activities in response to inputs from their environment (Orlikowski, 1991). In Chapter 6 we elaborate on this coordination mode in the context of distributed collaboration. We list in Figure 18 the types of technologies earlier discussed.

§ 5.1.5 Integrative view on Coordination Mechanisms

Together, the four categories of coordination mechanisms represent a portfolio, as depicted in Figure 18 (McCann & Galbraith, 1981). Literature suggests that mechanisms complement and substitute each other (Lawler III, 1989; Mintzberg, 1979). For instance, technologies support inter-personal coordination through communication media. Technology also enables work-based coordination by representing and replicating information across sites. They categories are therefore connected, as depicted in the figure.

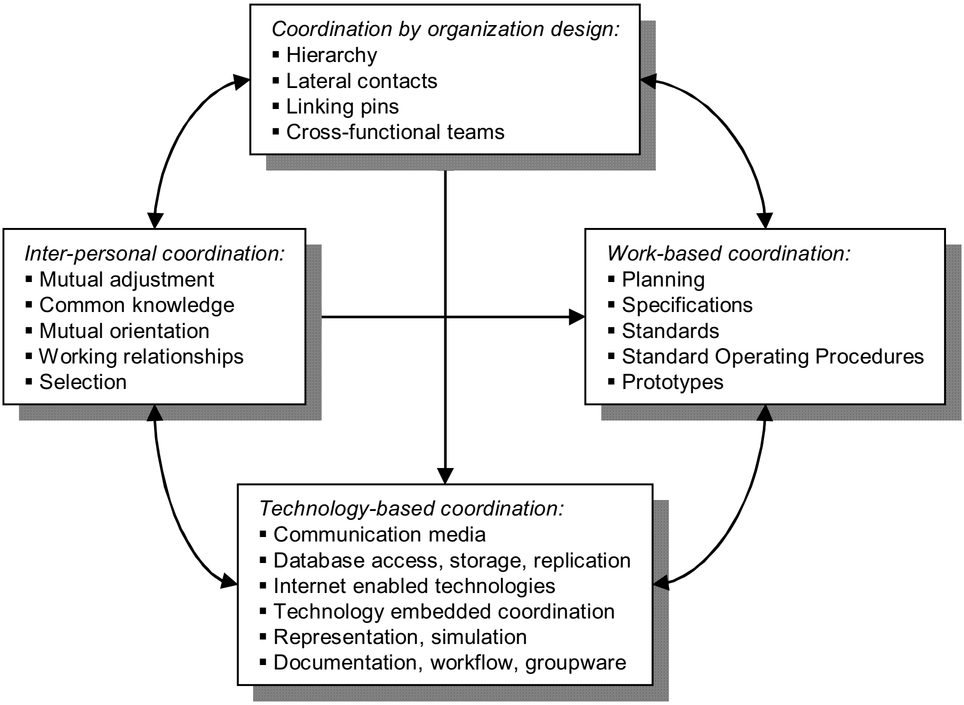


Figure 18 - Coordination mechanisms: an integrative view

The possibility to configure and adapt a portfolio of mechanisms calls for insight in the determinants of that decision making process (March & Simon, 1958). Scholars have proposed a set of contingencies that condition this choice, such as work unit size, interdependence, and uncertainty (Tushman, 1979; Van de Ven et al., 1976). For example, pre-specifying work becomes less feasible when uncertainty increases. Instead, actors mutually adjust their actions as they engage in nonroutine events (substitution of programmed for inter-personal mechanism) (Thompson, 1967). In a later section we expand on the relationship between contingencies and coordination and control mechanisms.

§ 5.2 Control Mechanisms: An Integrative View

While designing coordination involves the selection of mechanisms for integrating work, control mechanisms ensure that concerted action is achieved (Kirsch, 1996; Thompson, 1967). The roots of control in organization theory trace back to classic organization theorists like Fayol (1949) and cybernetics and system theory (Beer, 1959; Wiener, 1954). According to this perspective control consists of four activities: establishing a set of expectations or standards for work, observing actual task accomplishment, comparing these observations to expectations, and finally allowing for adaptation in case of deviation between observed and expected work. Initially, these principles were developed for controlling technology-driven processes. But subsequently, social scientists adopted these principles for analyzing control of social systems (Parsons, Bales, & Shils, 1981). In its rudimentary application, scholars proposed bureaucratic control where work is formally specified and monitored by supervisors. Their observation fuels corrective actions in case actual task accomplishment does not comply with standards (Blau & Scott, 1962). These programmed modes of control relate to work behaviors and outputs and allow organizations to deal with incongruence between individual and organizational goals (Ouchi, 1979).

The recognition of uncertainty in contingency theory has led to insights in other forms of control. Uncertainty and intricate dependencies make it difficult to conceive work in advance (Anthony, 1965). Expectations are necessarily incomplete, and rather emerge as work evolves. Hence, scholars proposed alternative modes of control that emphasize more the actors involved in the work process. Their commitment and relationships provide a means for controlling even ill understood work. Examples include clan control (Ouchi, 1979), internal or self control (Hage et al., 1971), trust-based control (Pennings & Woiceshyn, 1987), and input control (Flamholtz, 1979; Snell, 1992). Input control refers to selection and training of dedicated and competent individuals. In these person-oriented control modes, the controller is not necessarily a hierarchical boss or supervisor, but could include peers (Barker, 1993), or the workers themselves (Manz & Sims, 1980). Other pointed at the role of technology (Orlikowski, 1991), and proposed that actors outside an organization have a role in controlling intra-organizational performance (Peterson, 1984). For example, professional organizations (Kerr & Slocum, 1981) or customers (Smith, 1997) observe an organization's accomplishments and provide feedback. Independent third parties may check and certify a firm's activities, a ubiquitous phenomenon in trading relationships.

While these extensions of control modes have complemented our understanding of control modes, they have also complicated the field. Most of them rely on the same cybernetic principles of defining, observing, comparing and evaluating work (Manz & Angle, 1986). But little agreement exists on a taxonomy for relating and comparing the mechanism (Jaworski, 1988). Some researchers loosely divide the mechanisms in formal modes (output and behavior control), and informal modes (clan control, self control) (Kirsch, 1996). Or they conceive relationship and team based control modes as an add-on to Edward's (1981) taxonomy of simple control (supervision-based), technological control (control is embedded in technology), and bureaucratic control (control is embedded in the organization) (Barker, 1993; Simpson, 1985).

Enhancing control theory as a field of inquiry requires also reflection on the relationships between these traditional and more recent control modes (Flamholtz, 1996). Such an analytical process requires dimensions to compare the modes, and develop a taxonomy of control mechanisms. Tannenbaum (1956) proposed two dimensions: controller (or subject) and an object of control (something or someone). This complements Ouchi's (1979) distinction based on only the object of control, namely behavior or output. Using earlier work on input control (Snell, 1992) or ex ante control (Flamholtz, 1979), the object of control consists of inputs, behaviors and outputs (Litterer, 1965). The subject of control (controller) can be derived from the preceding discussion as including hierarchical supervisors (Blau & Scott, 1962), co-workers (Tompkins & Cheney, 1985), technology (Pennings & Woiceshyn, 1987), or the workers themselves (Hage et al., 1971). And also contractual partners (Ouchi, 1979) or third parties (like a notary) (Peterson, 1984). Table 7 combines these dimensions in order to propose a taxonomy for categorizing control modes.

Table 7 - Control mechanisms: an integrative view

	Objects of control:		
Controllers:	Input	Transformation process	Output
Hierarchical supervision	Hierarchical selection of inputs	Supervision of process	Hierarchical checking of outputs
Co-workers (clan)	Ballotage	Observation of peer behaviors	Co-workers outputs control
Technology	Technical monitoring of inputs	Technical monitoring of transformation process	Technical monitoring of outputs
Self	Self selection	Monitoring of controller's own behaviors	Controller's assessment of own outputs
Contractual party	Selection of contractual party	Direct monitoring of counterpart's behaviors	Contractual party assessment of counterpart's output
Third party	Third party input control	Third party observation of process	Third party control of outputs

Like the portfolio of coordination mechanisms, the control modes complement and substitute each other. Many of the contingencies that explain this process are similar to those found in coordination theory: interdependence, work unit size, uncertainty. A separate section proceeds on this topic. Substitution and complementation of control modes occur both across the columns (object of control), and the rows (subject of control). For example, uncertainty of a transformation process may result in a focus on selection of actors (input control), or the outputs of their work. Alternatively, hierarchical control of the transformation process may be substituted for peer control where co-workers provide feedback on each other's work. Not only are the contingencies in control theory similar to those in coordination theory. The mechanisms or modes themselves are also related. In the next section this connection is further elaborated.

§ 5.3 Coordination and Control as Siamese Twins

> "In fact, the two [coordination and control] are more closely connected than is always recognized." (Parker Follett, 1927: 168).

The portfolios of coordination and control strategies suggest overlaps and mutual dependence of the mechanisms. For example, hierarchical structures can be used for coordination among differentiated sub-units as well as control by managerial supervision. Programs for coordinating work become a mirror that reveals appropriateness of individual efforts ex post (Orlikowski, 1991). As a contractual specification or bureaucratic plan, programs make deviations apparent, and enforce consistency and predictability of performance (Adler & Borys, 1996; March & Simon, 1958). Working relationships used

for coordinating interdependent actions provide a basis for trust based control modes between peers or manager and subordinate (Pennings & Woiceshyn, 1987).
The relationship between coordination and control mechanisms is important because it constitutes one of the main connections between the two theories. So far, the discussion on this topic relies on a small number of organization theorists proposing different viewpoints. Some scholars refer to the similarity of the concepts, like Mintzberg (1979) referring to Litterer's (1965) remark that "Recent developments in the area of control, or cybernetics, have shown [control and coordination] to be the same in principle. Others point at the different role and nature of the two concepts: "Coordination and control have typically been employed to handle two different analytical problems. Coordination is the task of integrating each part of the organization so that it contributes to the overall objective (...) Control is more concerned with the meeting of a standard. If coordination brings together the different departments of the organization, control is concerned with how well each department does its set of tasks. Control implies evaluation; coordination implies integration" (Hage, 1980: 350-351).
In line with Parker Follet (1927), Reeves and Woodward (1970) extend this perspective by emphasizing the mutually dependent nature of the constructs. Coordination refers to the process of defining expectations and integrating differentiated actions (Thompson, 1967). Control is aimed at ensuring compliance of actual work to expectations, and integration of work (Child, 1984). And the two are related: coordination mechanisms are a prerequisite for control: "(...) planning, setting standards and issuing prescriptions for action, are all prerequisites of control. Without some concept of what should be done, it is impossible to make any assessment of what has in fact been done" (Reeves & Woodward, 1970). In turn, control ensures and materializes coordination.
The examples provided above suggest a perspective close to this line of reasoning. Like a Siamese twin, coordination and control are two different constructs but they complement each other. The same mechanisms may be used for achieving both coordination and control (Adler & Borys, 1996; Orlikowski, 1991). The following section on contingencies further explores this symbiosis.

§ 5.4 Contingencies

This section summarizes and elaborates on contingencies of coordination and control mechanisms. Contingencies explain the conditions for choosing from portfolios of coordination on control mechanisms (Van de Ven et al., 1976). From the contributive theories earlier introduced, the following contingencies were distilled: interdependence, uncertainty, observability, complexity, work unit size, and functional diversity. As far as control theory is concerned, goal incongruence is an additional construct that intertwines with interdependence and uncertainty. The following review assesses contingencies' relationship to coordination and control mechanisms. Terminology from the integrative view on coordination and control mechanisms is used to depict theory statements. The figures are structured in three columns: contingencies, coordination and control. In tune with organization theory practices, positive relationships between two constructs are depicted with a "+", negative ones with a "-". Relationships between constructs are numbered to facilitate referencing in later sections.

§ 5.4.1 Interdependence

The types of work dependencies earlier introduced (pooled, sequential, reciprocal, team, integrative) are often ranked in terms of intricacy, or the extent to which they are intertwined. Simple and loosely coupled dependencies include pooled and sequential dependence. On the other hand, reciprocal and team dependence represent dense and tightly coupled activities. Integrative interdependence could fit between these two ends of the spectrum. Thompson (1967) proposed that more complex forms increase the difficulty and costs of coordination (Relationship (1) Figure 19). With simple dependencies, programmed coordination suffices since actors are comprehensively instructed in advance, (2) Figure 19 (Grant, 1996b). But tight coupling implies that collective output is not an accumulation of individual contributions. It rather blends these (Dougherty, 1996). As tasks become more contingent upon each other, actors need to connect and know more about each other (Gabarro, 1990). Inter-personal coordination mechanisms like mutual adjustment and working relationship become important to integrate adaptively as the work unfolds, (3) Figure 19 (Weick & Roberts, 1993).

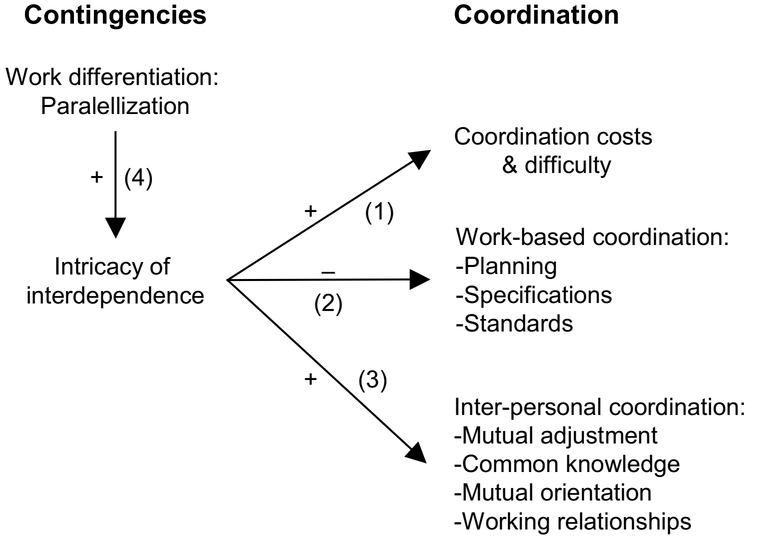


Figure 19 - Interdependence and coordination

Complex interdependence also affects the control process. Individual efforts are not easily recognized throughout the transformation process, paving the road for free-riders, (5) Figure 20 (Alchian & Demsetz, 1972). Complex dependence thus shifts the locus of control as self-managing groups are held accountable for their results, (6) Figure 20 (Manz et al., 1987). Within these teams, social norms and tacit observation govern participating individuals (Barker, 1993; Wageman, 1995). Self-control implies that task performers control their own accomplishments, as a substitute for external observation and adjustments. This is considered appropriate for autonomous tasks that are uncertain and require professional skills (Stinchcombe, 1990). At the same time, absence of external control may hinder coordination of work that is interdependent and perhaps unstructured, (7) and (8) Figure 20 (Manz & Stewart, 1997: 62-63).

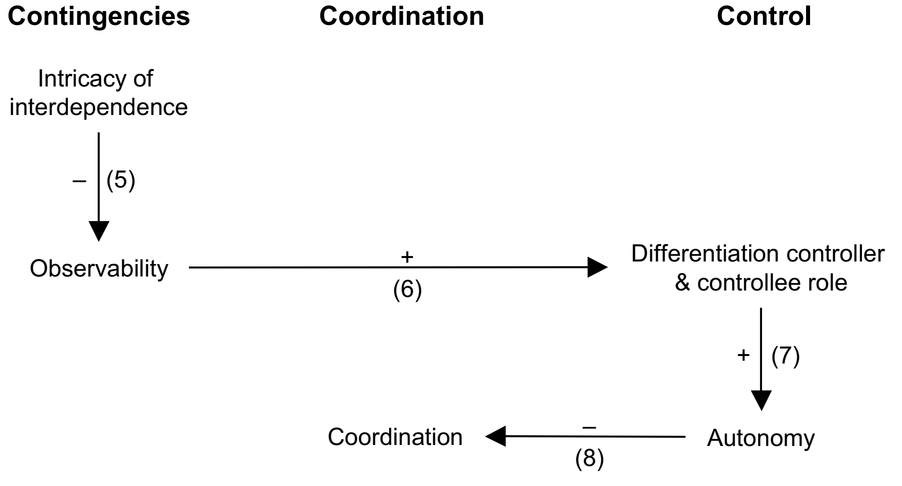


Figure 20 - Interdependence and control

Until recently, the type of interdependence was considered an inherent property of an organization's task environment (Thompson, 1967), and thus a static determinant of coordination and control modes (Van de Ven et al., 1976). Recent insights extend this view: actors may construct and modify dependencies. They can change the sequencing of work from linear to overlapping to parallel (Grant, 1996b). While parallelization reduces the amount of time spent on the aggregated work, research shows that it also increases uncertainty and intricacy of work dependencies, (4) Figure 19 (Loch & Terwiesch, 1998). In turn, this makes coordination and control demands more intricate, (1) Figure 19 .

§ 5.4.2 Uncertainty

A second contingency is uncertainty: the lack of information or know-how concerning the work actors are supposed to do (Galbraith, 1973). In its most simple form, transformation processes are stable but actors may experience variability in the demand for their outputs (Perrow, 1967). Or the input they depend on from other actors is unpredictable (Argote, 1982). This basic form of uncertainty has been referred to as variability (Van de Ven & Delbecq, 1974), or computational complexity (Grandori, 1997). Uncertainty supposes flexibility in the way actors response to the demands of their environment. Having a portfolio of routines at their disposal, they must accommodate to situational expectations (Pentland & Rueter, 1994).

Uncertainty may also indicate that actors have difficulty analyzing the situation (Perrow, 1967) and lack a mode for acting upon expectations (Kogut & Zander, 1992). This implies problems of equivocality, analyzability (Daft & Macintosh, 1981), and cognitional complexity (Grandori, 1997). They cannot instantly choose a mode for interpreting and processing signals received from the broader system in which they operate (Daft & Macintosh, 1981; Purser & Montuori, 1995). In all of these cases, uncertainty is defined by the interplay between task characteristics, task environment, and actors involved (Scott, 1990; Tushman, 1979). Tasks and work environment may prove unpredictable and beyond the control of an individual or group (Nohria & Gulati, 1994).

Uncertainty affects the mode for coordinating and controlling work. Stable, predictable work relies on programmed coordination, (9) Figure 21 (Van de Ven et al., 1976). Once followed, programs like standard operating procedures or output specifications connect workers' actions without their deliberate attention and interaction (Gupta et al., 1994). In fact, programs differentiate and integrate work at the same time: coordination is embedded in the specification of partial contributions (Sanchez & Mahoney, 1996). Structured coordination relies on separation of responsibilities for specifying, executing and supervising work, (10) Figure 21 (Burns & Stalker, 1961; Grant, 1996b). Knowledge of cause-effect relationships is centralized and not necessarily embodied in the actors eventually executing the program (Blau & Scott, 1962). Communications in the sense of revealing expectations and reporting progress rely on layered channels and formal exchange modes, (11) Figure 21, linked to (10) in the same figure (Galbraith, 1973). This suffices in predictable situations: since coordination is embedded in the program, actors do not experience the tissue of dependencies that exists (March & Simon, 1958). Yet uncertainty 'awakens' interdependencies because changes in one part of the work trigger responses in related components, (12) Figure 21 (von Hippel, 1990). The tighter actors are coupled, the stronger this effect is experienced since their actions are not relatively isolated and buffered like in loosely coupled systems (Weick, 1993b). Uncertainty triggers a shift to inter-personal and direct, non-hierarchical coordination modes (Galbraith, 1973). It requires direct exchanges between actors and outgoing attitudes to handle novel events, (13) Figure 21 (McCann & Galbraith, 1981; Weick & Roberts, 1993). Actors cannot take the embeddedness of their actions for granted, but instead must connect externally and acquire knowledge of adjacent responsibilities (Ancona, 1992; Hutchins, 1990). When work is delegated, uncertainty moves principal and agent from a classical 'hands-off' contract, to reciprocal involvement and division of work (Macneil, 1978). Still, work-based coordination has a role with uncertain tasks. It provides minimal structures - like prototypes (von Hippel, 1994) - that channel inter-personal adaptation (Barrett, 1998).

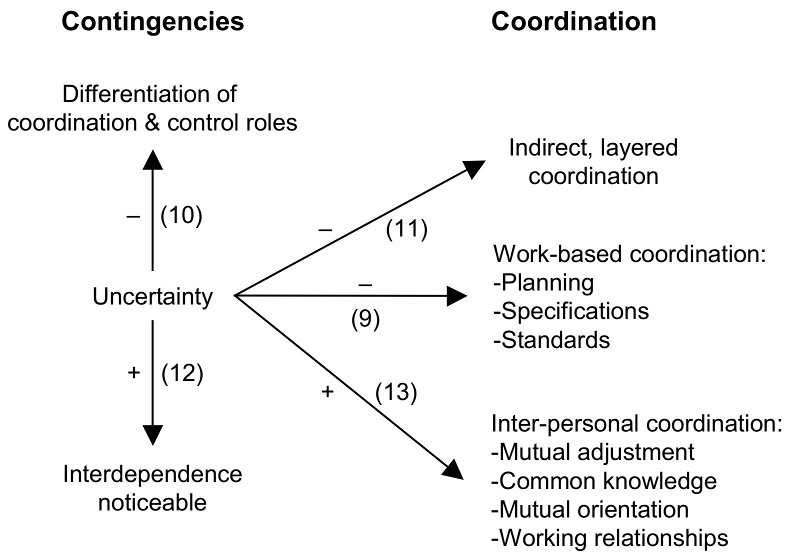


Figure 21 - Uncertainty and coordination

Uncertainty also alters control modes. In fact, control theory is closely intertwined with the contingency perspective on uncertainty. Both Thompson (1967 chapter 7) and Galbraith (1973: 12-13) relate control modes to 'understanding of cause-effect relationships'. Lack of understanding implies that a priori programming of behaviors and outputs for ex post assessment is not possible, (9) from Figure 21, and (14) Figure 22 (Anthony, 1965). The standards do not exist or are difficult to define. Instead, inter-personal forms of control like selection and socialization are employed to achieve reliable performance, (15) Figure 22 (Hage et al., 1971; Snell, 1992). This means a temporal shift to the initial phase of the work, which, in turn, enables denser interaction processes during task accomplishment, (13) from Figure 21, and (16) Figure 22 (Pfeffer, 1978).

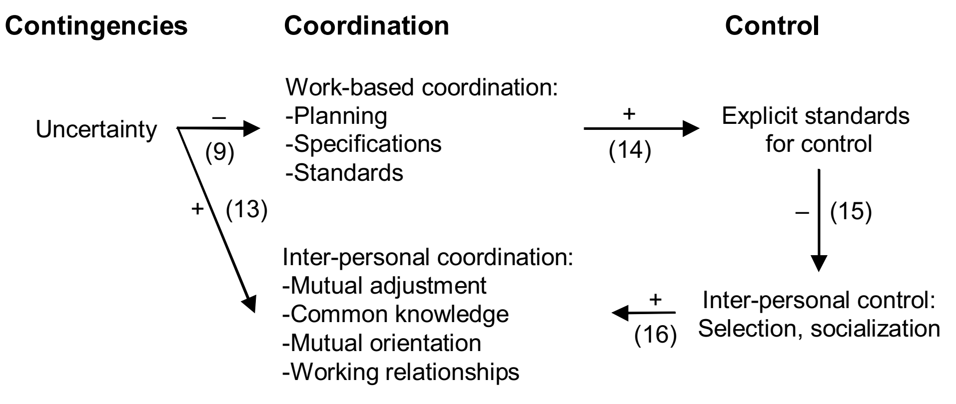


Figure 22 - Uncertainty and control

§ 5.4.3 Uncertainty and Goal Incongruence

As an organizational economist, Ouchi (1980) proposed a trade-off between specifiability of work and goal incongruence between controller and controllee. Goal divergence increases the risk that the controllee's behaviors and outputs deviate from the controller's interests (Ouchi, 1980). In response, work expectations are spelled-out in advance and closely monitored. Expectations concerning reciprocal behaviors are defined and explicitly aligned through resource incentives and penalties (Jensen & Meckling, 1986). Hierarchies and classic contracts enable this control mode that relies on programmed coordination (Williamson, 1991). Uncertainty changes the role of goal incongruence since work specification is no longer possible. Apart from intermediate solutions like the controller using information systems to monitor the controllee (Kirsch, 1996), scholars point at interpersonal control mechanisms like trust (Weick & Roberts, 1993: 378) and relational contracts (Macneil, 1978). In fact, trust and clan-based mechanisms change the premise of goal divergence as the relationship between controller-controllee is rooted in careful selection, and mutual support (Ouchi, 1979).

§ 5.4.4 Joint Effect of Interdependence and Uncertainty

Task dependence and uncertainty - or predictability, structurability - may affect simultaneously the need for information processing, and the choice of coordination mechanisms. Interaction between the two variables is depicted in Table 8. The first cell 1 implies that two or more units accomplish structured tasks in an autonomous fashion. This is extended to cell 2 with unpredictable work, and cell 3 with tasks that are both tightly coupled and structured. The fourth cell refers to tightly coupled work that is unpredictable at the same time.

Table 8 - Interdependence and predictability of work

	Predictable work	Unpredictable work
Interdependence low	Cell 1. Structured, loosely coupled work	Cell 2. Unpredictable, loosely coupled work
Interdependence tight	Cell 3. Fixed pattern of interdependence	Cell 4. Tightly coupled, unpredictable work

The effect of uncertainty - a shift to interpersonal coordination modes (Van de Ven et al., 1976) - is exacerbated by the tight form of dependence. This reinforces the need for coordination across units involved, a combination of (1) and (3) Figure 19, and (13) Figure 21. As March and Simon (1958: 169) already noted:

> "Interdependence does not by itself cause difficulty if the pattern of interdependence is stable and fixed (i.e., cell 3 - author). For in this case, each subprogram can be designed to take into account all of the other subprograms with which it interacts. Difficulties arise only if program execution rests on contingencies that cannot be predicted perfectly in advance (i.e., cell 4 - author). In this case, coordinating activity is required to secure agreement on estimates that will be used as the basis for action,

> or to provide information to each subprogram unit about the relevant activities of the others. Hence, we arrive at the proposition that the more repetitive and predictable the situation, the greater the tolerance for interdependence. Conversely, the greater the elements of variability and contingency, the greater is the burden of coordinating activities that are specialized by process."

Literature on HRO further extends this insights. It explains the risk of tight connectivity among units that may fail in the execution of their work:

> "Normally, individual failures stay separate and unlinked if they occur in a linear transformation system (cell 2 - author) where they affect only one adjacent step and if they occur in a loosely coupled system where that effect may be indeterminate (...). If the couplings become tighter (cell 4 - author) (...) then more failures can occur and they can affect a greater number of additional events" (Weick, 1993b: 190-191).

The combination of close dependence and unpredictable work calls for intensive coordination efforts. Uncertainty implies that the form and intensity of interdependence is not fixed. Insight therein evolves as the work itself unfolds. In this process, units should keep each other therefore updated on intended action patterns at a frequent pace (Roberts & Moore, 1993).

§ 5.4.5 Observability

Supposing that an external control mode is chosen (controller and controllee are not the same persons), task uncertainty - the "understanding of cause-effect relationships" (Thompson, 1967) - implies that desirable accomplishments cannot be defined in advance. This undermines the cybernetic control cycle as work standards do not exist for assessing the actual execution of activities (see Figure 13). But even if controllers know their expectations, problems of observability (the second activity in the cybernetic cycle, see same figure) hinder their control efforts (Scott, Mitchell, & Peery, 1981). Agents may work remotely or with clients, like salespersons (Staples, 1997). Their behaviors remain outside the controllers' scope and become in a sense uncertain for them.

As a consequence, literature proposes that controllers focus on agents' outputs rather than their behaviors (Govindarajan & Fisher, 1990). Reports and successful contracts are examples of outputs a controller can review to assess the controllee's accomplishments (Cooper, 1992; Olson, 1982; Perin, 1991). As an alternative, agency theory proposes that controllers can still attempt to control agents' behaviors if they invest in information systems (Kirsch, 1996).[20] They purchase remote observation as a substitute for direct supervision. Observations on the controllees' behaviors are transmitted to the controller to resume a cybernetic control cycle. Figure 23 shows the adapted cycle for controlling a process with direct versus transmitted observation. In fact, apart from deploying technology, the controller can achieve a similar control mode by commissioning local representatives to observe the controllee's behaviors.

[20] An example of a remote (security) observation systems is watching people and/ or material objects by means of a web cam and permanent internet link.

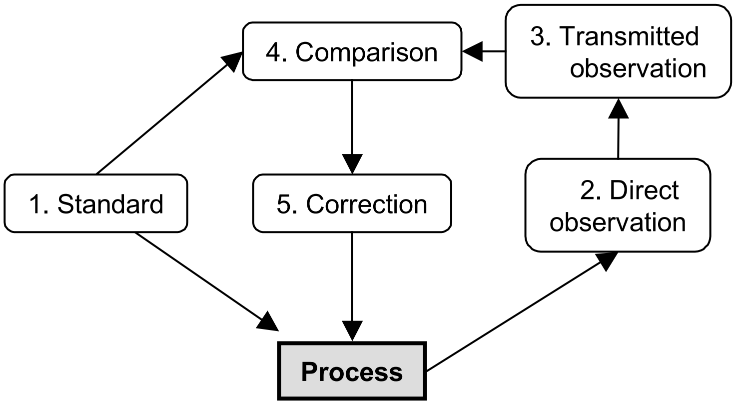


Figure 23 - Remote cybernetic control cycles

§ 5.4.6 Work Unit Size

Work unit size - the number of people involved in a single job - may increase for various reasons. With agency relationships, size increases when the principal delegates the work to multiple agents, or when one of the agents sub-delegates work to others (Hart & Moore, 1999; Penrose, 1959). Size also increases when work is differentiated for reasons of efficiency (Smith, 1793) or knowledge specialization (Grant, 1996b; Purser & Montuori, 1995). As more actors become involved, the scope of their work contacts decreases. Assuming that the total amount of time they spend for connecting with peers remains about the same, they can either maintain a large number of superficial contacts. Or they interact closely with a limited segment of the network, (17) Figure 24 (Galbraith, 1973). As the denseness of interactions in the system decreases, size adds to the risk of confusion (Gulick, 1937). Actors lack overview and representation that characterize smaller groups (Brooks, 1975; Weick & Roberts, 1993). This absence of 'global transparency' (Adler & Borys, 1996) translates into poor perception of their individual embeddedness (Nonaka & Takeuchi, 1995). Size reduces awareness of dependencies between the multiple tasks and people involved (Brooks, 1975). Instead of mutual adjustment and small group meetings (Van de Ven et al., 1976), scholars have proposed alternative means for achieving integration.

First, formal coordination modes like plans and standards, (18) Figure 24 (Mintzberg, 1979). The thought process that precedes these blueprints coordinates large-scale activity in advance. Once completed, specification of expected behaviors and outputs provides an embedded form of coordination that substitutes for mutual adjustment (Sanchez & Mahoney, 1996). Second, information systems increase the capacity of the system as a whole to communicate, (19) Figure 24 (Galbraith, 1973). They enable actors to organize and disseminate articulated knowledge relating to the group's past, present and future (Walsh & Ungson, 1991). Third, larger groups can be split apart in smaller units that maintain forms of interactive collaboration, (20) and (21) Figure 24 (Dougherty, 1996). Links between units are facilitated by group representatives, integrators (Lawrence & Lorsch, 1967b), liaisons (Galbraith, 1973) or gatekeepers, (22) Figure 24 (Allen, 1984). Hence, a structure emerges of interconnected nodes that channel inter-unit communications

(Burt, 1992). Intelligence on a system level becomes depend on the reliability and capacity of these linking pins to connect with other integrators, while retaining inclusion in their respective subunits.

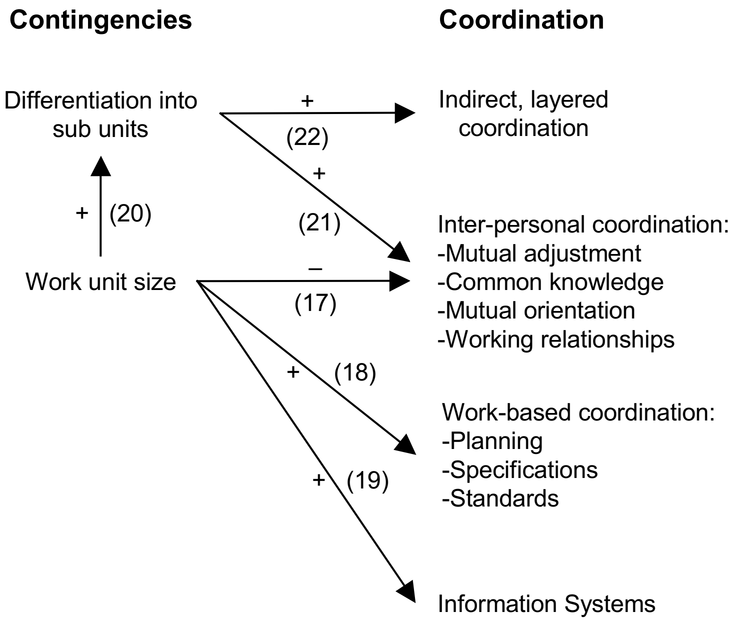


Figure 24 - Work unit size and coordination

Size also affects the mode of control, both differentiated (external) and self control modes. Differentiated control refers to the situation that controller and controllee are not the same person, the former being a customer, manager, or colleague (Smith, 1997). Their direct observation of an actor's behavior constitutes a rich form of assessment (Ouchi, 1978). But since their span of control and resources are limited (Penrose, 1959), the number of actors they can observe is limited, (23) Figure 25. Size makes it also difficult for actors controlling their own work. Their insight on an aggregated level is contingent upon the opportunity they have to connect to other contributors. As indicated, size reduces the ramification or depth of their networking efforts. As a result, they have reduced insight in the broader work context, and the embeddedness of their role, (24) Figure 25 (Nonaka & Takeuchi, 1995).
Literature points to alternative means for ensuring performance in large-scale systems. First, the larger system can be broken apart in multiple smaller units, replicating control forms common to smaller entities, see also (20) Figure 24. These entities require additional supervisory roles (Penrose, 1959), or members steer their own efforts, (25) Figure 25 (Manz et al., 1987). Second, direct observation of behaviors is substituted for simpler representation of actors' work (Cooper, 1992), like output measures, (26) Figure 25. Observation of output is easier to transmit, especially when quantifiable (Ouchi, 1978). "In a large organization (…) output measurement is necessary even if means-ends relations are

well understood, because the subunits must have a simple measure of performance, which can be readily understood by others in the organization" (Ouchi & Maguire, 1975). Information systems facilitate this approach by capturing and disseminating performance metrics to controllers, (27) Figure 25 (Orlikowski, 1991).

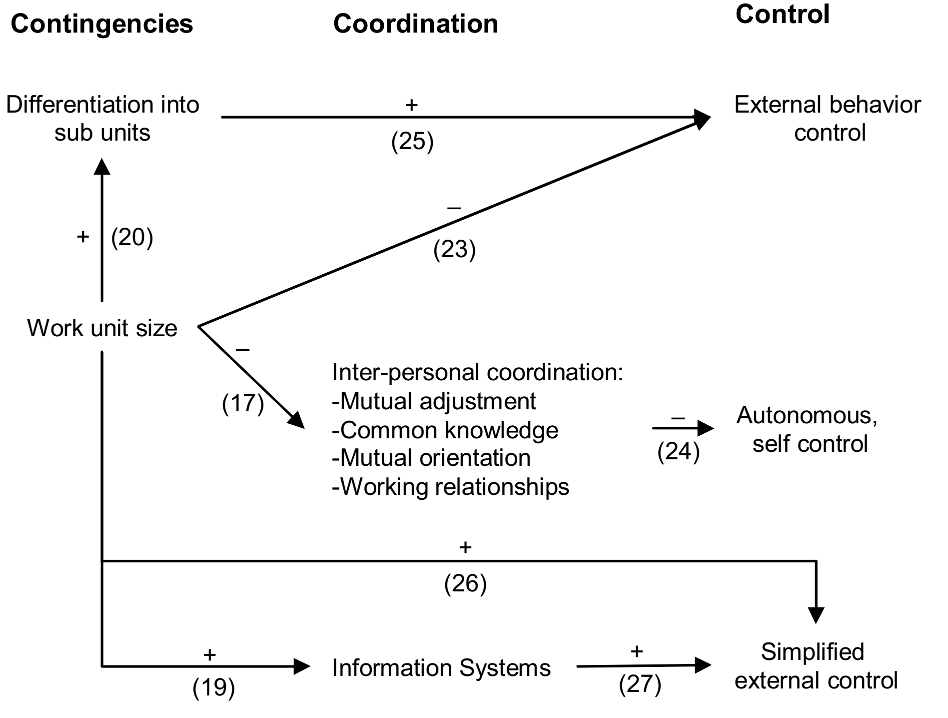


Figure 25 - Work unit size and control

§ 5.4.7 Complexity

Complexity refers to the number of elements that are connected, and the number and type of relationships among these (Haeckel & Nolan, 1993). As earlier indicated, it applies to situations or tasks that are intricately dependent, and possibly uncertain. Complexity increases when project become larger (Kirsch, 2000), or more people are involved (Brooks, 1975). It affects coordination and control modes although literature does not specify a uniform response pattern.

A common approach is to formalize and centralize the way work is divided, coordinated and controlled, (28) and (29) Figure 26. "Projects that are high in complexity demand formal and detailed planning and control in order to track and integrate all of the separate pieces" (Kirsch, 2000: 299). Others emphasize the difficulty of connecting different parts of a larger task. They suggest to promote interpersonal exchanges to surpass intricate task demands, (30) and (31) Figure 26. "Somehow, all of the participants must continue to

interrelate with other participants as they jointly struggle to arrive at viable solutions" (Goodman, 1981: 3).
A final perspective combines elements of the two approaches. Complexity - possibly combined with uncertainty - may prove formalization unfeasible. Yet exclusive reliance on mutual adjustment may provide too little structure, especially with large work unit size. As an alternative, people may define and formalize the overall structure of tasks - architectural design (Henderson & Clark, 1990) - and define standards for interfaces between subunits and tasks (Sanchez & Mahoney, 1996). Detailed elaboration of subtasks remains unspecified but should adhere to the (minimal) level of structure imposed (von Hippel, 1990).

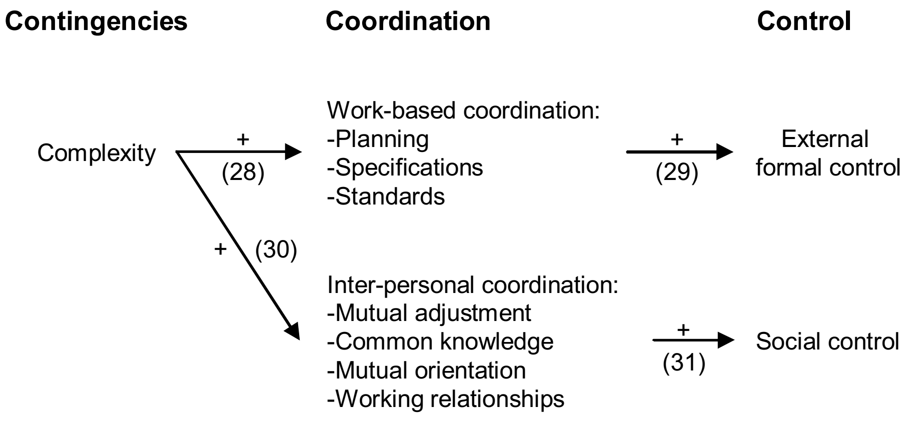


Figure 26 - Complexity, coordination and control

§ 5.4.8 Functional Differences

Functional diversity means that two or more units working on the same task have different outlooks, perceptions, and work procedures, (32) Figure 27 (Dougherty, 1990; Lawrence & Lorsch, 1967b). These differences may constitute barriers that hinder cross-unit contact and work coordination (Tushman, 1979). Lack of commonality and interest reduces information processing capacity and effectiveness, (33) Figure 27 (Krauss & Fussell, 1990). This becomes especially apparent when units undertake a joint that task is uncertain and requires interlocked contributions (Dougherty, 1992).
Under these conditions, extensive communications are necessary to generate reciprocal insight in perceptions and work patterns, (34) Figure 27. This is rooted in what Lawrence and Lorsch (1967) call 'good relations.' The stronger functional differences are, the more important good contacts become. Dougherty (1990) came to similar conclusions in her research on interdepartmental collaboration in new product development. "Expertise alone is not enough. Interdepartmental relationships that were creative, interactive, and participatory in order to blend this expertise were also important to comprehensive market understanding. These relationships were also tightly coupled and well executed, not

‘loose’” (Dougherty, 1990: 75). Working relationships and frequent exchanges enhance awareness at both sides. This becomes especially relevant when task are intertwined and innovative, (35) Figure 27. “(…) (T)o coordinate such highly interdependent activities, innovators must understand the constraints in other functions, anticipate others’ needs, and use dense, two-way communication to process fragmentary information” (Dougherty, 1996).
Fostering collaboration across different units also relies on transferring people to become locally immersed (Edström & Galbraith, 1977), and extend their specialized knowledge base (Grant, 1996b). Alternatively, representatives bridge the diverse units as linking pins, (36) Figure 27 (Galbraith, 1973). Instead of direct contact, a layered form of coordination emerges as with large work unit size, (20) and (22) Figure 24.

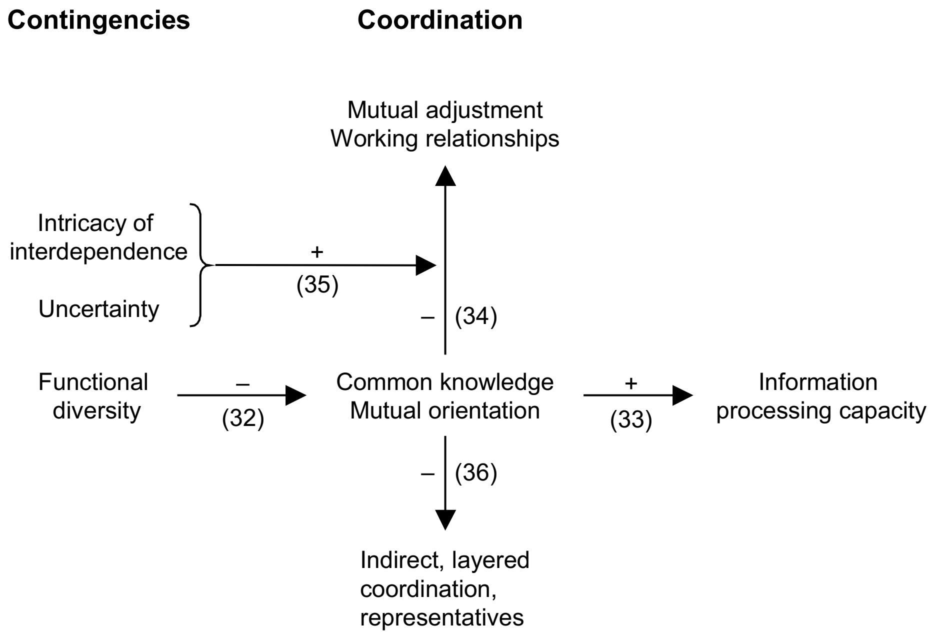


Figure 27 - Functional diversity and coordination

§ 5.5 Towards an Integrated Theory of Work Coordination and Control

> “(…) (I)n my argument (…) a science of organization is in progress in which law, economics, and organization are joined” (Williamson, 1994: 77).

Williamson’s (1994) quote (see above) implies a considerable challenge to organization theory in general. Here, a contribution to that endeavor is made as far as coordination and control are concerned. The constructs and relationships elicited from literature constitute the initial material for an integrated theory of work coordination and control. They are elicited from theories in organization sciences and organizational economics. Figure 28 shows the relationships among the contingencies and portfolios of coordination and control mechanisms on an overview level.

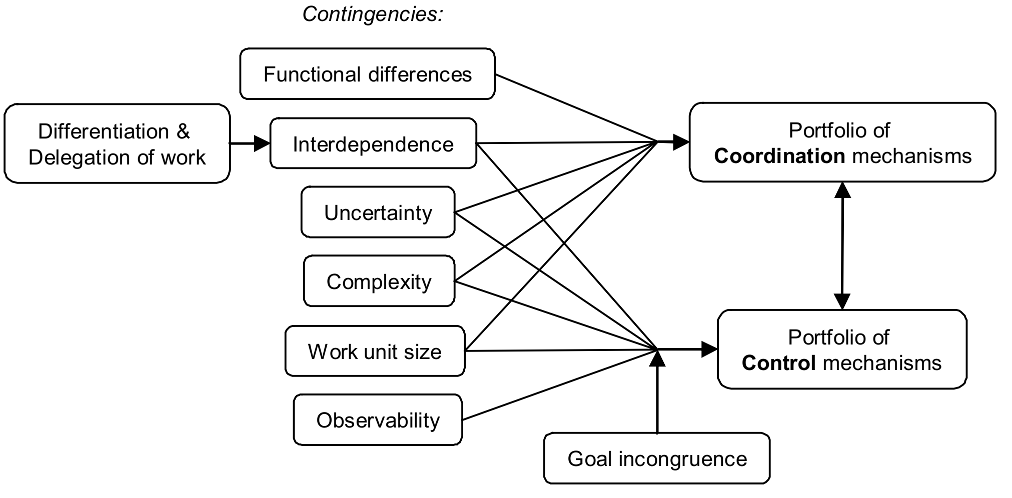


Figure 28 - Integrated model of work coordination and control

The model starts with work differentiation and delegation. Differentiation means that work is partitioned, and more people become involved to accomplish the large task (Smith, 1793; Thompson, 1967). Delegation is derived from agency theory, and implies that one person (the principal) asks another person (the agent) to perform a task (Eisenhardt, 1989a). Both result in interdependence among the people involved in the single task or request for accomplishing a task.

Interdependence is one of the contingencies - or determinants - of coordination and control mechanisms (Van de Ven et al., 1976). Others include functional differences, uncertainty, complexity, work unit size and observability. Together, they explain the choice, use and effectiveness of coordination and control mechanisms, including substitution patterns. This is depicted by the arrows that connect the contingencies to the portfolios of coordination and control. The nature of these causal patterns was earlier explained. In line with literature, some contingencies affect either coordination or control, others have an impact on both. Goal incongruence has a mediating effect on contingencies of control mechanisms. The portfolios of coordination and control mechanisms are linked like Siamese twins, as depicted by the bi-directional arrow in between.

Chapter 6 Polycontextual, Distributed Collaboration: Literature Review

> "Please sign up! At least email me back a "Hello" so I know you're still interested and not tired of all my emails!" - Coordinator of volunteer work at non-profit organization in Miami, FL to group of (occasional) volunteers, including the author (e-mail message).

The second part of the theory section extends insights in coordination and control theory to settings where people contribute from different activity contexts and/or geographically distributed sites. We seek to provide an initial answer to sub question 3a and 3b.

The chapter features a gradual build-up. It starts with research on activity environments that are polycontextual yet collocated. We discuss research on crossing the boundaries of multiple activity contexts. We then move on to electronic media and teleworking as examples of technical linkages and settings where people work from regionally dispersed locations. The chapter continues with a detailed analysis of studies on distributed communications and the role of groupware. Finally, we discuss and analyze two pieces of research on global software projects in detail (Meadows, 1996b; Millar, 1999).
The chapter's broader focus ensures that insights from research on other forms of distributed working (like regional teleworking) are incorporated. To date, only a limited number of empirical studies exist on distributed working, managing and collaboration processes. Those available often have research questions and theories that are (slightly) different from our focus. Hence, these studies are extensively analyzed, where possible using interview excepts, with an emphasis on the effects of distributedness on work coordination and control. The analysis of literature on distributed work is used to develop a model for empirical research in the next chapter.

§ 6.1 Polycontextuality and boundary spanning

A promising debate has emerged in organization theory on 'boundary spanning'. The phenomenon starts with the recognition that multiple communities - possibly but not necessarily cross-functional and geographically separated - contribute to a single aggregated work outcome. As their efforts become interdependent, boundary spanning provides a framework for studying coordination modes. Contributors to this emerging field come from areas as diverse as social cognitive theory (Star & Griesemer, 1989), technology management (Henderson, 1998; Tyre & von Hippel, 1997), information management (Karsten, Lyytinen, Hurskainen, & Koskelainen, 1999), Cockpit Resource Management (CRM) (Chute & Wiener, 1995, 1996), activity theory (Engeström, Engeström, & Kärkkäinen, 1995). Here, the papers by Engeström (1995), Karsten et al. (1999) and Chute and Wiener (1995, 1996) are discussed and linked to our research.

§ 6.1.1 Engeström et al. (1995)

Engeström et al. (1995) combine cognitive science and activity theory in their research on boundary spanning. Specifically, their work connects to literature on expertise. In that field, most researchers adopt a so-called vertical perspective to study expertise, usually in a single area of specialization. Engeström et al. (1995) intend to complement this angle with a horizontal view. As they explain: "In their work, experts operate in and move between multiple parallel activity contexts. These multiple contexts demand and afford different, complementary but also conflicting cognitive tools, rules, and patterns of social interaction" (Engeström et al., 1995: 319). Their research addresses the challenge experts face to bridge multiple communities or contexts, also referred to as polycontextuality. For instance, different departments or locations that are involved in the same work endeavor.

Crossing boundaries of multiple contexts may take different forms. First, Engeström et al. (1995) point to an example where engineers travel as boundary crossers and representatives between a firm's plant and laboratory to resolve manufacturing problems (Tyre & von Hippel, 1997)

Second, actors from different context may develop common mental models, vocabulary and standards to connect distributed activities (Engeström et al., 1995: 322). This form of common knowledge may include 'boundary objects', i.e., physical artifacts representing work that is accomplished in a polycontextual environment (Star & Griesemer, 1989).

Third, members of different contexts can directly engage with each other in dialogue and argumentation. Contexts are more broadly connected than with representatives. An example is participatory development methodologies where users and system analysts iteratively interact to define requirements and design the system.

The three forms of bridging are related to the (inter-organizational) coordination mechanisms earlier discussed (Galbraith, 1973; Grandori, 1997).

Engeström et al. (1995) illustrate the role of these forms of boundary crossing with three case studies. The first case concerns collaboration between specialist and lay inhabitants of a municipal welfare and health center. Since the size of the groups involved was rather large, boundary crossing relied on representatives that participated in meetings. This attempt was not successful, partly because of the way representatives from the lay inhabitants connected to the group they represented. "The meetings were attended by representatives, not by those whose problems were the initial motivation of the project" (Engeström et al., 1995: 325). A second case deals with the relationship between two small groups of teachers at an elementary school, each aimed at developing a new curriculum model. Boundary crossing was accomplished by joint meetings that fostered presentation of group perspectives and dialogue. A final case deals with an industrial manufacturer, in particular interaction between a parts production and assembly hall. Boundary spanning is triggered when parts do not comply to specifications and cause problems in the assembly process. It was accomplished by representatives from both halls who met and discussed problems. Their dialogue benefited from common knowledge about the production process. People also used the semi-finished product that caused the problem as a point of reference or boundary object.

The work by Engeström et al. (1995) can be interpreted in the light of this research and organization literature. Their proposed forms of boundary crossing closely resemble coordination modes. First, the use of representatives to connect larger groups (form possibly different locations) is similar to contingency theory's liaison and integrator roles

(Lawrence & Lorsch, 1967b). Engeström et al. (1995) complement this view by focusing on problems occurring in the relationship between representatives and their groups. Second, the last case illustrates the role of standards and boundary spanning objects to achieve coordination across multiple contexts (Mintzberg, 1979). Finally, Engeström et al. (1995) point at more people-oriented means for linking communities. Meetings between members or representatives of groups facilitate exchange of views and coordinate distributed activities. Commonality of jargon and knowledge across communities facilitates this approach.

§ 6.1.2 Chute and Wiener (1995, 1996): Collocated Polycontextuality

The papers by Chute and Wiener (1995, 1996) are part of a distinct research area called Cockpit Resource Management (CRM). Wiener was one of the founders of this field of inquiry that is part of Human Factors research in aviation (Wiener, Kanki, & Helmreich, 1993). It focuses on communication relationships in aviation that define safety. That is, communication between pilots, between pilots and Air Traffic Control, and between pilots and cabin crew. The papers of interest here contribute to the latter area. It focuses on issues emerging in the interaction process between cockpit and cabin crew. This is important since the quality of that process drives flight safety, especially when nonroutine conditions arise.
Chute and Wiener's (1995, 1996) research addresses concerns with cockpit-cabin collaboration. In the period preceding their research, a number of accidents have happened that points towards problems in cockpit-cabin collaborative relationships. We interpret and re-analyze their studies here from the perspective of our research.

Chute and Wiener (1995, 1996) mention several gaps that exist between cockpit and cabin contexts. Together with other basic issues these lead to behavioral collaboration problems. Their papers conclude with recommendations to address these concerns and enhance flight safety.

First of all, Chute and Wiener (1995, 1996) distinguish a number of 'gaps' that exist between the cockpit and cabin context. A primary gap is physical (Figure 29). Even though both areas are adjacent and as such not truly physically distributed, they are still separate. The research shows that crews experience the cockpit door as a barrier to communications. Physical separateness leads to lack of visual contact, awareness and understanding between the two contexts. People do not know what is going on in the other crew's area and what their duties are.

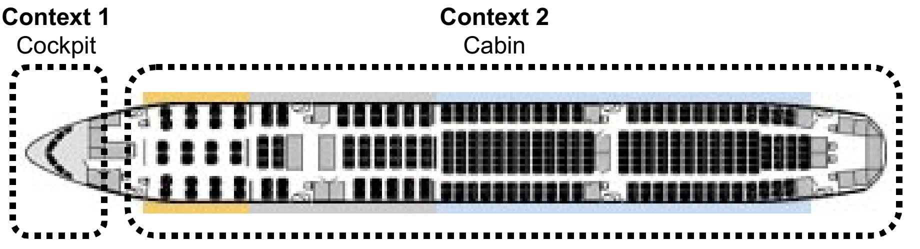


Figure 29 - Polycontextuality: cockpit and cabin[21]

A second gap is cultural. On average, members of cockpit and cabin crews have different attitudes, preferences, and gender. Pilots are often male, technically oriented, and used to a strict hierarchy, while people in the cabin are predominantly female, service oriented, and egalitarian.
Third, technical differences exist between both contexts.
Fourth, people from cabin and cockpit often work for different organizational entities. This creates walls in their experience and inhibits collaboration (Chute & Wiener, 1995, 1996).

On top of these gaps, the research points to several basic issues that inhibit cross-context collaboration.
First, at both sides lack knowledge of the counterpart context. They do not know standards, usances, terminology even on a basic level. This contributes to misunderstanding and distrust among the crews.
Second, in the US the Federal Aviation Authority has regulations that seek to promote a ‘clean cockpit’ (i.e., no disturbances for the pilots). This makes cabin crew hesitant to contact cockpit crew members either directly or through on-board communication systems.
Third, workload in the cockpit and cabin make it difficult to spend common time before or during a flight.
Finally, cabin and cockpit crews often collaborate for only a limited number of flights or flight legs. This implies that they have limited opportunity for building working relationships.

Apart from these basic issues, Chute and Wiener’s (1995, 1996) research mentions behavioral concerns that further constrain effective collaboration. Before flights, there are no interpersonal introductions and ‘ice breakers’. This increases the likelihood of misunderstandings and coordination problems later on. During flights, communications between the crews are insufficient and ineffective. A consequence is that people have unrealistic expectations of other people’s job performance. They are misinformed and cannot tune in precisely. Different viewpoints exist without people being aware of them.

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[21] Interior of Boeing 777-200/-200ER. Source: Boeing site, July 2001, http://www.boeing.com/commercial/777-200/int.html. Copyright © 2001 The Boeing Company. Graphics adapted for the purpose of this study.

All in all, this constrains teamwork that is particularly important in abnormal situations when safety might be at risk.

Chute and Wiener's (1995, 1996) conclude their studies with some suggestions for adapting current practices. These recommendations were in part from cockpit and cabin crew members participating in the research. They are intended to enhance co-operation, and prepare crews for safety emergencies.[22]
First, people should display a more proactive boundary-crossing attitude. They should take the initiative in an organized manner to contact their counterparts.
Second, the authors suggest to merge the crews' organizational entities into a single unit. This facilitates common objectives and consistency in training, policies, and procedures. It also clarifies the chain of command across both contexts.
Third, pilots and flight attendants should be kept on the same schedule for some time. This way, people get to know each other, and build trust. Collaboration thus becomes more routine and predictable.
Fourth, knowledge of other people's job should be encouraged. When flight attendants have knowledge of aircraft parts and terminology, they can communicate appropriately with the cockpit. Similarly, the more pilots know about cabin operations, the better they can fine-tune interactions with cabin crew. Overall, enhancing reciprocal knowledge is believed to reduce misperceptions and distrust. One way to accomplish this is to have joint cabin and cockpit crew training. Another approach is to provide opportunities for jump seat rides in the cockpit for cabin crew members. This immersion in the cockpit environment enables cabin crew members to "familiarize themselves with the normal procedures and workload and to learn more about the operation of the aircraft" (Chute & Wiener, 1995: 273). A captain summarizes the issue at stake as follows:

> "I think the more we know about the jobs each of us are asked to do, the better we are able to communicate with each other. I also think it would be valuable to have some common training time. I realize, in general, what the flight attendants' responsibilities are in emergencies, but I have not actually seen what they do" (Chute & Wiener, 1996: 229).

Fifth, before flights, cabin and cockpit crew should introduce themselves briefly to each other. This improves working relationships and later communications. As people become more familiar with their counterparts, they know more accurately expectations at both sides and communication styles. During flights when the need for swift communication may arise, people benefit from easier communications.
Finally, communications in flight should be channeled through one linking pin - probably lead flight attendant - instead of random contacts between cockpit and cabin. On this measure, one pilot remarked: "I believe that action alone would solve 90% of the coordination problems" (Chute & Wiener, 1996: 221).
In sum, Chute & Wiener highlight the role of linking pins as boundary crossers in collocated polycontextual work environment. In later sections we expand on other

[22] Novel policies in the US and abroad that have been implemented after September 11, 2001 may have changed some of these findings.

researchers' investigation of linking pins in globally distributed projects (Meadows, 1996b; Millar, 1999).

§ 6.1.3 Boundary Objects

Karsten, Lyytinen et al. (1999) expanded on the role of boundary objects to integrate communities of actors involved in the same project. They studied the design of huge paper machines that are semi-custom built by a Finnish company. Groups involved in such a project include various departments from the main company, customers, and subcontractors (Karsten et al., 1999). The research focuses on interaction between these groups, in particular by means of technical specifications. These are conceived as boundary objects (Star & Griesemer, 1989) and conscription devices (Henderson, 1998). Specifications reflect group viewpoints and require these to be explicitated (Boland & Tenkasi, 1995). They evolve with the project and become a 'cascade' of boundary objects that documents and integrates past contributions (Henderson, 1991).
Karsten, Lyytinen et al. (1999) join earlier research (Davenport, 1998; Henderson, 1991) that points at the challenge to formalize and automate coordination of multiple diverse contexts while retaining flexibility. Communities may have autonomous and dynamic expectations and thus become connected in a reciprocal, unpredictable manner. This constrains the capability of a single information boundary object - like groupware, ERP - to promote coherence and transparency. "The fluidity and flexibility that is part of the loose structure of boundary objects was paralyzed by the fact that the whole system was computerized. (…) The huge size and complexity of the interlocking systems intimidated people" (Henderson, 1991: 464).
An implication for geographically distributed projects is that sites need autonomy when their work is linked in a complex and unstructured manner. Remote coordination and control may not benefit from extensive specification and representation of local efforts, but require an alternative portfolio.

§ 6.2 Theories on Electronic Media Use

Theorizing on the generic use of electronic media (for both collocated and remote communications) started with social presence theory (Short, Williams, & Christie, 1976) and especially Media Richness Theory (MRT) (Daft & Lengel, 1986). MRT has led to a considerable stream of research that explains media choice (Rice & Gattiker, 2000). However, application of the theory on advanced media like email and vmail led to inconsistent findings that called for complementary theorizing and empirical research (Carlson & Zmud, 1999; Lee, 1994; Markus, 1994; Ngwenyama & Lee, 1997). This section presents MRT and examples of these more recent approaches.

§ 6.2.1 Media Richness Theory

MRT emerged in the early 80s in the tradition of contingency and information processing theory (Daft & Lengel, 1986; Daft & Macintosh, 1981; Trevino, Lengel, & Daft, 1987). It asserts that organization design should match information processing requirements and capabilities.

First, information processing requirements are defined in terms of uncertainty - lack of information - and/ or equivocality, a “messy, unclear field” (Daft & Lengel, 1986: 554) - (Perrow, 1967). Each of these result from an organization’s technology (work processes), interdepartmental relationships, and the environment. Second, capabilities to process information depend on a set of structural mechanisms. These include mechanisms traditionally proposed in contingency theory, like rules, plans, information systems, direct managerial contact (Galbraith, 1973), integrators, and group meetings (Tushman, 1979; Van de Ven et al., 1976). Daft and Lengel (1986) extend this repertoire by considering communication media. They suggest that communication media differ in their capacity to process rich information (Daft & Macintosh, 1981). Richness of media depends on their capacity to provide immediate feedback, the number of cues and channels used, personalization, and language variety (Daft & Lengel, 1986: 560). The richest medium is face-to-face that contact provides immediate feedback, multiple cues, and the opportunity to use natural language. Shifting to alternative media reduces richness, in the sequence telephone, personal documents for communications (letters, memos), and impersonal documentation like forms. Table 9 pairs structural mechanisms and communication media, and shows their capacity to reduce equivocality and/ or uncertainty.

Table 9 - Structural mechanisms & media to reduce uncertainty & equivocality

	Structural mechanisms	Communication media	
Structure facilitates rich, personal media	Group meetings	Face-to-face (FTF)	Equivocality reduction
	Integrator	FTF, telephone	
	Direct contact[23]	FTF, telephone, letters	
⇕	Planning	Documentation	
Structure facilitates less rich, impersonal media	Special reports	Documentation	
	Formal IS	Documentation	
	Rules and regulations	Documentation	Uncertainty reduction

Adopted with modifications from Daft and Lengel (1986: 561)

Daft and Lengel (1986) elaborate on sources of uncertainty and equivocality. First, organizational technology (work processes) is characterized by task variety and task analyzability (Perrow, 1967). The former determines uncertainty, the latter equivocality. Daft and Lengel (1986) propose a matrix that combines the two dimensions of technology to define matching structural mechanisms and communication media. Second, interdepartmental relationships are defined by work dependencies (Thompson, 1967), and differentiation. Dependence increases uncertainty and information processing needs (Van de Ven et al., 1976). Differentiation refers to interdepartmental differences in terms of functional specialization, time horizon, goals, frame of reference and jargon (Lawrence &

[23] Direct contact refers to lateral interaction between department heads. Unlike *group meetings*, department members are not directly involved (Daft & Lengel, 1986: 561; Galbraith, 1977).

Lorsch, 1967b) - (Daft & Lengel, 1986: 564). Greater differentiation implies absence of a common perspective and experience. It is therefore associated with equivocality and richer media. Finally, the environment affects information processing needs in two ways. Equivocality depends on analyzability of cause-effect relationships (Thompson, 1967), while uncertainty relates to an organization's efforts to collect data on its environment (Pfeffer & Salancik, 1978).

Since MRT was developed in the early 80s, it does not cover advanced communication media like videoconferencing, email, and groupware. More recent work has extended their framework to these media (Trevino, Daft, & Lengel, 1990). DeSanctis and Jackson (1994) propose an integrative typology derived from research on lateral coordination of a multinational's geographically distributed IT function. Electronic media - ranging from simple to complex - include (DeSanctis & Jackson, 1994):

- *Document sharing systems* allow people to share textual messages or visual and audio objects.
- *Electronic mail, bulletin board, and conferencing systems* enable more complex forms of (remote) interaction.
- *Electronic meeting systems* support and structure group meetings.
- *Discussion databases* allow people to interact asynchronously or synchronously.

MRT has implications for globally distributed projects. Media availability and choice depends on properties of the task at hand and project environment (Meadows, 1996b). Complex, unstructured projects require extensive investments in teleconferencing conversations, phone calls, and videoconferencing. For structured work email, fax and basic groupware functionality suffice.

A common characteristic of MRT and more recent work like DeSanctis and Jackson (1994) is their focus on inherent properties of electronic media. These include the possibility to provide immediate feedback, and the number of cues transmitted (Daft & Macintosh, 1981). Media properties define their capability to represent people or objects remotely (Lombard & Ditton, 1997). And the choice of electronic media depends on their matching with task-related determinants, like uncertainty and interdependence (Daft & Macintosh, 1981). Criticisms and extensions of MRT suggest that media choice is a more complex process than MRT proposes (Rice & Gattiker, 2000). In particular, they criticize MRT for not incorporating the role of people using electronic media. Media are not inherently rich or lean, but actors' use of media and their perception of media richness counts (Lee, 1994). In turn, this relates to the context in which media are used, people's prior experience with the messaging topic and media, and their working relationships (Carlson & Zmud, 1999; Markus, 1994).

§ 6.2.2 Markus (1994)

Markus (1994) investigated managerial use of email by contrasting MRT with alternative theories. Recent extensions of MRT rank email between telephone and nonelectronic written communications based on MRT's original criteria for defining richness (Markus, 1994). Email is therefore not a rich medium, and not a likely choice for managers

commonly engaged in equivocal tasks (Daft & Lewin, 1984). Markus (1994) argues that MRT is an individual level, rational choice theory. It does not satisfactorily explain how people choose between face-to-face communication and various electronic media for two reasons. First, MRT uses face-to-face communications as reference point for defining criteria of media richness. It does not consider new attributes of advanced media that may 'enrich' supposedly lean media (Markus, 1994). Such capabilities include multiple addressability (broadcasting a message to multiple recipients), and the fact that messages are stored and searchable on a computer (Sproull & Kiesler, 1991). Second, Markus (1994) points out that interpersonal communications - including mediated ones - represent a social phenomenon that cannot be explained with individual choice theory - like MRT - alone. She proposes alternative theories that take social dimensions of media use into account: critical mass theory and social definition theories. Critical mass theory emphasizes the role of widespread availability of electronic media, and individual responsiveness in using them. Social definition theories argue that media use is gradually institutionalized in an organization, and reinforced through collective norms and social control (Markus, 1994).
Markus (1994) conducted empirical research on managerial perception and use of email in a single company. She used a survey, analyzed email messages of a single day, and interviewed managers and administrative assistants. Results showed that managers did consider email a lean medium as MRT claims. However, they appeared to use it not only for straightforward messages, but also for discussing equivocal issues, contrary to what MRT would predict. Markus' (1994) qualitative data revealed additional themes on media use.

- **Documentation** - Respondents emphasized their use of email's documenting and archiving properties (Markus, 1994). First, preceding a phone call, they sent extensive basic information on a topic by email. This reduced the length of subsequent real-time interactions. Markus (1994) reports on one managers receiving a lengthy email from his subordinate before placing a call: "He (a subordinate - author) had the whole thing written down (…) before he called. That way, when he called, he didn't have to explain it all to me. We were able to take care of it in just a few minutes. If it weren't for the (email) message, we might have wasted 20 minutes on the phone" (Markus, 1994: 517).
  Second, email messages make communications explicit and storable. People saved messages to proof past communications if need be. "E-mail is invaluable as a source/ follow-up tool to having made necessary requests (…). The printout can be placed directly into a backup file and is there for later reference (…). When a project is held up due to lack of response from another area, it is easy to document one's efforts to attain the information and to properly place blame for any deadlines not met" (Markus, 1994: 522). In fact, documented messages thus become part of a control cycle, whereas the first mentioned use of email was more coordination oriented.

- **Broadcasting and prior message inclusion** - functionality of email applications allow people to send or forward messages to multiple recipients. With forwarding, past communications are often automatically included in the new message. A chain of interrelated exchanges emerges that represents the historical evolution of a topic. This facilitates updating people directly or indirectly involved, or even those joining later: "(…) they created "mosaic messages" - complex message chains that not only documented the evolving consensus but also made it possible to add newcomers easily to the conversation at a later point of time" (Markus, 1994: 518).

- **Media alternation** - since email transmits only textual messages, its capacity to sustain fine-tuned contact appeared limited compared to the phone. A regional vice president complemented email with phone conversations to maintain "the personal connection" (Markus, 1994: 520): "We (each of my direct subordinates and I) talk (on the telephone) once a week whether we need it or not (i.e., for work-related issues). We talk for different reasons than we message. We talk for the personal connection (…). Mail messages don't work if it goes on too long (without telephone or face-to-face interaction). We have to talk once a week or it gets impersonal." The phrase "whether we need it or not" coincides with results from Meadows' (1996) research where respondents also emphasized regular contact even if there was no apparent work-related need.

For geographically distributed projects, Markus' (1994) research has important implications, especially for intra-organizational remote collaboration. It shows that email can even be used for equivocal tasks, and facilitates documentation and broadcasting of messages. The research makes it also likely that phone calls or possibly visits are needed at a regular pace to maintain remote contact.

§ 6.2.3 Channel Expansion Theory

Another extension of MRT is channel expansion theory (Carlson & Zmud, 1999). Carlson and Zmud (1999) argue that MRT fails to explain results from empirical research on new media (email, vmail). Even more recent approaches that take social factors into account do not produce consistent findings. Channel expansion theory provides an alternative explanatory model that relates perception of media richness to four categories of experiences: experience with the channel, experience with the messaging topic, experience with the organizational context, and experience with communication co participants (Carlson & Zmud, 1999: 155). More experience in these categories equips people with "(…) knowledge bases that may be used to more effectively encode and decode rich messages on a channel" (Carlson & Zmud, 1999: 155). Knowledge bases make people perceive channels as rich, since they are able to exploit minimal cues.

Carlson and Zmud (1999) empirically tested channel expansion theory with a survey on email usage. Their findings seemed to support the main hypotheses, and explain some inconsistencies in earlier research with respect to email (Carlson & Zmud, 1999). Channel expansion theory remains in the tradition of MRT; it does not raise fundamental questions on perceived richness and social dimensions of media use like Markus (1994). Rather, the theory suggests that common experience bases cause an upward shift of a curve that relates media cues and perceived richness. That is, people perceive the same media as being richer.

Channel expansion theory combines and updates portions of contingency theory and MRT (Daft & Lengel, 1986; Lawrence & Lorsch, 1967b), TCE (Williamson, 1975), and literature on working relationships (Gabarro, 1990), common knowledge (Grant, 1996b), and mutual knowledge (Krauss & Fussell, 1990). Contingency theorists and MRT argue that functional diversity between departments increases equivocality and information processing needs (Daft & Lengel, 1986; Lawrence & Lorsch, 1967b). More differences in attitude and behavior require stronger integration efforts, such as good working relationships (Lawrence & Lorsch, 1967b). TCE proposes that people operating in the same organizational entity develop a common jargon and economize on exchanges (Williamson, 1975). Literature on working relationships, common knowledge and mutual knowledge suggests that knowing more of a communication partner, and sharing similar knowledge economizes on interactions (Gabarro, 1990; Krauss & Fussell, 1990).

For geographically distributed projects, channel expansion theory points at the importance of common knowledge bases across sites. It suggests that effective remote collaboration requires selection, socialization or training of participants to ensure experience across the categories mentioned. Shared experience allows them to use lean media in a rich mode, and engage in equivocal tasks.[24]
An implication of common task-related expertise is that cross-functional remote collaboration seems more difficult than between specialists in the same field. Experience with organizational context implies that people in the same (albeit distributed) organization have an advantage over offshore outsourced projects. They can leverage shared experience with organizational procedures and technology. And they can capitalize on working relationships established on prior occasions.

§ 6.3 Teleworking

> "So what if he beats me for a few hours - I know by the quality of his final report whether he's doing the job" (Perin, 1991: 254)

Research on teleworking - also referred to as telecommuting - offers insight in a form of remote collaboration where managers, subordinates and peers work (temporarily) out of office. This seems relevant for understanding globally dispersed projects where people connect remotely most of the time. Even though teleworking usually occurs within the same country and region, teleworkers still experience the effects of distance. They substitute face-to-face interactions for electronic media to remain connected with counterparts. This section focuses on empirical research. It concludes with a reflection on remote control - a recurrent theme in teleworking studies.

§ 6.3.1 Staples (1997)

Staples (1997) investigated remote management - the situation where manager and subordinate work from physically separate locations -, and the role of information technology as a potential enabler thereof. Physical separation includes teleworking from

[24] This contrasts with Media Richness Theory which predicts that increasing information processing capacity demands richer communication media (Table 9).

home, but also subordinates stationed at customer sites, or working from other (mobile) locations. In an exploratory phase of the research, Staples (1997) conducted focus group meetings with people from five organizations in Canada. Their experiences with remote working and management were discussed and summarized in lists of key issues. Staples (1997) grouped issues around categories. Two of the most relevant are elaborated below.

- **Communications** - First, compared to collocated office settings, remote workers participate in less informal communications. Distance seems to increase the barrier to contact people outside formal meetings or apparent task-driven communications needs (Kraut & Galegher, 1990). As a consequence, remote workers remain somewhat uninformed and outside the main stream of work as it unfolds in the office (Cramton, 1997). When their tasks relate to work in the office, this incompleteness of insight may result in uncoordinated actions (Vaughan, 1997).
  Second, the use of electronic media for remote exchanges requires special skills and attitudes, since cues common to face-to-face contact are absent. Skills and attitudes include making intended communications explicit, and responding quickly to messages received (Jarvenpaa & Leidner, 1998). Electronic media seem less suitable for sensitive communications like negative feedback (Meadows, 1996b; Millar, 1999).

- **Technology** - Remote working increases the importance of technology since it becomes the primary means for maintaining contact (Cramton, 1997; Meadows, 1996b; Millar, 1999). As the focus groups indicate, this includes advanced, reliable technical infrastructure as well as training and support.

The focus groups also pointed at directions for improving remote management. Their suggestions for communications and information technology issues are analyzed below.

- **Communications** - distant collaboration has the potential of miscommunications and leaving people under informed. Avoiding these effects requires deliberate attention to maintain frequent and effective remote contact: "(…) frequent communications are necessary to maintain a feeling of being informed and part of the organization for an isolated worker" (Staples, 1997: 40). Physical separation makes basic technology for document sharing more important (Majchrzak et al., 2000a), as well as provision of connectivity information (like people's agenda). It requires explicitness of expectations, and formal planning to substitute for the loss of informal contact (Markus, 1994; Meadows, 1996b). Especially synchronous interactions like teleconferences require careful role assignment, preparation and documentation (Meadows, 1996b). Remote exchanges depends on particular skills to deal with the limited functionality and set of cues electronic media provide. Conveying a message requires providing elaborate context; recipients must quickly respond (with asynchronous media) and actively probe for clarification where needed. Remote management should be alternated with visits from both manager and subordinate. Millar (1999) also pointed at the role of reciprocal visits to gain insight in local contexts. This facilitates subsequent remote contact by electronic means, since people expand their knowledge base in the categories mentioned by channel expansion theory (Carlson & Zmud, 1999).

- **Technology** - remoteness increases dependence on information technology, which should therefore be highly reliable. A variety of technologies is often used to collaborate remotely (Knoll & Jarvenpaa, 1998), possibly including a shared network, groupware, and videoconferencing. Distributedness demands standardization of information technology to shape a homogeneous environment (Dickson, DeSanctis, Scott Poole, & Jackson, 1997). This avoids incompatibility issues, and thus reduces behavioral costs of connecting remotely (Kraut & Galegher, 1990).

§ 6.3.2 Kurland and Egan (1999)

Kurland and Egan (1999) refer to three forms of telecommuting (or teleworking) in their study: satellite work centers (a dedicated corporate facility convenient for employees or customers), neighborhood work centers (similar to the satellite center but accommodating employees from multiple firms), and working from home. Apart from telecommuting advantages - like flexibility, autonomy and cost reduction - Kurland and Egan (1999) cite two major concerns from literature. First, from a managers' point of view, physical separation from subordinates interferes with traditional managerial processes of communication, coordination and control (Mintzberg, 1998a). "How do you measure productivity, build trust, and manage people who are physically out of sight?" (Mason, 1993). As they cannot observe staff behaviors remotely, research suggests that managers become output oriented (Olson, 1982). In general, literature proposes that output control is appropriate for representing and transmitting workers' accomplishments, albeit in a less flexible and rich mode than behavioral control (Cooper, 1992; Ouchi, 1978).
Second, employees working away from the main office may feel isolated, both socially (lack of informal exchanges), and professionally (out of sight is out of the organization's mind). This study includes only professional isolation, also referred to as organizational justice. It reflects telecommuters' concern of being involved in organizational decision making processes, and being fairly assessed and rewarded for their efforts.
Kurland and Egan (1999) conducted a survey and semi-structured interviews with managers and telecommuting staff to explore the relationship between telecommuting, managerial monitoring strategies, and staff perceptions of organizational justice. As far as relevant for the focus of our research, the study yielded the following results.
First, distance increases the risk that people are not updated and aware of what happens at a remote site (Cramton, 1997; Vaughan, 1997), in this study referred to as professional isolation (Kurland & Egan, 1999). This problem surfaces when distributed people are involved in a task that is unstructured and closely interlocked (Jarvenpaa & Leidner, 1998). Incomplete participation of a remote workers becomes even more apparent with tasks that are accomplished under time pressure:

> "(A) project . . . I was working on . . . was a real fire storm project. There were people working all hours of the day and night to get this thing out and some key decisions (were made) . . . (y)ou come to a point (when a decision has to be made) and they have to be made whether you were there or not and so you could be working on something at home and then the whole tenor of the project changed when you came back in; it's like, "Okay so I just wasted six hours, fine yeah." That kind of thing . . . (So) you have to sort of be there because it's sort of happening really quickly and if you're telecommuting, even though there are things like e-mail and voice mail and other(s), things are happening really quickly. People don't think to call you up and tell you this is happening or to ask your opinion on that" (Kurland & Egan, 1999: 510).

Similar to findings from other researchers (Majchrzak et al., 2000a; Sia et al., 1998), distance seems to reduce information processing capacity. This conflicts with information processing needs when task uncertainty and tight interdependence occur simultaneously (March & Simon, 1958), see Table 8.
Second, one manager explains that physical separation of subordinates implies more deliberate effort from both sides to keep each other updated. Distance implies that manager-subordinate processes of coordination and control are less self-explanatory and impromptu. Criticality of tasks is associated with intensification of efforts to communicate remotely.

> "I would say ..., on the average, (I communicate with the tele-commuter compared to the nontelecommuters) a little bit more . . . (S)uppose she's doing something and that particular thing is on the critical path. Because I can't simply count on her being at her desk to check to see how something's going all the time, I always want to be very proactive about making sure that I know how things are going, where she's going to be at, and that things are going okay.
> And if any key communication needs to happen, that they're going to be happening on schedule. So what I would do is, it would take a little bit more effort on my part, communicat(e) with her and kind of mak(e) sure that we (keep) each other comprised of where each other are (sic) and so forth—that we always know how things are going and that it's (sic) going smoothly" (Kurland & Egan, 1999: 506).

Third, managers' concern to monitor teleworkers translated into selection of individuals on the basis of particular traits, like trustworthiness. Distance makes manager-subordinate exchanges during the process of work accomplishment more difficult as just discussed. This seems to shift the control mode partially to selection, an example of input control (Snell, 1992). "(…) we learned that some supervisors identified individuals who they believed could work effectively away from the office, and then offered the telecommuting option to these selected individuals. One supervisor even insisted that an individual exhibit the traits necessary to successfully telecommute before he would hire that person" (Kurland & Egan, 1999: 507).
Finally, the research did not find clear support for the proposition that managers of teleworkers become more output oriented. Or that telecommuters' jobs become more formalized and planned. (In fact, in line with contingency theory, tasks may be too uncertain for defining outputs in advance, or specifying behaviors (Kirsch, 1996; Ouchi, 1977)). Instead, a regular pace of informal contact seemed to build and maintain trust between manager and subordinates (Kurland & Egan, 1999: 509). This is embedded in a formalized pattern of scheduled meetings, possibly collocated for regional telecommuters:

> "(I)n our environment I have meetings, audio meetings . . . scheduled every week. (...) from a training perspective, we have regularly scheduled weekly team meetings for both our field service and sales groups where everybody gets together and they are in the same room. You know, they can all look at each other. And that may be the only time that everybody's together" (Kurland & Egan, 1999: 509).

§ 6.3.3 Perin (1991) and Wiesenfeld, Raghuram et al. (1998)

Perin (1991) studied those telecommuting practices, where "salaried professionals might substitute work at home for some part of their regular work week and remain electronically in touch with their offices (…)" (Perin, 1991: 242). Despite advantages of such programs in terms of flexibility, undisturbed working, and cost savings, Perin (1991) asserts that their adoption remains limited. Part of her explanation relates this phenomenon to the importance of direct supervision, also for salaried professionals. For the professional, presence in the office is considered a prerequisite for visual observation and recognition by one's manager. This in turn provides the basis for performance assessment and rewards. For the professional's manager, Perin (1991: 250) describes his or her major concern being "How can I supervise my employees if I can't see them?"

Distance not only implies that direct supervision of behaviors becomes unfeasible. It also makes clan control forms that rely on socialization and peer contact less likely. "(T)here are fewer opportunities to socialize employees when organizations are (…) dispersed over large geographic areas (…)" (Sparrow & Daniels, 1999: 57). A similar concern was aired by Wiesenfeld, Raghuram et al. (1998). They conducted a single-firm study on people working most of their time from home or client sites. A survey measured this group's communication behaviors, and the extent to which they identify with their employer. Wiesenfeld, Raghuram et al. (1998) pointed at a paradox in recent literature that emphasizes clan control modes in geographically dispersed settings:

> "What remains unclear is how identification can be strengthened in a virtual context, particularly because the traditional means by which member identification is created and sustained (...) may not be available to virtual workers. Thus, virtual organizations may find themselves in a catch-22 situation: on one hand, maintaining the organizational identification of virtual employees is especially critical because it helps organizations meet the challenges of managing dispersed employees (i.e., obstacles to coordination and control). On the other hand, virtual employees are the least likely to be exposed to organizational factors that have traditionally strengthened member identification" (Wiesenfeld, Raghuram, & Garud, 1998).

When distance makes the use of behavioral supervision and clan control modes less likely, alternative mechanisms need to be found. First, telecommuting increases professionals' autonomy and self-responsibility for work planning and accomplishment. Second, a more traditional response, as Kurland and Egan mentioned (1999), is to focus on outputs. This makes sense when identifiable outputs result from the subordinate's work, and these reflect their efforts. As a realistic U.S. government agency manager remarked on his mobile agents: "So what if he beats me for a few hours - I know by the quality of his final report whether he's doing the job" (Perin, 1991: 254). Third, referring to Olson's (1982) research, Perin (1991) describes how duties and work procedures of telecommuters working 3 days a week from home were formalized beforehand. Their accomplishments became subject to a formal reporting system, making them feel more supervised remotely than when they worked in the office. Formalization and output control thus substitute for monitoring and communications common to collocation. Fourth, the group of telecommuters just mentioned were selected for their competence (Olson, 1982). Since distance increases job autonomy and the need for self-reliance, selection becomes an input control mode to ensure remote workers' capability to handle task demands (Kurland & Egan, 1999).

§ 6.3.4 Dimitrova and Salaff (1998)

Dimitrova and Salaff (1998) conducted a study on teleworking at a large telecommunications firm in Canada. They compared communication patterns and media use of two teleworking groups: provisioners and consultants. Provisioners perform predictable, independent administrative tasks related to the installation of telecommunications hardware. Consultants are embedded in a network of contacts and relationships to advice clients on managing their call centers. Since their job depends on the customer, they often meet face-to-face to sell and negotiate a deal. They also communicate extensively with peers to exchange ideas and experiences. When remotely, consultants prefer a rich and synchronous medium like the phone to keep updated with customers and peers. They alternate phone with other media like voice mail and email to ascertain ongoing connectivity.

Provisioners on the other hand operate more autonomously and inside the company's boundaries. They do not interact considerably with peers or their supervisor, since the work is mainly captured in documented workflows. Email and electronic file exchange suffice for teleworking: "To make a list of the software to go with the new equipment, provisioners exchange spreadsheets over e-mail with the company's software group: "I give them the job number and what I am putting in, and electronically send it across to them"" (Dimitrova & Salaff, 1998: 265). Distant collaboration is feasible when tasks are to a large extent represented in documentation and are autonomously accomplished (Olson, 1982). Technologies like electronic document exchange, shared databases and workflow systems embed and channel task performance (Majchrzak et al., 2000a; Maznevski & Chudoba, 2000). Documentation is less central to the consultants' job which is more fluid and person-oriented. Since the phone is their 'lifeline', they use documentation and textual communications technologies more as a backup medium. The study thus shows that teleworkers' use of media is a function of work interdependence, and the extent to which task accomplishment is structured and relies on documentation.

§ 6.3.5 Telework and Remote Control: A Synopsis

Remote control is a recurrent theme in the studies on teleworking. While teleworking mostly concerns urban or regional work setups, one could expect that findings from research on teleworking have strong relevance for globally dispersed projects.

This section relates the research to the integrated matrix of control mechanisms earlier introduced (Table 7). It reveals substitution patterns to compensate for the effects of distance. Table 10 shows the matrix with the findings from teleworking literature added in brackets. The columns refer to the object of control processes: input, transformation process (behaviors), and output. The rows show entities taking on the role of controller.

Table 10 - Impact of distance on control modes

Controllers:	Objects of control: Input [intensified use]	Transformation process [← less likely →]	Output [intensified use]
Hierarchical supervision [less effective]	Hierarchical selection of inputs [intensified use]	Supervision of process [less likely, formalize]	Hierarchical checking of outputs [intensified use, frequent]
Co-workers (clan) [difficult to maintain]	Ballotage	Observation of peers [less likely]	Co-workers outputs control
Technology [intensified use]	Technical monitoring of inputs	Technical monitoring of transformation process	Technical monitoring of outputs
Self [intensified use]	Self selection	Monitoring of controller's own behaviors	Controller's assessment of own outputs
Contractual party	Selection of contractual party	Monitoring of counterpart's behaviors	Contractual party assessment of counterpart's output
Third party	Third party input control	Third party observation of process	Third party control of outputs

Starting with the columns, distance reduces especially the opportunity for keeping updated with someone's behaviors (the transformation process column). Compared to collocated situations, face-to-face and observation of a person actually working at his or her disk is not possible remotely (Sia et al., 1998; Staples, 1997). In response, three possible changes occur. First, managers (the first row) may formalize task accomplishment to make it more transparent (Olson, 1982; Perin, 1991). They can easily fit intermediate updates in the overall planning. Similarly, agency theory proposes that when an agent's behaviors are not observable, the principal should complement a behavior-based contract with information systems (Govindarajan & Fisher, 1990; Kirsch, 1996).

A second response to unobservability of behaviors is a shift in the object of control, across the columns. Managers emphasize selection of employees capable and committed to work remotely (Perin, 1991; Sparrow & Daniels, 1999). In the transformation process cell, this form of input control is depicted with the arrow to the left hand. As an alternative, people are assessed based on task outputs (a shift to the right). Traditionally, this consists of pure output controls that emphasize tangible results (Olson, 1982). But one study also noticed a hybrid form of behavior and output control where manager and subordinate maintained frequent, punctuated exchanges (Kurland & Egan, 1999). This recurrent contact does not represent behavioral observation as the subordinate is rather telling about his or her work. Nor is it a form of output control since it permeates the task accomplishment process. Managers formalize this remote mode - which could be referred to as punctuated output control - for teleworkers involved in urgent tasks (Kurland & Egan, 1999).

Third and finally, the control mode may shift across the rows as controller roles are affected by distance. Teleworkers cannot maintain frequent face-to-face contact with managers and peers (Kurland & Egan, 1999). As a consequence, hierarchical and co-worker control modes (first two rows) become less likely (Wiesenfeld et al., 1998). Instead, a shift down the columns seems to occur, where the teleworker becomes more responsibility for his or her own work (self control), and relies on technology to remain updated and exchange work (Dimitrova & Salaff, 1998). As earlier mentioned, self control seems less appropriate for workers whose tasks are interlocked remotely (Manz & Stewart, 1997).

§ 6.4 Distributed Communications

This section describes empirical research on distributed communications and collaboration. It is an extension of the general theories on electronic media use introduced in the preceding section. The studies presented here were selected and analyzed for dealing with the effects of geographical distributedness on processes of communication, coordination and control.

§ 6.4.1 Vaughan (1990, 1997)

The explosion of the NASA Challenger space shuttle on January 28, 1986 led to scrutinous investigations to find possible causes for failure in the so-called O-rings, rubber rings that seal the aft of the space shuttle's solid rocket boosters (Vaughan, 1990, 1997). Vaughan's (1996) historical ethnographic study complements formal inquiries and reporting by the Presidential Commission and the U.S. House Committee on Science and Technology. Over a period of nine years she analyzed documented records, and interviewed people inside and outside the organizations involved in the launch.

For the study of geographically dispersed work, her analysis of one event in the launch decision making process is important. It concerned a teleconference (audio-only) meeting that lasted 2 hours from 8:45 PM EST onwards, and involved 34 people from different organizations at three sites: engineers from Morton Thiokol in Utah (contractor for the rocket propulsion system), NASA managers at Marshall Space Flight Center in Alabama (overall responsibility for launches), and NASA staff at Kennedy Space Center in Florida (operational launch site).

Thiokol engineers were concerned about the cold temperature predicted for the launch and advised against the launch. Low temperature had caused earlier problems with the O-ring system. But they lacked quantitative data - commonly expected to raise a safety issue in Thiokol and NASA - to support their concerns. At the same time, flight cancellation was costly and undesirable for NASA managers because of commitments and additional preparation efforts. NASA managers at Marshall therefore urged Thiokol engineers at the start of the meeting to motivate their concerns. Vaughan's (1997) analysis of subsequent events during the teleconference focuses on the interplay of local and remote exchanges. It is best reflected in her own words:

> "In three locations, people could not see each other, so words and inflections were all important. Midway in the teleconference, the people assembled at Morton Thiokol in Utah held an off-line caucus. In it, a senior Thiokol administrator who knew little about the technology took charge, repeating the challenges of the Marshall managers.
>
> Without any new data to support their arguments, the engineers could not build a stronger data analysis. Four administrators in Utah reversed the original engineering recommendations, going back on-line and announcing that Thiokol had re-examined

> their data, reversed the decision, and recommended launch. When Marshall managers asked, “Does anybody have anything to more to say?” no one spoke up.
>
> Ironically - and fatally - people at Marshall and Kennedy did not know that the Thiokol engineers still objected. Moreover, Thiokol engineers did not know that during the caucus, people at the other two locations believed the launch was going to be canceled. They also were unaware that the top Marshall administrator, participating in Alabama, was making a list of people to call in order to stop the launch” (Vaughan, 1997: 92-93).

The third paragraph of this section illustrates how remote meetings differ from collocated ones. Participants lacked comprehensive insight in opinions, interactions and actions at remote sites. This seems to be caused by, first, limited direct or active involvement from local actors in the teleconference. Second, the teleconference technology only supported audio transmissions, and did not reveal visual cues like facial expressions. A relatively lean technology was used in a situation of asymmetrical knowledge distribution and an equivocal discussion topic (Weick, 1997: 399). Third, local conversations (like the caucus at Thiokol in Utah) remained outside the mainstream teleconference. People at Marshall and Kennedy only heard supposed results from Thiokol administrators. The combined effect was that actors could form only a limited representation of processes and positions at partner sites in a situation of equivocal and risky decision making .

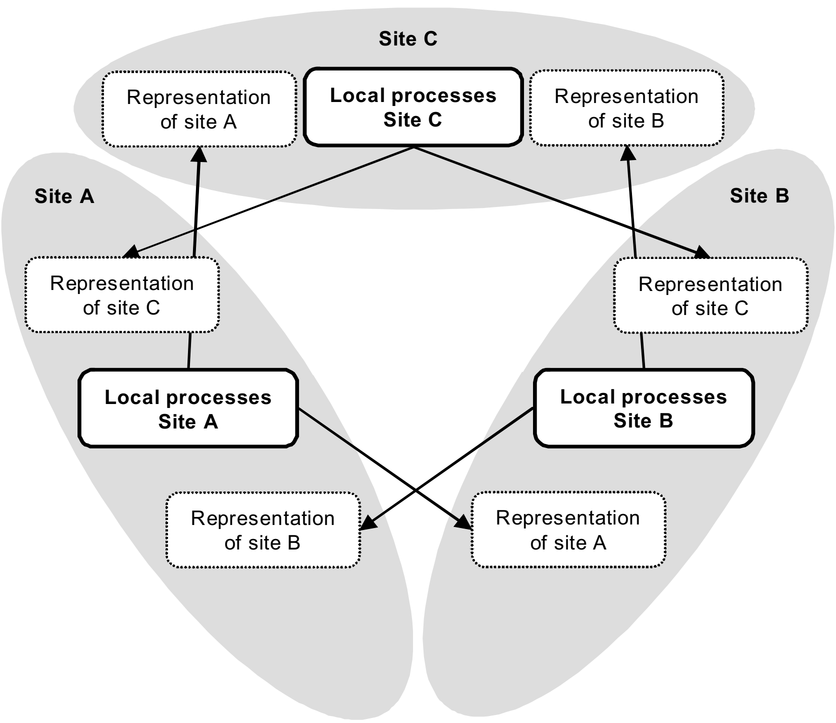


Figure 30 - Distributed communications and awareness

In a similar way, Roberts (1997: 409) indicates in her review of Vaughan's (1996) book that "(…) the geographical arrangement eliminated any possibility for understanding the situation or for bringing together important information developed across the centers." She also refers to another instance the morning after the teleconference when distance seems to impede effective collaboration. Weather-related inspection at Kennedy Space Center yields results of interest to Thiokol engineers. However, physical separation and absence of interactions leave groups from both sites unaware of information dependencies between them. "(…) at 1:30 AM on January 28th, the Ice/Frost Inspection team assessed the ice on the launch pad. They alerted Rockwell, the prime contractor for the orbiter, about the ice conditions. By 9:00 AM a Rockwell representative said Rockwell could not assure that it was safe to fly. Rockwell, at Kennedy Space Center, had no way of knowing about the previous evening's teleconference, when the concern over temperature rested heavily on the minds of Thiokol's engineers in Utah" (Roberts, 1997: 409).
Both examples illustrate that remote collaboration is not only a problem of availability of communication technology, and media richness properties. It also appears difficult to assess when to communicate remotely and with whom. And to define whose responsibility it is to connect people who are involved in the same issue or have knowledge of relevance to their counterpart. This raises coordination questions for distributed projects, in particular when they are not planned in detail in advance. Like: should local actors be expected to connect on their own initiative? Are lateral liaison necessary to foster relevant connections? Or does distributed collaboration need a centralized role of project coordinator on a meta-site level?
Vaughan's (1997) research indicates, in line with Meadows' (1996), that absence of such mechanisms leaves actors unaware of remote contexts. They supplement this with assumptions of counterparts' preferences and expectations, resulting in imprecise connectivity of distributed actions.

§ 6.4.2 Mars Climate Orbiter

Another space-related example concerns the loss of the Mars Climate Orbiter (MCO) spacecraft in September 1999. The spacecraft was controlled by the Mars Climate Orbiter spacecraft team in Denver, Colorado, and the mission navigation team in Pasadena, California.

On September 30, 1999, the Media Relations Office of NASA's Jet Propulsion Laboratory at CALTECH released the following statement:

> "A failure to recognize and correct an error in a transfer of information between the Mars Climate Orbiter spacecraft team in Colorado and the mission navigation team in California led to the loss of the spacecraft last week, preliminary findings by NASA's Jet Propulsion Laboratory internal peer review indicate. "People sometimes make errors," said Dr. Edward Weiler, NASA's Associate Administrator for Space Science. "The problem here was not the error, it was the failure of NASA's systems engineering, and the checks and balances in our processes to detect the error. That's why we lost the spacecraft." The peer review preliminary findings indicate that one team used English units (e.g., inches, feet and pounds) while the other used metric units for a key spacecraft operation. This information was critical to the maneuvers required to place the spacecraft in the proper Mars orbit. (...)".

The communication problem between the distributed sites led to loss of the MCO spacecraft on September 23, 1999 when it entered the Martian atmosphere on a trajectory that was lower than expected. Subsequent research by NASA's Mishap Investigation Board (MIB) led to a report on November 10, 1999 (NASA, 1999). The MIB elaborates on the specific root cause of the loss:

Apart from the root cause, MIB cites the following factors that contributed to the loss:[25]

1. Errors went undetected within ground-based computer models of how small thruster firings on the spacecraft were predicted and then carried out on the spacecraft during its interplanetary trip to Mars
2. The operational navigation team was not fully informed on the details of the way that Mars Climate Orbiter was pointed in space, as compared to the earlier Mars Global Surveyor mission
3. A final, optional engine firing to raise the spacecraft's path relative to Mars before its arrival was considered but not performed for several interdependent reasons
4. The systems engineering function within the project that is supposed to track and double-check all interconnected aspects of the mission was not robust enough, exacerbated by the first-time handover of a Mars-bound spacecraft from a group that constructed it and launched it to a new, multi-mission operations team
5. Some communications channels among project engineering groups were too informal
6. The small mission navigation team was oversubscribed and its work did not receive peer review by independent experts
7. Personnel were not trained sufficiently in areas such as the relationship between the operation of the mission and its detailed navigational characteristics, or the process of filing formal anomaly reports
8. The process to verify and validate certain engineering requirements and technical interfaces between some project groups, and between the project and its prime mission contractor, was inadequate

From our perspective, it is interesting to look at the report as far as it focuses on collaboration processes between the teams in California and Colorado. This leads to the following observations. The teams used different measurement standards for communicating spatial distance and navigation plans. In itself, this complicates remote collaboration. The diversity could work if communications were more formal and interactive (feed back loops). For instance, communications mention explicitly the measurement system used. Interactivity implies that the receiver feeds back his/ her understanding of the communication, including the measurement units.

[25] Source: E-mail to NASA public list for MCO project *mars98-owner@www.jpl.nasa.gov*, on November 10, 1999.

§ 6.4.3 Cramton (1997, 1999, 2001)

Cramton (1997) reports on remote collaboration of 13 international student teams involved in a 6-week assignment that required close cooperation. Teams consisted of 2 students from 3 locations and used only electronic communication tools. Cramton (1997) adopted a grounded theory approach to analyze email messages exchanged by the student teams, and their reflective papers. Her analysis resulted in a number of themes, framed as problems of information dispersion and mutual knowledge (Cramton, 1997, 2001; Cramton & Webber, 1999). These are discussed here as far as relevant to the research.

- **Failure to communicate contextual information** - team members had never cooperated before, and lacked insight in each other's context and constraints. Two behaviors relating to contextual information surfaced. First, during the project, students incompletely informed and updated counterparts on their absence, local organizational rules, or technical constraints. "(…) people did not always perceive the need to describe their situation to remote teammates whose situations might be quite different" (Cramton, 1997: 300). Second, it appeared that when members did send messages to inform on their absence for example, recipients failed to take note of them.
  A consequence of incomplete informing and careless receiving was that interpretation and attribution of remote partner's actions (and absence of actions) mainly relied on assumptions. Since these usually did not correspond with real causes or motivations, conflicts arose or relationships suffered. Counteracting this phenomenon requires according to Cramton (1997) different behaviors from both sides. On the initiating side, team members are responsible for updating someone not familiar with their context. "Relationships fared better when preoccupied teammates immediately explained their situation to their remote partners" (Cramton, 1997: 300). On the receiving end, close attention is required to digest and interpret messages, and ask for confirmation if need be. "Dispersion may require extra effort on the part of teammates to create a mental map of their partners' situation into which they can fit new information as it arrives" (Cramton, 1997: 300).

- **Difficulties in communicating the salience of information** - reliance on textual exchanges made it difficult to convey the nuance of senders' intentions, and the relative importance of a topic. "Writers often assumed that what was salient to them would be salient to their readers. Tone of voice, facial expressions and body language add meaning to communication, but also help signify salience. Electronic communication proved to require skills for directing attention that many team members did not have" (Cramton, 1997: 300). Crafting email messages thus required scrutinous attention to possible ways in which recipients would read and interpret them. Incomplete knowledge of the recipient's context, and absence of feedback on messages made this task possibly even more difficult.
  Similarly, from the recipients' point of view, interpretation of the communication intent behind a 'lean' textual message proved challenging. This required precision in reading messages to detect possible intentions and requests. And feedback by requesting the sender to clarify or confirm the receiver's interpretation. "A member of Team 17 observed, "People always said, 'Hope to hear from you soon.' Who then has

responsibility for initiating communication?" The salience of the request for feedback seems to have been greater for senders than receivers" (Cramton, 1997: 300).

- **Unevenly distributed information** - asymmetrical information distribution was caused by the use of incorrect email addresses, and exchanges deliberately not including all team members. Unlike collocated teams that access to multiple media and instances for interaction, the student groups relied mainly on email for interaction and participation. Hence, the effects of exclusion seem stronger since it leaves only silence, and little opportunity to find out what the group's mainstream activities are. "Private exchanges of e-mail distort perceptions of the volume of activity in the team, and may confuse the team's pacing and sense of timing" (Cramton, 1997: 302).
  As earlier indicated, members can only guess what their partners' activities are, and they may respond inappropriately when their impression is not correct. Limited feedback loops in distributed settings make it difficult to surface and restore these mismatches. "Analysis of the team histories suggests that these kinds of perceptions can be excruciatingly difficult to identify and change when a team is dispersed. Private "conversations" may create much more confusion for dispersed teams than face-to-face teams" (Cramton, 1997: 302).

- **Interpreting the meaning of silence** - on occasions, team members did not respond to messages for technical reasons or other motivations. This left the original sender with the puzzle of interpreting absence of communications. As Cramton (1997: 302) indicates: "(…) silence meant all of the following at one time or another: I agree. I strongly disagree. I am indifferent. I am out of town. I am having technical problems. I don't know how to address this sensitive issue. I am busy with other things. I did not notice your question. I did not realize that you wanted a response."
  Interpreting silence remained a guess, also because partners lacked additional channels to find out or possess historical knowledge on their counterparts. Technical issues or time-zone related misunderstanding were attributed to personal intentions of (non)participation (Cramton, 1997: 302). It took long for attributors to find out real causes, and for the 'victim' to become aware of counterpart's attributions and impressions.

In another piece of research, Cramton and Webber (1999) assessed the impact of geographic dispersion on teams in an international consulting firm where staff frequently participate in distributed teams. The study distinguishes two dimensions of geographic dispersion: frequency of remote collaboration, and actual distance between sites. A survey was conducted to investigate the effect of both on three variables: team processes, relationships and outcomes.
For the relationship between dispersion and team processes, the research suggests that frequency of dispersion (not geographic distance per se) negatively affects communication intensity and coordination effectiveness. In line with literature on physical proximity (Allen, 1984), people communicated less frequently and extensively the more they worked from different locations. The second relationship in the study showed that geographic distance (and not frequency of dispersion) contributed to the fact that people perceived each other as being less trustworthy and dependable (Cramton & Webber, 1999: 20).

Finally, performance effectiveness appeared to suffer from both geographic distance and frequent dispersed collaboration.

§ 6.4.4 Jarvenpaa et al. (1998)

Jarvenpaa et al. (Jarvenpaa et al., 1998; Jarvenpaa & Leidner, 1998; Knoll & Jarvenpaa, 1998) organized and conducted research on geographically distributed collaboration of international students (the same setting as Cramton (1997) referred to). Students - scattered across different continents - relied on email and occasional chatting to accomplish assignments that moved from simple introductory tasks to a challenging team deliverable. Jarvenpaa et al. (Jarvenpaa et al., 1998; Jarvenpaa & Leidner, 1998; Knoll & Jarvenpaa, 1998) studied the students' communication behaviors, and the evolution of trust among team members. Data for the analysis included students' email messages and their responses to questionnaires.

Jarvenpaa and Leidner (1998) surveyed 29 teams over two periods, and assessed for each period the level of trust (high versus low) as compared to the mean level for the overall sample. Teams were assigned to one of the four categories that emerged: LoLo indicating low trust in period 1 and 2, LoHi for low trust in period 1 but high trust in period 2, HiLo, and HiHi. Jarvenpaa and Leidner (1998) present mini-case studies for three teams per categories, using transcripts of students' email messages. These are insightful for understanding geographically distributed collaboration, and briefly discussed as far as relevant for this research. The sequence from LoLo to HiHi teams is illustrative for analyzing determinants of respectively less effective and effective remote collaboration.

- **Team LoLo 1** - typical for this group was the lack of responsiveness of some members. Members did not update others on their local situation or constraints. Long and frequent lapses of communications led an active participant to remark: "I have observed that effective groups are those who communicate constantly and (are) committed to all datelines set" (Jarvenpaa & Leidner, 1998). Often members did not provide direct feedback on prior messages, or even relate their communications to these.

- **Team LoLo 2** - this team also suffered from lack of responses to messages. Proposed schedules were not adhered to. Similar to Cramton's (1997) observation, messages were not precisely read and incorporated in subsequent work.

- **Team LoLo 3** - team members were confused about the overall work process in a distributed setting. On reflection, one participant compared the distributed assignment with collocated projects: "Although some things didn't work well it was a good experience to see IF it is possible to work in such a virtual environment. In my opinion, it's much more complicated to communicate in such a way without face-to-face contact" (Jarvenpaa & Leidner, 1998). This seemed also related to a lack of responsiveness and broad participation. An exclamation of one member is illustrative: "Please can EVERYONE provide DETAILS about the idea they like most. I am scared because I can't see how to proceed" (Jarvenpaa & Leidner, 1998).

- **Team LoHi 1** - on average, this group frequently interacted and produced satisfying results. At the start rules for interaction were proposed and agreed upon, but not always adhered to. Some members of this team did not precisely connect to prior communications or specifications like deadlines. "Another member stated that he did not understand what to do for the second assignment even though two members had already submitted their parts of the second assignment to the group" (Jarvenpaa & Leidner, 1998).

- **Team LoHi 2** - the team experienced initial contacts as challenging given the lean properties of email: "Quickly establishing a mutual understanding is not an easy task," and "Everyone makes an introduction, but the impression you get is like via a letter" (Jarvenpaa & Leidner, 1998). Members were nevertheless strongly involved and provided information on their schedule and availability. They were responsive to each others' proposals, and executed tasks according to commitments made. People were positive on their group effort as one student remark illustrates: "Dear Virtual Team members: now you are almost becoming real to me" (Jarvenpaa & Leidner, 1998). Keeping commitments seemed an important aspect of their successful remote collaboration: "I enjoyed very much working with you. You all did what you promised to do. In a teamwork, it's the most important thing" (Jarvenpaa & Leidner, 1998).

- **Team LoHi 3** - members disappeared because of other commitments, but failed to update counterparts. They responded slowly, which led one participant to compare distributed collaboration with "playing chess with one move made every 24 hours" (Jarvenpaa & Leidner, 1998). Eventually, a prototype website (which they were supposed to build) was ready and functioned as coordination node for improvement efforts.

- **Team HiLo 1** - team members expressed concern to maintain an overview of the project, and embed their efforts in the larger project tasks. Wrote one student: "(…) plz (please - author) plz plz mail me in what way I can contribute (…). I still am a little confused. Just tell me what I need to contribute" (Jarvenpaa & Leidner, 1998). They missed meetings to address equivocality of their group task, as one participants reflected: "How hard is it to carry out an entire project without having those boring professional meetings" (Jarvenpaa & Leidner, 1998). Like other teams, students agreed on the need for rules and planning to structure the interaction process, but failed to implement and/ or comply to these.

- **Team HiLo 2** - response lapses were typical also for this team. Feedback on interactions were unpredictable (sometimes because of technical problems), and delays were hardly explained. Jarvenpaa and Leidner (1998) offer an example on one of the students: "He offered an idea for the project. He received no immediate response and sent a second message asking if his message was received." Days later responses dripped in that referred to did not adequately connect to the issue.
  In an effort to encourage broader participation, an active participant sent a complaining note to the (central) project administrator. The message was then copied to professors of other project members, and led - supposedly - to local exchanges between professors and 'controllees'. Organizational structure (local professors and a

central project administrator) was thus used to control the participation of counterparts.

- **Team HiLo 3** - this team started actively on the group task, and proposed rules and procedures for the collaboration process. Enforcing these appeared often unfeasible. Without the desired effect, some members attempted to enhance participation by sending emails like: (capitals in original) “The situation is not very encouraging. UNLESS ALL TEAM MEMBERS START CONTRIBUTING SERIOUSLY NOW, WE WILL NOT GET A SATISFYING RESULT” (Jarvenpaa & Leidner, 1998). ‘Inactive’ members excused their behaviors with reference to technical difficulties and lack of task understanding.

- **Team HiHi 1** - members were committed to participate in the distributed group. They exchanged numerous messages that also included descriptions of their personal context and experiences. The team did not define rules and procedures for interactions, perhaps because earlier social interactions made these superfluous. (By contrast, other groups that engaged in less socializing upfront and remained task centered afterwards, often proposed - possibly as compensation - rules and procedures for their exchanges). The team here did agree on a schedule that broke the work process down in milestones and deadlines. One member took the responsibility for collecting ideas and summarizing them. When members worked on tasks that were closely dependent, they coordinated their efforts on a detailed level: “Emma and Anders coordinated their working times as did Riikka and Linda because of overlap in their work” (Jarvenpaa & Leidner, 1998).

- **Team HiHi 2** - at an early stage, a member explained her confusion with distributed communications. She described the need for confirming message exchanges: “one of the frustrations I have with this virtual team process is that there seems to be no way of knowing what has been sent or received” (Jarvenpaa & Leidner, 1998). Consequently, the team formalized communications: “The team developed a system of numbering messages and agreed to confirm receipt of messages by referring to the number” (Jarvenpaa & Leidner, 1998). A recurring issue in the teams is lack of topic understanding, and insight in the work process. “Machtelt expressed confusion over the topic, saying that she was “not quite sure what to do, and what to write” and asked them to describe to her “in short clear terms”” (Jarvenpaa & Leidner, 1998).

- **Team HiHi 3** - this group did not socialize at the start of the project but developed elaborate rules and procedures for communicating. It thus illustrates the phenomenon described for team HiHI 1. Jarvenpaa and Leidner (1998) describe the team’s focus on interaction norms: “The team agreed upon procedures at the start of the second week - they would read all messages before responding to any, use meaningful subject headings, code their messages for easy reference, and divide into roles,” and, “The members discussed the proper way to exchange versions of the paper well before anything had been written.”

Knoll and Jarvenpaa (1998) report on the same type of student assignment, providing some additional insights in distributed collaboration.

First, they explain that criteria for selecting students were "fluency in English, access to the internet, and the possession of an individual electronic mail account for receiving mail from his or her teammates" (Knoll & Jarvenpaa, 1998: 5). The first criterion refers to a basic type of common knowledge (Grant, 1996b). It constitutes an upfront attempt to reduce diversity and thus equivocality for the actual collaboration process (Daft & Lengel, 1986; Lawrence & Lorsch, 1967b).
Second, participating students reported that collective work progressed slowly in a distributed context (see also earlier team LoHi 3). "Team members were astonished at the turnaround times required for decisions and production" (Knoll & Jarvenpaa, 1998: 6). Tasks requiring interactive arguing suffered in particular from reliance on asynchronous emails.
Third, students experienced a tension between the need for feedback communications and time zone differences. Real-time chatting appeared unfeasible because of time zone differences or technical delays. As an alternative, students used asynchronous communications (email) across multiple time zones. This implied that participants could process only one communication cycle (receiving messages, sending comments) per working day. Leveraging time differences in a 'follow-the-sun" mode appeared unfeasible. "Almost all students in both studies decried the 24-hour lag that resulted from sending one message per shift. The teams were burdened, rather than liberated, by the time zones" (Knoll & Jarvenpaa, 1998: 9).
Time differences enforced precise planning and deliberate anticipation of working hours at counterparts' sites, especially for organizing occasional real-time exchanges. Knoll and Jarvenpaa (1998: 10) quote students illustrate: "I learned to specify not just the earliest start and latest finish dates, but a specific period of time during the day taking into account each country time difference (…)," and, "the team realized rather slowly that the discussion proceeds rather slowly via the e-mail, it takes a week before everyone has commented on an idea presented by one member of the team." Different time zones necessitate group members to actively update others on their mail-checking behaviors and availability for real-time communications. As one student commented: "I think it will be handy to let each other know how often you check your mailbox and if you know an exact time we could even have a live meeting sometime" (Knoll & Jarvenpaa, 1998: 10).
Finally, Knoll and Jarvenpaa (1998) distill a set of functional and dysfunctional behaviors in distributed teams. It should be noted that this applies to situations where people collaborate remotely for the first time, using mainly email to accomplish increasingly challenging tasks. Behaviors that appeared functional and relevant for this research can be summarized as follows:

- **Documentation** - Knoll and Jarvenpaa (1998) point out that in face-to-face contexts, people communicate more frequently and have ample opportunity to access information. Distributed collaboration reduces this fluid mode of connecting. Instead, stronger emphasis should be placed on documentation in several ways. First, inputs from people at various locations should be collected, integrated and distributed. In this process, prior communications are included for reference, like the mosaic message chain Markus (1994) describes. Second, documentation itself thus becomes a central means to elicit comments for extension and improvement. It becomes a coordinating 'boundary' object to connect distributed participants (Henderson, 1991; Karsten et al., 1999). Third, as a group moves on, archived documentation becomes their memory for posterior reference.

- **Organizational structure** - effective team members contacted the central project coordinator in case counterparts did not respond to messages. They thus relied on the (remote) organizational structure in addition to their direct partners.

- **Remote communications behaviors** - Knoll and Jarvenpaa (1998) list effective and ineffective behaviors in distributed groups. Ineffective behaviors include ignoring others' messages, leaving rules implicit, and making assumptions instead of checking one's understanding of communications. Effective attitudes for remote communications concern both the sender and receiver involved. For senders effectiveness means careful crafting of messages with sufficient explanations, and possibly providing additional clarifications. Receivers should read messages precisely, confirm reception, and respond rapidly. They should provide feedback by rephrasing their understanding, and ask for clarification if need be. Following up on requests or commitments is considered important, as is fostering broad participation of other people connected to the topic. Functional behaviors also included alternation of lean and rich media, here email with chats. The latter medium is considered richer since it allows for real-time interactivity (Lombard & Ditton, 1997). In all, Knoll and Jarvenpaa's (1998) recommendations for remote behaviors closely correspond to those suggested in literature on collective mind (Weick & Roberts, 1993), and High Reliability Organizations (Eisenhardt, 1993; Roberts & Moore, 1993).

§ 6.4.5 Hinds and Bailey (2000)

Hinds and Bailey (2000) develop propositions for investigation the impact of geographic dispersion and time zone differences on the occurrence of conflict in groups. The study proposes that distance and time zone differences have two consequences: the use of electronic media, and so-called "unshared context". In turn, these explain the emergence of conflict in group with distributed participants.
Hinds and Bailey (2000) suggest that electronic media reduce the salience of communications, and lead to task-centered interactions. Difficulty in conveying rich and unstructured communications imply that groups are constrained in executing tasks that require intense coordination efforts (Hinds & Bailey, 2000). In addition, empirical work shows that people who collaborate remotely do not share information evenly across sites (Cramton, 2001). This is because people do not realize that their remote counterparts do not have access to the same information. And communication by electronic media requires more effort than local exchanges (Kraut & Galegher, 1990).

The abovementioned factors contribute to the "stickiness" of information: it is hardly shared beyond its original location (von Hippel, 1994, 1998). This applies in particular to non-structured information and tacit knowledge. Local work with remote dependencies may remain unconnected with incomplete communications (Vaughan, 1990, 1997). Research found that "(C)onflicts among (distant) sites went unidentified and unaddressed longer than conflicts among members of collocated groups (…)" (Armstrong & Cole,

1995: 194). Apparently, people using electronic media find it difficult to bridge unshared contexts (Hinds & Bailey, 2000).
Temporal differences further exacerbate these behaviors and consequences: people cannot connect remotely at any time during their working day (Barley, 1998; Hinds & Bailey, 2000). Finally, task dependence across sites makes the effects of unshared contexts more visible, and therefore conflicts more likely (Hinds & Bailey, 2000; Walton & Dutton, 1969).

§ 6.4.6 Abel (1990)

Abel (1990) describes an experimental research project at the Xerox Palo Alto Research Center (PARC) between 1985 and 1988. The computer research organization was split into two groups, and assigned to sites in Palo Alto, CA and Portland, OR. This geographical setup is shown in Figure 31, with the US West Coast depicted on the right. The purpose of this project was to test remote collaboration relying on electronic media. In addition to email and internet groupware functionality, a permanent two-way audio/video link (video wall) was set up between two rooms at both locations. At any time, researchers could walk in the room at their site to see if anyone else was available in the remote room. This facility was extended with a video network of multiple cameras at each site, remotely controllable from any workstation. This simulated a collocated work environment in many ways: people could look at rooms and check for availability of people.
Abel (1990) reports on several themes of distributed collaboration and communications that emerged from the experiment. We analyze these using Figure 31. The figure depicts three categories of groups for each site, and categorizes remote connections with the letters A to D. In addition, the links are numbered 1 or 2 if two similar connections could be made. For instance, B1 connects local researchers in Portland with colleagues from the same site who are visiting Palo Alto. B2 refers to the opposite case where Palo Alto researchers communicate with their local colleagues who visit Portland at that time.

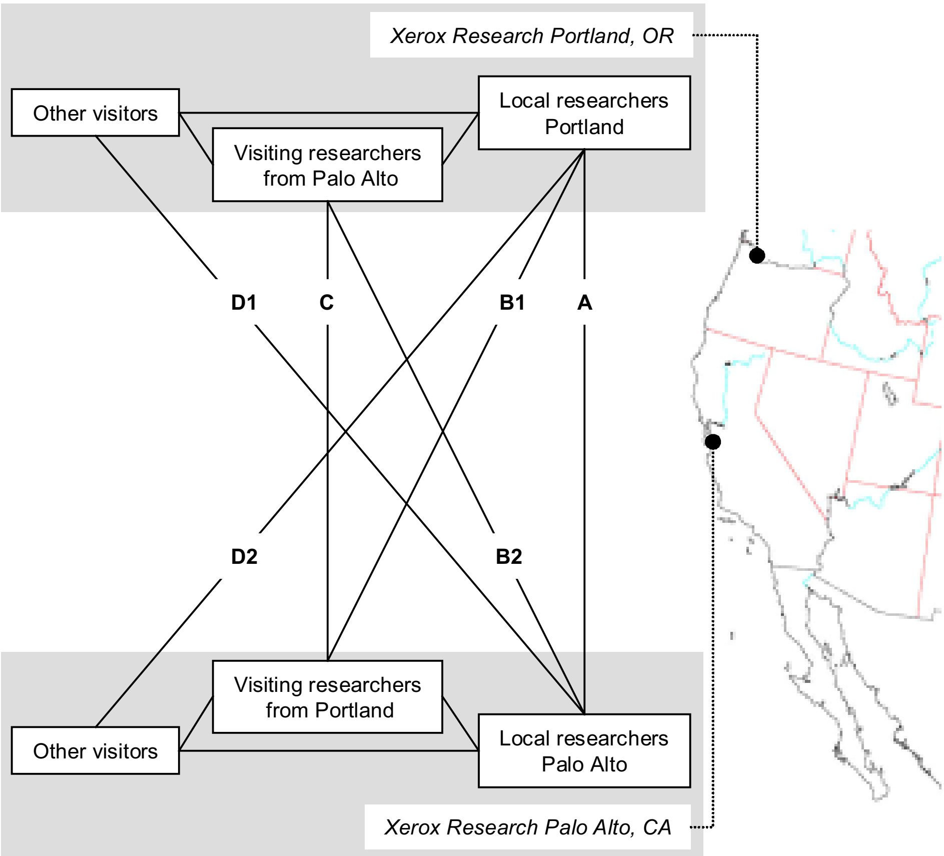


Figure 31 - Distributed communications at Xerox Research

A first finding is that during the experiment, people remained quite well involved in, and aware of events at the counterpart site. When a Palo Alto researcher traveled to Portland to join a research meeting, he could participate almost instantaneously in local communications:

> "He (the Palo Alto researcher - author) had not visited Portland in person for over six months. He happened to arrive during this technical discussion. Almost without missing a beat and without almost any "introduction protocol," the Palo Alto based lab member joined this brainstorming session. As the discussion wound down after about fifteen minutes, the Portland folks realized that the Palo Alto based lab member had arrived in person, and welcomed him" (Abel, 1990: 497).

In the preceding period of distant interaction, people had shared knowledge about the project (connection A in Figure 31). This enabled a smooth transition between remote and collocated collaboration (Abel, 1990).
Second, the video link enabled to some extent managers to keep track of subordinates remotely. It restored the loss of manager-subordinate contact Meadows (1996) described in

an offshore outsourcing situation. At the same time, it should be realized that the Xerox experiment was within the same company and region (US west coast), and it did not involve cultural differences.

A third theme is that participants in video conversations developed special rules for interacting or giving demonstrations. Careful planning and preparation were required beforehand, since adaptation during the meeting appeared more difficult. While presenting, people had to pay special attention to shaping their remote communications and presence:

> "We have become sensitized to the different social protocols of the link. For example, we have adapted to the technology in giving cross-site demos in the following ways:
> 1. Wearing bright colors to give more cross-site presence,
> 2. Preparing ahead of time because glitches are much more difficult to deal with over the link (the communication mechanism and demo are using the same channel),
> 3. Trying not to move too much so that the video compression doesn't dominate the conversation,
> 4. Doing things "on cue,"
> 5. Speaking loudly, and choosing carefully when to speak, etc" (Abel, 1990: 499-500).

Fourth, the video wall appeared more supportive for researchers with established working relationships than newcomers or visitors. This corresponds with media expansion theory, which states that more 'experience with communication co participants' implies that people perceive a medium as being richer (Carlson & Zmud, 1999). Compared to face-to-face contact, video appeared not capable to establish strong initial contacts (connection D2, Figure 31):

> "(A visitor) met (two of the Portland researchers) over the video from Palo Alto. The next day she was in Portland physically. Someone said "Well at least you met (the Portland researchers) via the video before you came up." The visitor emphatically said, "I hadn't really met until I met them in person in Portland!"" (Abel, 1990: 501).

When people had only 'met' remote colleagues through videoconferencing, they perceived a discrepancy when meeting these persons face-to-face during a visit. The richness of face-to-face communications compared with videoconferencing is well illustrated with the following quote from a Portland-based consultant. He had communicated with Palo Alto staff remotely (connection A, Figure 31), and visited that site for the first time:

> "(...) The (Palo Alto lab members) that I had met only on (video) seemed different in person. My pre-trip perception of their faces and individual traits did not match reality that well. I had problems matching faces to names.

At the same time, this consultant's inclusion in the Portland context facilitated and in a sense enriched his videoconference experience with Portland colleagues while visiting the Palo Alto site (connection B1, Figure 31):

> "On the other hand, I found talking to (the Portland) people via (video while in Palo Alto) to be easy and natural" (Abel, 1990: 505).

Fifth, interactive discussions on new or challenging topics still required collocated presence. The video facility did not allow for multiple rapid exchanges to gain insights in participants' point of view:

> "(...) Somehow when we were all in the same room together it seemed easier to get this back and forth (discussion) to happen than over the video" (Abel, 1990: 502).

Finally, despite its limitations and special requirements, the video wall did simulate collocation. While most media require dedicated effort to contact someone (sending an email, placing a call), the permanent video link enabled also random informal contacts. Researchers with established working relationships could leverage the medium to sustain these. They perceived the remote location as close by, as became apparent when the link was down at one point of time:

> "I ... have missed the link, and have already started to think of Portland as one might expect a remote lab to be thought of - a group of people who are intellectually known to exist, but that's it. At least with the (video), I felt like we had a common back fence over which to chat" (Abel, 1990: 506).

§ 6.4.7 Kraut & Galegher (1990)

Kraut and Galegher (1990) studied the relationship between physical proximity and the development of collaborative relationships among scientists in a large industrial R&D laboratory. Specifically, they investigated collaboration projects between pairs of scientists located in the same corridor, same floor, different floors or different buildings. The likelihood of joint work increased clearly with the measures of proximity just mentioned. Kraut and Galegher (1990) propose several explanatory factors that are summarized here.

First, distance reduces the frequency of communications as proven by a standing tradition of research (Allen, 1984). Despite the availability of electronic communications media, people interact more frequently the closer their offices are.

Second, proximity increases the quality of communications. Kraut and Galegher (1990) define high quality communications as two-way interactions, involving more than one sensory channel (Kraut & Galegher, 1990: 161). Initial discussions among scientists when they have only a vague notion of possible collaboration thrive on informal, face-to-face exchanges. They use these gathering to surface common interests and share knowledge. Electronic means are not likely to sustain this phase that is characterized by rapid interactions and spontaneous exchanges of documents and notes (Kraut & Galegher, 1990: 162).

Third, distance increases the costs of communications. Apart from monetary expenses for phone calls or travel, they include "the burden of having only intentional, structured interactions via a restricted modality within an already existing relationship" (Kraut & Galegher, 1990: 162). Proximity to other scientists promotes impromptu contacts with little effort. At a later stage of collaboration, scientists must exchange on numerous small topics relating to their joint project. They were often used to fluid communications with collocated partners to handle these reciprocal dependencies. Distance tended to slow down this traffic. Kraut and Galegher (1990: 163) quote one researcher's experience:

"This was the first project that I had done long distance and it certainly made it more time consuming. I was used to being able to walk down the hallway from my office to (my collaborator's) office to talk to him about a problem (…).
(In the long distance collaboration) we either relied on the mail going back and forth or even phone conversations and that just wasn't as satisfactory as talking face-to-face. (…) It took a long time, and I wasn't used to having that much of a lag for the turn-around. (…) I was used to being able to make it much faster."

The quote illustrates the fact that face-to-face contact is richer than electronic media like phone or mail. It also emphasizes the occurrence of delays in distributed collaboration. This phenomenon also surfaced in other research on remote collaboration (Jarvenpaa & Leidner, 1998; Meadows, 1996b), and seems related to individual responsiveness to mediated communications (Jarvenpaa & Leidner, 1998). Kraut and Galegher (1990) use their findings to propose two requirements for remote communications technology: low personal costs and high quality. Low costs refer to the behavioral effort for a person to use electronic connectivity tools, rather than financial costs to an organization. High quality means that real-time multi-sensory communications are feasible.

§ 6.4.8 Nemiro (2000)[26]

Nemiro (2000) conducted a study on creativity in various distributed groups. She investigated factors that contribute to a creative workplace, even though members are spread across multiple locations. Nemiro (2000) found that the creating a connection between team members is key to shaping a creative work environment. She distinguished two types of connections. First, task connection, referring to clarity of goals and commitment of actors. And second, interpersonal connection consisting of "information sharing, trust, and personal bond" (Nemiro, 2000: 102).
While the focus of her studies is slightly different, the connection concept overlaps with our research. We selected therefore 5 quotes from her research and re-analyzed them.

"(…) It should have been a fun project. It was not fun because there were a lot of assumptions made, which I think sometimes a problem with [a] virtual environment is that assumptions are made by one party sitting in their office, closed door, typing away, and they said, oh yes, this must be what this meant, so they fire off an e-mail. We interpret it in a completely different way. We don't have the luxury of a dialogue back and forth. Instead we have the aggravation of e-mails back and forth, one shot e-mails. So there was a tremendous amount of unclarity, and there was a lot of assumptions made about which party would do what, and who would pay for what, and what the end result would be, and basically people's role's roles would be (…)" (Nemiro, 2000: 112-113).

What this quote suggests is that remoteness leads to a shift from interactive - probably face-to-face - communications to emails. This implies a simultaneous shift from synchronous to asynchronous communications, and from rich (audio, sight) to lean (text)

[26] This resource provides extensive insight in the topic of our study, especially the quotes from research interviews. As a source of secondary empirical data, it is re-analyzed here from our perspective, not merely summarized.

interactions. The interviewee seems to point at a mismatch between the needs of a collaborative work environment, and communication modes people have at their disposal. Lean, asynchronous communications delay the work since two-way dialogue is stretched out in chains of emails. More importantly, email does not enable people to develop an understanding of their counterparts and the collaborative task. People lack knowledge of their counterpart and therefore the larger collaborative task. They miss the 'big picture' that seems easier to emerge in a dialogue format. Instead, they start working from assumptions that often do not match counterparts' point of view.[27]

In a second quote from an international car manufacturer's team, one member from outside the US commented:

> "The fact that we are actually talking to the U.S., and we know names and everything, it really has made a big impact and a big improvement ... Since we went over there [to the United States] last October, and that was the first time anyone had gone there from our area, I spent 3 weeks with them. When I came back, we've had an excellent relationship since then ... because up until then it was just a name" (Nemiro, 2000: 115).

This experience shows that people appreciate face-to-face communications. Temporary immersion in the counterpart's context (here the US) enables people to build interpersonal rapport and effective working relationships. These visits enable subsequent remote collaboration that relies on electronic media. The issue here confirms professional literature suggesting that team members should meet face-to-face at the start of a project (O'Hara & Johansen, 1994).

A third quote focuses on the transition from a collocated collaborative work environment to one that is geographically distributed:

> "I think because virtual teaming is a comparatively new organizational approach that it definitely adds challenge, and adds stress. I think a lot of companies, mine included, are rushing rather head long into an embrace of the virtual concept. And I must say, even though I am a proponent of an aspect of virtuality, this community business, I do have some reservations about whether people will be able to accommodate to the new framework of the virtual workplace as rapidly as management expects it to" (Nemiro, 2000: 117).

The interviewee seems to point at the fact that distributed collaboration differs substantially from collocated collaboration. This requires an adaptation process from people working in distributed teams, as well as their managers.

Finally, an interviewee stresses that remote, virtual counterparts should be treated just as 'real' as someone in the same physical setting. This demands considerable effort since people lack the luxury of frequent face-to-face communications.

> "I don't think that people should get it in their head that because I'm working at a distance with somebody that the human side and the human issues go away. They don't. All of the personality or what people call personality issues, all of the communication issues, all of the need to respect and be conscious of the other

[27] For related views see our earlier discussion of (Vaughan, 1997; Weick & Roberts, 1993) and (Jarvenpaa & Leidner, 1998). See also (Meadows, 1996b) and Figure 36.

person's feelings and where they're coming from, all of that is still there. Whether you're in the same office building and conference room together, or whether you're on the other end of a telephone or a computer terminal, the person doesn't go away in a virtual team. What we have to do is to work very hard to keep this a very personal relationship. You have to respect the fact that it's another human being who has feelings and emotions, and ups and downs, and assumptions and lenses. That doesn't go away when you [are] working [at] a distance. And you have to find ways to manage al of that if your team is going to be successful" (Nemiro, 2000: 118).

§ 6.5 Groupware

Groupware - also referred to as collaborative technology (Majchrzak et al., 2000a) and Computer-Supported Cooperative Work (CSCW) (Kling, 1997) - is one of the technologies that has become widespread to support (remote) collaboration. It combines telecommunications with integrated functionality for message exchange, documentation, and time and workflow management. This section discusses empirical research on the use of groupware for coordinating and controlling geographically distributed work.

§ 6.5.1 Majchrzak, Rice, et al. (2000)[28]

Majchrzak, Rice et al. (2000) conducted a comprehensive study on a geographically distributed team of engineers in the United States, responsible for designing an advanced rocket injector. The members worked only part-time for this project and came from 3 different organizations, referred to as RocketCo with 3 sites each 1 mile apart, StressCo located 100 miles from RocketCo, and 6SigmaCo, 1000 miles from RocketCo (not real names). They had not collaborated on prior occasions, and only 2 of the 8 members were actually experienced in rocket injectors. The project was considered challenging and required participants to contribute in a tightly interdependent mode. The team used a collaborative technology (CT) called Internet Notebook. Project participants could login to this browser-enabled groupware environment that was centrally maintained by the vendor. The system supports CAD/CAM drawings, document management and communications.
The research focuses on knowledge sharing and reuse among distributed team members. Two authors were participant observers throughout the project. Ethnographic data collection was complemented with weekly questionnaires and feedback sessions.
The project started with a collocated kick-off meeting with 5 members of the team. Rules, norms and plans were agreed upon to govern subsequent remote exchanges. The intention was to "use the CT for all communication and knowledge-sharing needs" (Majchrzak et al., 2000a: 11).[29] For meetings, the engineers planned to login to the CT all at the same

[28] This research on a virtual design team has led to a number of papers (Majchrzak et al., 2000a; Majchrzak, Rice, King, Malhotra, & Ba, 2000b; Malhotra et al., 2001; Rice, Majchrzak, King, Ba, & Malhotra, 2000). We analyzed (Majchrzak et al., 2000a) extensively because of its qualitative research approach and content focus that is relevant to our research.
[29] Page numbers refer to the 1998 working paper version of the paper.

time, and use teleconferencing tools for audio. The groupware system was thus supposed to take on a central role, as depicted in Figure 32 with the bold lines connecting people from 3 sites.

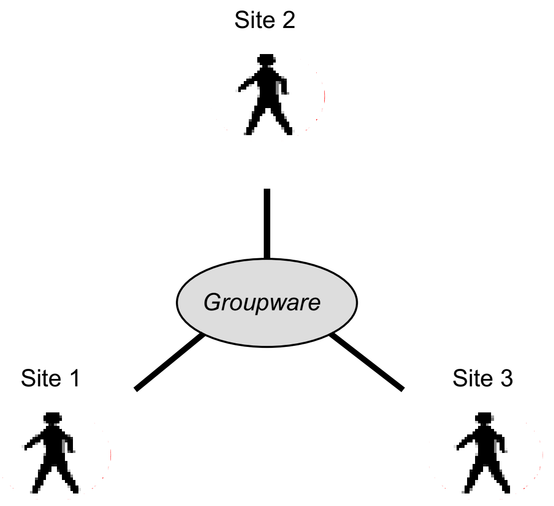


Figure 32 - Initial, intended use of groupware

Majchrzak, Rice et al. (2000) describe the team's experiences of dispersed collaboration during subsequent project phases.
First, the CT functioned as a shared platform for storing, sharing and commenting individuals' contributions. It became a 'focal artifact' (Majchrzak et al., 2000a) that represented the unfolding design, much like boundary objects quoted in other research (Engeström et al., 1995; Henderson, 1991; Karsten et al., 1999).
Second, the team deviated in some ways from the initially agreed upon protocol, which envisioned among others a central role for the system. For instance, some RocketCo members discussed project related matters during informal meetings (like during lunch in the cafeteria). They did not enter results in the CT, implying that remote members were not updated. This is similar to the meeting Vaughan (1997) describes, where remote participants remained unaware of a local caucus at Thiokol. It appears difficult to achieve full inclusion of group members in a remote context. In another paper on presumably the same research, the authors point at the importance of 'Guarding Against Alienation'. A team member of the design team is quoted as follows: "It is very important to me to not feel left out. If I'm not there [meaning not physically collocated at Rocketdyne (presumably RocketCo - author)], I want to know I'm not missing anything" (Malhotra, Majchrzak, Carman, & Lott, 2000: 21).
Third, distributed synchronous brainstorming sessions appeared difficult. Engineers were used to rapidly drawing design proposals with paper and pencil. In the distributed setting, they were not able to use the system in the same way. Instead, they decided to enter their proposal asynchronously in the system, and discuss them later on. During a particularly strained phase of the project, the team decided to arrange a collocated meeting to iron out

diverse interpretations of members. Like Abel (1990) noticed, people seem to prefer face-to-face meetings for highly interactive discussion sessions.

Fourth, the system provided extensive functionality for connecting keywords to entries, and generating automatic messages related to team member interest profiles. However, the fluidity of the design process (with bi-weekly changes) made information quickly outdated and irrelevant. Entering keywords was therefore too 'costly' in Galegher and Kraut's (1990) terms. As a consequence, it became increasingly difficult to trace past contributions, one of the potential contributions of the CT in a distributed environment.

Making ideas explicit in the CT environment became also costly for other reasons. People were concerned that their entries could be used in formal investigations in case any errors were made. They preferred to submit contributions only when these were 'absolutely correct' (Majchrzak et al., 2000a).

In fact, a different role for the CT emerged than originally envisioned. It was unable to become the central platform for facilitating group interactions since the design process had too dynamic and transient aspects (Majchrzak et al., 2000a). More likely, teleconferences and face-to-face meetings were held to handle equivocal tasks, brainstorm, clarify a topic, or deal with conflicts. These were probably situations of reciprocal or team interdependence with simultaneous interlocked exchanges (Van de Ven et al., 1976). The CT complemented this versatile process by providing collective design and project management functionality. It visualized, documented and linked contributions, and processed information on the accomplishment of project tasks. The combined use of meetings and the CT confirms findings from other researchers (Jarvenpaa & Leidner, 1998; Markus, 1994) that people use multiple technologies to connect remotely. Figure 33 illustrates this emerging way of using the groupware. Compared to Figure 32, the bold lines reflect inter-personal contact - by means of teleconferences or visits - between sites as a main form of coordination. Groupware (here depicted with dotted lines) still has an important role, but rather to support and document the interaction process.

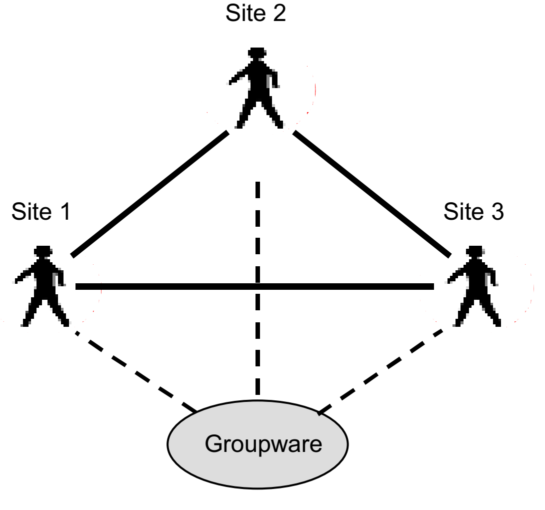


Figure 33 - Emerging use of groupware

§ 6.5.2 Goodman and Darr (1998)

Goodman and Darr (1998) investigated the use of an Electronic Library System (ELS) by a division of a Fortune-100 company in the U.S. The company has about 60 sites for selling and servicing equipment for business offices. The ELS was initiated to capture best practices, evaluate these and make them available in a structured format to corporate sites through the existing network. Two themes emerged from Goodman and Darr's (1998) study that are relevant to the research.

First, the system made contributions explicit, visible and retrievable throughout the network of distributed locations. "It created a memory independent of any individual, and it allowed for searching for solutions and for updating of the memory" (Goodman & Darr, 1998: 436). Preserving organizational know-how in technology is not a new notion (Walsh & Ungson, 1991). As Jelinek (1979) noted: "Administrative systems are the mechanisms for impounding and preserving knowledge" (Jelinek, 1979: 62). Similar to Majchrzak, Rice et al. (2000), information technology and telecommunications have expanded this role. They enable people to document insights in digital format, and group these in a centrally structured, searchable database environment. Storage technology and functionality facilitate updating and expanding these resources. They extend a passive retrieval type of environment with proactive prompting mechanisms to notify people of new entries that match their interest profile. Remote access to the database broadens the community contributing to, and benefiting from the information and underlying knowledge base.

A second theme refers to the actual use of the system. Majchrzak, Rice et al. (2000) noted that groupware cannot exclusively facilitate distributed collaboration, especially with unstructured and interlocked activities. Likewise, Goodman and Darr (1998) found that the system was mainly employed for straightforward problems. Entering or searching for information on more complex issues was not likely, partially because of technical limitations. One of the reasons was also the heterogeneity of local business contexts. "There are so many variations between office to office … it's hard to share" (Goodman & Darr, 1998: 16). As Lawrence and Lorsch (1967) suggested, differences in work-related orientation increases information processing and integration efforts. While they referred to cross-functional diversity, the same could apply to regional differences of machine operations and experiences. As a consequence, knowledge sharing beyond a homogeneous region is not effective and likely. But within those regions, Goodman and Darr (1998) found that people in the same job sustained inter-personal contacts to exchange know-how, rather than using the system. "Machines react differently in different regions. I always turn to my own work group for ideas … we are in the same region" (Goodman & Darr, 1998: 16). These communities leveraged their common language and memory to resolve complex problems.

In sum, groupware supports coordination of distributed worked by documenting and providing access to information on structured tasks. Groups of people working in similar roles and business areas benefit in particular from this support. In this case, existing communities of people working in the same geographical region substituted for that role.

§ 6.5.3 Ciborra and Patriotta (1998)

Ciborra and Patriotta (1998) investigated the use of Lotus Notes for new product development projects at a division of Unilever. The system is accessible for multiple product development centers world wide. It formalizes the development process with a funnel model that contains punctuated milestones for project deliverables and decision making. Actual new product development projects were supposed to follow this template and provide detailed information in the Lotus Notes environment. On some occasions, product development staff experienced the system as constraining. They were used to more informal processes and procedures for developing a product and getting it approved, also remotely. Instead, the system was supposed to embed and handle the majority of project exchanges as a central node. It imposed a framework for explicit, frequent reporting of (intermediate) outputs. In all, the system required considerable effort for staff to enter project information into the system in accordance with the generic model. It thus increases the costs of collaboration in terms of efforts (Kraut & Galegher, 1990). Even though groupware offers extensive documentation and communication functionality, it seems not capable to channel effectively equivocal work on a distance, see also (Goodman & Darr, 1998; Majchrzak et al., 2000a).

As the system made contributions explicit and viewable across sites, it allowed managers to observe entries in the system and work progress. This discouraged staff to enter preliminary ideas and discuss proposals, similar to the concerns that arose in the study by Majchrzak, Rice et al. (2000). Consequently, system access was split into two layers. One for staff with full access to work-in-progress, and a restricted layer for management to monitor formal deliverables.

§ 6.6 Distributed Organizing in Global Software Projects

We conclude this chapter with an analysis of two studies on global software projects (Meadows, 1996b; Millar, 1999). These resources provide extensive insight in the topic of our study, especially the quotes from research interviews. As a source of secondary empirical data, we re-analyze the data here from our perspective rather than merely summarizing them.

§ 6.6.1 Meadows (1996b)

One of the most comprehensive studies to date on geographically distributed IS projects was completed by CJ Meadows in 1996 as a Harvard Business School dissertation (Meadows, 1996b). Its purpose was to assess two questions: (1) “How should international outsourcing projects be coordinated and controlled (for both successful project outcome and enhanced relationships)?” And (2) “What projects and tasks (within projects) are good candidates for international outsourcing?” (Meadows, 1996b: 47). The research focused on international IT outsourcing projects at Tata Consultancy Services. It encompassed an exploratory, grounded-theory phase in the Philippines that resulted in a preliminary framework and set of propositions. A second, theory-testing phase in India was intended to validate these findings with structured interviews and a research. Structured interviews were conducted with TCS project managers at TCS sites in Bombay, Bangalore, Madras, and New Delhi. The interviews concerned projects involving these sites and clients in the USA, Canada, UK, The Netherlands, Switzerland, Australia, and Japan. Typically, TCS staff in India cooperated with remote client IT staff and users to develop and implement an information system. As indicated, Meadows' (1996) work is currently one of the few studies on global IS Projects, with a focus close to our research. Results from the study are therefore summarized and analyzed comprehensively, including relevant quotes.

§ 6.6.1.1 Remote Work Division: The Role of Prototyping

Meadows' (1996) research focused on offshore outsourced IS projects in which vendor staff develops or maintains a system for a client firm. This implies an agency relationship that has been defined as "(…) the ubiquitous relationship, in which one party (the principal) delegates work to another (the agent), who performs that work" (Eisenhardt, 1989a: 58). Delegation of work means that the agent is informed on the principal's expectations, and delivers work in accordance with these. For IS work, methodologies for structuring this process include the waterfall model and prototyping as earlier introduced.

Using the waterfall model for remote outsourcing means that user requirements are analyzed, specified, and sent to vendor staff for coding. Different people are responsible for capturing user requirements and programming the software. The former task is typically performed by client IT staff, independent consultants, vendor representatives (Meadows, 1996b). The offshore vendor team becomes responsible for the latter task. Literature documents problems associated with this work division. Such as capturing complex and fluid requirements in a comprehensive manner, and transferring requirements understanding to the programming team (von Hippel, 1994). Geographic distance between analysts (on-site) and programmers (offshore) seems to exacerbate this transfer problem (Meadows, 1996b). Says one of the TCS managers on his project (Meadows, 1996b: 112):

> "We weren't the primary requirements-analysis agent, so we didn't learn enough to understand the business completely. That hurt us down the road" (Manager, Finance Co. #2 Project).

On the other hand, vendor involvement in the analysis process appears to reduce their dependence on client staff, and facilitate subsequent project phases (Meadows, 1996b: 112):

> "Most requirements analysis and high-level design on our projects is done by the client, but on this project, we did it, and it made the rest of the work easier. We are not as dependent on their feedback and approval" (Manager, Transportation Co. #2 Project).

Meadows (1996) reports on other projects that use prototyping for remote outsourcing. The prototype visualizes the system-under-development, and thus enables the client to provide feedback throughout the development process (Meadows, 1996b: 108).

> "Mistakes and lessons learned? This project should've been Rapid Application Development, not this methodology. We should have prototyped, shown the client the "look and feel" of the system and gotten feedback" (Manager, Telecom. Co. #1 Project).

§ 6.6.1.2 Remote Management and Liaisons

Even for outsourced projects, client firms may maintain the overall responsibility for managing the project. Client management manages vendor personnel to some extent, especially when they are stationed at the client site. In principle, offshore outsourcing could imply that vendor personnel is managed remotely from the client's site. Yet Meadows' (1996) research suggests that managers lack the direct and nuanced connectivity to subordinates common in collocated situations (Haeckel & Slywotzky, 1999; Mintzberg, 1994). As one of the vendor managers explains (Meadows, 1996b: 113):

> "A common mistake of on-site managers is not letting the off-site manager manage the off-site people. The off-site manager knows the situation minute-to-minute and is from the same culture, able to understand all the nuances of what the team members will and will not say outright" (Manager, Telecom. Co. #1 Project).

Liaisons

Meadows (1996) also found a second theme related to organization design. Vendors commonly stationed representatives at the client site. These liaisons worked locally with client staff and maintained remote contact with the offshore vendor team. This practice follows proposals in contingency literature to connect departments through a liaison, linking pin or integrator (Galbraith, 1973; Lawrence & Lorsch, 1967b). Meadows (1996: 111) found that this focal person channels communications between on and offshore, even though technically speaking ramified connections are possible.

> "It is extremely important to have a focal person on-site and a focal person off-site, otherwise there's too much mish-mash in communications and people don't respond" (Manager, Computer Co. #5 Project).

Other respondents confirmed the last part of this quote. They emphasize that the remote vendor team needs a dedicated, onshore foothold to ensure adequate responses in their interests (Meadows, 1996b: 87-88).

> "On-site presence is also critical for demanding attention and learning the client's business: building the business knowledge is easier to do on-site. Off-site questions get answered in one or two days - on-site can be immediate, and you have continual contact with client expertise" (Manager, Computer Co. #4 Project).

Concerns associated with liaisons

Meadows (1996) found risks and disadvantages associated with the use of liaisons. First, going through an on-site person substitutes for direct contact between client and (remote) vendor personnel. As a liaison facilitates communications between these groups, he or she may (unknowingly) interpret and filter messages (Meadows, 1996b: 111):

> "The risk is that we do not talk directly to the user, so the level of interpretation is high. Our on-site coordinator interprets what the users say and passes it to us, and we interpret what he says. It's just like the telephone game (Manager, Computer Co. #5 Project).

Second, indirect contact also limits or slows down the establishment of working relationships between sites (Meadows, 1996b: 111):

> "We learned slowly how to communicate with the client, because everything was filtered through the on-site person" (Manager, Chemical Co. Project).

Third, since both sides become dependent on a single channel - possibly just a single person - their linkage is vulnerable to breakdown (Meadows, 1996b: 103):

> "Communication protocols were agreed on, and all communication was to go through our client liaison. Unfortunately, he was sick for a week, and the client was totally cut off then. We hadn't planned for that (he also wasn't available on the phone). So, we learned contingencies - if this person is unavailable, contact that one, and mail is always multiple" (Manager, Transportation Co. #2 Project).

Finally, with complex projects, liaisons may lack the capacity, resources, or knowledge to support exchanges going back and forth between sites (Meadows, 1996b: 111):

> "We had communication problems because we would tell the on-site coordinator something assuming he knew something, but he didn't, and he didn't understand what we wanted and had to ask for explanation, etc. This was a problem at the construction phase, when communication grew highly technical, which sometimes was not fully appreciated by the on-site coordinator. Getting from the initial question to the ultimate answer took a long time!" (Manager #1, Insurance Co. Project).

An organization theory perspective on liaisons

It is interesting to further analyze the use of liaisons from an organization theory perspective. First, Eisenhardt's (1993) research on high reliability organizations that operate in high velocity environment. She describes the importance of multiple channels of communication between (often remotely) interacting groups: "The (second) theme is the importance of rich real-time information (...). Thus, there are multiple, real-time channels between individuals and multiple individuals connected with one another. The result is a dense web of communication" (Eisenhardt, 1993: 132). This suggests that remote sites are preferably not exclusively linked through a single linking pin. Their role is complemented with multiple contact persons and some form of direct communication, as the manager of Transportation Co. #2 Project mentioned (see quote above).

A second link to organization literature concerns Ronald Burt's theory of Structural holes (Burt, 1993, 1997). Structural holes exist when one actor connects two or more (groups of) actors that have no alternative, direct linkage. Figure 34 applies this notion to the client-vendor relationship. Client staff (lined dots) maintains contact with remote vendor staff (black dots) through the on-site vendor liaison (black dots).

Figure 34 - Structural holes in remote client-vendor collaboration

Burt (1997) focuses on the benefits for the linking pin to maintain nonredundant contacts. His framework can also be used to analyze issues of remote, inter-organizational collaboration as Meadows (1996) describes. The measures suggested by the Manager of the Transportation Co. #2 Project (see quote above) complement the remote link with direct contact between client and vendor staff. Figure 35 shows additional dotted lines that could represent copied messages or alternative contact persons. This reduces the risk of depending on exclusive channels for remote collaboration.

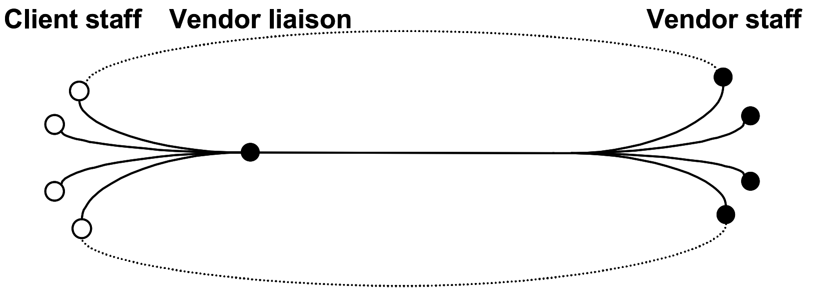


Figure 35 - Redundancy in remote client-vendor contact

§ 6.6.1.3 The Role of Face-to-face Contacts

Meadows (1996) assessed the role of face-to-face interactions in geographically distributed projects. This may take the form of vendor staff visiting the client site, or people from the client site (client staff or vendor liaison) visiting the vendor site. Sometimes, the nature of work undertaken makes it possible to do without cross-site interactions, as the following quote illustrates (Meadows, 1996b: 113):

> "On-site and off-site didn't have to work together much (this was a highly technical project), so we didn't build much of a relationship" (Manager, Computer Co. #2 Project).

But in many other cases, Meadows (1996) found that face-to-face interactions are important to promote rapport and reciprocal insight in expectations and collaboration modes. This common knowledge facilitated remote cooperation once people returned to their site (Krauss & Fussell, 1990).

> "When I was on-site at the beginning of the project, we developed our "common language." Then, when the client came here, we had no problems communicating. Now, I understand European clients better. I can usually assess whether perceptions are in synch, and I can foresee and try to preempt some problems" (Manager, Transportation Co. #1 Project).

Similarly, offshore vendor staff benefited from past immersion in a remote context to cooperate offshore in their current projects (Meadows, 1996b: 87, 109):

> "Even the English is a little different, but the people are getting used to each other's specific ways of communicating. If you've been in the U.S., you can figure out what they're saying, but if you've never been or never dealt with a foreign client, there will be problems. I try to pass on my understanding of communication, but it's difficult because this project doesn't send people over. It's not the same hearing it second-hand" (Manager, Publishing Co. Project).

Visits by onshore liaisons to the offshore team were considered important since remote collaboration mainly relies on interaction between these two. Liaisons could transfer client-related know-how, and anchor their familiarity with offshore staff (Meadows, 1996b: 109):

> "What really helps with a shared way of talking and doing things is having on-site people come back off-site" (Manager, Computer Co. #3 Project).

Meadows (1996) also found that client staff visits to the offshore team improved working relationships and facilitated remote collaboration. Says Meadows (1996: 109): "Many managers said they strongly encouraged clients to visit, even if for only a few days, in order to "get a feel" for the environment and become aware of different constraints and capabilities."

§ 6.6.1.4 Remote Communications

Meadows (1996) emphasizes the importance of remote communications to sustain cooperation between sites. Her research covers protocols for using electronic media and crafting viable remote contacts. One of her first findings is that distance between sites impedes fluid exchanges between offshore vendor staff and users. As two respondents mentioned (Meadows, 1996b: 112, 107):

> "We really missed quick, small, easy contact with the end user. That's the hassle with working remote" (Manager, Computer Co. #5 Project).

When the project proceeds without sufficient interaction, teams start working from their own assumptions concerning expectations from remote counterparts. Since these are not anchored in solid exchanges, activities remain uncoordinated without both sides being aware of that. Figure 36 shows how local processes rely on assumptions that do not match expectations on counterpart sites.

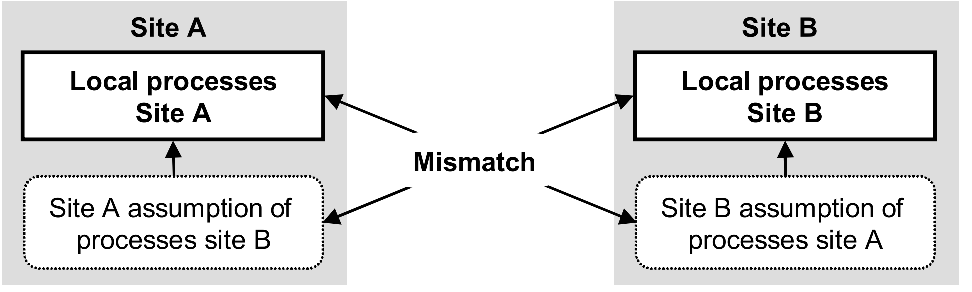


Figure 36 - Assumption-based coordination between sites

These mismatches may surface rather late in the project and require extensive exchanges and adjustments (Meadows, 1996b: 107):

> “The client gave us requirements, and we thought they wanted us to make the system from that. They thought it would be iterative and that there would be changes. Neither of us thought to confirm assumptions” (Manager #1, Telecom. Co. #1 Project).

Shaping distributed communications

Teams avoid uncoordinated distributed performance in a couple of ways. First, they foster frequent, informal exchanges across sites. Instead of limiting interactions to occasions with an apparent need for exchange, they maintain contact on an ongoing basis. This makes potential mismatches apparent in an early stage (Meadows, 1996b: 106):

> “You need to talk to your clients frequently, and not necessarily officially all the time. You have to build rapport between module leaders and managers on- and off-site. Informal talk is important for that and also important for rectifying things in the system - small things, mostly, which make the user very happy” (Manager, Finance Co. #3 Project).

A second mode for avoiding miscommunications is to encourage feedback. Recipients of a message communicate their interpretation and intended action pattern back to the sender for verification. In fact, this constitutes a double feedback loop, since the original sender can comment on the first feedback loop (Meadows, 1996b: 107):

> "Reconfirm what the other person has said and what you understand. This is one of the sources of miscommunication that can play havoc” (Manager, Telecom. Co. #1 Project).

Even senders seek feedback from recipients to ensure reception of their message (Meadows, 1996b: 103):

> “Earlier, when we were not connected with e-mail, we sent lots of faxes. Unfortunately, we thought that when the fax machine confirmed sending, we thought they would get it. Sometimes they didn’t. So, now, we always confirm, and if we don't hear within a day, we contact them again” (Manager, Transportation Co. #2 Project).

A similar emphasis on feedback loops is proposed by literature on High Reliability Organizations. Roberts and Moore’s (1993) research on the Exxon Valdez disaster revealed the importance of cross-checking among crew members: “Both the ship handling requirements and the nature of the environment prescribed the use of a more tightly coupled system in which players in various organizations recognize their interdependence with one another. (...) Tight interconnections would have been represented by continuous feedback and checking with one another about the meaning of orders, placement of warning lights (...)” (Roberts & Moore, 1993: 245).

Third, Meadows (1996) reports on the use electronic media, in particular asynchronous ones like email and fax. Crafting textual messages that transmit the sender’s intention in a format that is recognizable for the receiver appeared challenging, especially with language differences (Meadows, 1996b: 79):

> “There were some language problems where the nuances were lost in translation (and by writing instead of hearing someone’s voice) - something would be said too strongly or without friendly feeling. We realized then that their English and our English were different! After a few months, we learned to soften their messages on receipt, and pointed out the harsh feelings to them. Whenever we did, they invariably said that was not the intention” (Manager, Transportation Co. #1 Project).

Textual media required particular attention to clarity and comprehensiveness of messages to achieve the desired effect (Meadows, 1996b: 107):

> “It has to be precise and clear. Always try to understand who you are communicating to. You must put the same message to different people in different ways. Otherwise, it doesn't have the same impact” (Manager, Computer Co. #4 Project).

Finally, Meadows (1996) found that the vendor emphasized documentation and formalization of client-vendor interactions. On a contract level, the vendor preferred detailed documentation to explicitate vendor and client expectations (Meadows, 1996b: 106):

> “This project was lacking a proper contract with the client - an explicit agreement on exactly what they wanted and how things should be managed. I will always make sure next time everything is clear and written out. Having nothing written created problems later on” (Manager, Computer Co. #1 Project).

During the project, remote communications tended to become formalized compared to collocated situations (Meadows, 1996b: 105):

> “Informal communication had to formalize. When you are there on-site, informal is OK, but not for off-site!” (Manager, Computer Co. #3 Project).

Vendor staff preferred a formal, lockstep development process with client approval milestones. This was considered important to deal with turnover of client personnel and deal with change requests (Meadows, 1996b):

> “We would send documents, the client manager would ignore them, we would keep working and call, and then he would say OK but not sign anything. This was OK in the beginning but became a disaster when the client manager changed!” (Manager, Computer Co. #3 Project).

In a similar mode, synchronous remote interactions like phone calls or teleconferences are embedded in a process of documentation. Before people from both sides meet, minutes were setup and distributed. The meetings themselves were logged and translated into action items. Afterwards, results were documented, made available to both sides, and verified.

> "If there's a teleconference, we record and send minutes, even for daily teleconferences. Minutes do clarify whether misinterpretation occurred. Our on-site person reads the minutes every day" (Manager, Chemical Co. Project).

§ 6.6.1.5 Interlocking Technical Infrastructure

Meadows' (1996) research suggests that remote client-vendor collaboration benefits from standardizing and interconnecting their communication infrastructures. Access to the counterpart's network means that both parties can use the same email system and databases. Another form of infrastructure integration is incorporating vendor staff in the client's telephone system. Vendor staff thus receives internal extensions as if they were part of the client's organization.

Interconnected infrastructure supports close forms of collaboration that include reciprocal dependencies (Kumar & van Dissel, 1996). It appears to reduce perceived distance between client and vendor sites, and becomes more desirable when the client involves the same vendor in multiple projects over time (Meadows, 1996b). Meadows (1996: 93) quotes vendor managers on the importance of integrated email and telephone services:

> "Since we've had such a long relationship, we use Unix e-mail to communicate with our client and will move to their new e-mail system soon (...)" (Manager, Bombay).

> "(...) Projects here sometimes use the dedicated voice system of the client, so it's like being members of their office" (Manager, Madras).

Other vendor managers emphasized the feeling of quasi integration with the client's operations (Meadows, 1996b: 102, 103)

> "(...) Being in the same network as the client and having their e-mail and facilities as our e-mail and facilities is a big deal. We are closer to the client than our account rep., who is in their city but not hooked into their system" (Manager, Telecom. Co. #1 Project).

> "Key for managing communication? Hook into client e-mail! We didn't have it at the beginning, but now we do. They feel like we work for them, not another company, and that level of openness and sharing and quick feedback really helps us do our job" (Manager, Transportation Co. #2 Project).

§ 6.6.1.6 Time Zone Differences[30]

Respondents in Meadows' (1996) research mentioned their experiences with time zones in offshore outsourced projects. Outsourcing creates a remote agency relationship between

[30] Background information on time zone differences is provided in Part 2 § 7.1.2 .

vendor and client with bi-directional communication flows. For instance, vendor staff has to absorb knowledge on the client's business requirements and project expectations. And the client must verify vendor achievements and pass on change requests. Time zone differences almost inevitable impact these dependencies for Indian software houses like TCS, because most of their clients are in Europe or North America. They can be avoided, though, by having vendor representatives at the client's site as a first layer of problem solvers (Meadows, 1996b: 112):

> "On-site gets input from the client and takes care of urgent problems, so the client has control, and the on-site people are in a good time zone for them" (Manager, Computer Co. #4 Project).

Project teams can even use time differences to their advantage. They assemble work at the end of their working day and pass them on before the next working day at a counterpart site (Meadows, 1996b: 112).

> "Before we go home, we collect all issues and send them to Australia. When they get into office, they have them all, and no time is wasted. We adapt our work - shifts for even the people in Australia so they overlap enough to teleconference" (Manager, Finance Co. #2 Project).

As this quote indicates, using time zones beneficially requires local adaptation. For synchronous communications, people must be aware of office hours at other sites. They may even have to alter their working patterns to enable real-time interaction (Meadows, 1996b: 112).

> "The on-site people were split into a day shift and a night shift specifically in order to get them ready for passing info. between the U.S. and India. It was just a one-time effort for two weeks before some of the on-site people came back to India. One group was on days and the other on nights for a week, then the two switched for a week" (Manager, Computer Co. #4 Project).

Dependencies may also arise in the period that office hours do not overlap, for example during afternoon in the USA and night in India. On these occasions, people may rely on asynchronous communications to send a request before the working day at the counterpart site starts. Potentially, the receiving side (e.g., India) starts working as soon as they arrive, and have the work ready when the sender (e.g., in the USA) returns to office. Meadows (1996), however, points out that this requires comprehensive messages that explain a request in detail such that additional exchanges are not necessary (Meadows, 1996b: 112):

> "The problem in passing off information is that there's no second chance to ask for clarification. People learned to give very comprehensive instructions"
> (Manager, Computer Co. #4 Project).

§ 6.6.1.7 Remote Control

Offshore outsourcing implies that vendor staff works miles apart from the client site. Compared to collocated situations, the client lacks opportunities for regular face-to-face meetings, or even directly controlling vendor staff working at the client's site. Distance makes clients loose a feeling for work progress, and this may make them "nervous" and "uncomfortable". Gradually, formal controls on the vendor side reduced this tension (Meadows, 1996b: 106):

> "At first, the client was uncomfortable with how to control something halfway around the world. "How do I know you'll work the eight hours you charge me, and who will work on what, and how you will manage it?" I provided updated information constantly on who did what when, etc. Systematic, detailed tracking and reporting made them comfortable because they felt like they knew everything that was going on. I gave them estimated hours for everything, then if we went over, I gave the reason. They wanted everything (everything!) communicated. It took seven or eight months after I came back to Madras before they were truly comfortable. Now, they trust me to make people work, but I'm trying to make them trust TCS, not just me personally. It is hard to build trust remote!" (Manager, Publishing Co. Project).

The quotes also illustrate some of the measures vendor firms implement to enable remote control. These coincide with earlier mentioned modes for remote collaboration and communications. But the emphasis here is more on ensuring remote work accomplishment, rather than activity coordination.

A first mode for remote control is on-shore liaisons. Their control role works both sides. On the one hand, they follow up on requests from the offshore vendor team concerning the client site. The following quotes reveal this function (Meadows, 1996b: 87):

> "The client had a project manager and didn't want an on-site person, but we said they must. If we had relied on their manager, the project wouldn't have finished on time, because he had other responsibilities - we could not have gotten timely answers" (Manager, Energy Co. Project).

On the other hand, liaisons provide the client firm with an on-site 'portal' to the vendor team. Client staff relies on the liaison to handle requests for the offshore team. Some clients even prefer a number of vendor representatives onshore to reinforce this role (Meadows, 1996b):

> "It is transparent whether we are in Bombay or London or Chicago. On-site does exactly what off-site does, but they are on-site because the client put that in the contract. They want to see them in person" (Manager, Computer Co. #4 Project).

Second, remote control benefits from comprehensive contractual specifications and planning upfront. Vendors make the development process transparent by specifying phases and ways for reporting and communicating. This makes the client becomes more comfortable with the actual unfolding of the project. They use documentation of the project process to follow progress and detect possible deviations. Formalization continues throughout the project in a couple of ways. Major milestones or change requests require written approval from the client. Communications are verified to ensure proper understanding and agreement with proposed action patterns. Meetings are documented and verified for ex post proof if need be (Meadows, 1996b).

> "If anything's important (for example, if it affects the schedule), lay it down in writing. We could not always insist on the client writing it down or signing an acceptance form, but near the end, we refused to work without sign-off" (Manager, Computer Co. #3 Project).

Third, once the project starts, vendor staff keeps the client regularly and comprehensively updated on work progress. Since the client lacks collocated interaction with the vendor team, they almost exclusively rely on these communications to get an idea of work progress. For that reasons, vendor managers emphasize their proactive attitude to update clients extensively in a standardized format, especially when the offshore team deviates from the original plan (Meadows, 1996b: 107, 104).

> "Keep the client informed always. If you're not able to meet a deadline, inform them well in advance. Always put things in a proper format and give weekly status reports. We didn't do enough of that early on and learned. Never assume that they know!" (Manager, Finance Co. #1 Project).

Regular contact encompasses not only formal reporting, but also informal exchanges and rapport on a management level. This provides client and vendor with a good feel for offshore work progress and onshore expectations.
Finally, in addition to reporting on work progress, vendor staff transmits intermediate outputs of the work itself. Regular deliverables show the client tangible results of the offshore team. At the same time, they involve the client in the control process. Given the risk of miscommunications on a distance, iterative verification cycles ensure that the offshore team's efforts are coordinated with client expectations (Meadows, 1996b: 107).

> "We sent software every fortnight during development at whatever stage of development. The client wanted to scan through code in the process of development. That helped, because they could change what was being done before it was finished and had to be re-worked" (Manager, Finance Co. #5 Project).

§ 6.6.2 Millar (1999)

Millar (1999) reports on two research projects that investigated the management of internationally distributed software trading partnerships in India and Malaysia. She conducted in-depth case studies that included interviews on a managerial level with representatives from software exporters and international trading partner companies.
Millar (1999) adopts a learning perspective to explain the dynamics of international software trade. She points out that software is a knowledge-intensive product. Insight in the requirements that drive the software development process is distributed among multiple users. Incorporation of user expectations therefore depends on interaction between user communities and software development professionals.
Using theory from developmental psychology, Millar (1999) proposes that vendors in developing countries experience a 3-phase learning trajectory. First, they become an insourcing partner by providing onshore staff to client firms. This allows them to acquire the expertise and skills to enter a second phase of "punctuated offshore work" (Millar, 1999: 11). Vendors alternate onshore and offshore phases, and start to take on more complex projects. Or they have on-site liaisons that link onshore client staff and offshore vendor staff. A third, "rare" phase is "process internalization" (Millar, 1999: 14). Know-how acquired at the client's site is generalized and incorporated at offshore vendor locations. It is then leveraged to other distributed projects that rely mainly on remote collaboration, even for complex projects.

Millar (1999) presents for the first two phases of her framework quotes from interviews with vendor managers and executives. These are insightful for the purpose of this study and are therefore analyzed below.

Concerning the first phase, one interviewee vendor explains the properties of working onshore, at the client's site:

> "On-site (...) you have the comfort, you know on a daily basis what's happening, comfort level is very high and you know the people, the calibre, etc" (Millar, 1999: 10).

The quote suggests that collocation provides a natural way for gaining insight in staff capacity. It also keeps people updated on work progress automatically since they participate in the same context. Conversely, geographic distributedness may impede awareness of remote staff capacity and work progress.
A British firm that partners with a Malaysian company considered on-shore rotation of offshore vendor staff important for acquiring client-related know-how.

> "What we're certainly doing, on the (Malaysian firm) side, is doing quite a lot of physical interchange of people. (...) So that they get a good idea of what goes on in a European product team. (...) They certainly have a much better understanding of some of the dynamics of the project (...)" (Millar, 1999: 10).

In addition to generic insight in the client context, on-shore rotation also increases awareness of project evolution. The quote seems to indicate that entirely remote connections would fail to transfer insight in client operations and project intricacies.

For the second phase, Millar (1999) found that migration to punctuated offshore work depended on the vendors' track record onshore. This also determined the complexity of projects outsourced. An Indian vendor representative commented:

> "More than anything else, (on-site) it has been building up credibility with customers. Providing satisfactory services to them over a short period of time, winning their confidence and then moving on to getting more complex work to be done out of here" (Millar, 1999: 11).

Unless clients have perceived on-site satisfying performance, they seem reluctant to embark on remote work arrangements, especially for more complex projects. Distance may limit their ability to control vendor performance. And remote coordination of complex work may appear unfeasible at early stages of cooperation. This could imply that - compared to collocated projects - remote work arrangements have limited capacity for information processing and problem resolution.

Similar to Meadows' (1996) research, Millar (1999) found that vendors often choose a liaison model to connect on- and offshore:

> "The way we conducted this remote maintenance was, certain people will be there on-site as our on-site co-ordinators. The bulk of the staff will be sitting in India" (Millar, 1999: 12).

The second phase of punctuated offshore work makes the difference between onshore and remote working more apparent. An Indian vendor representative points at the need for extensive communications with offshore collaboration. In turn, this makes technical infrastructure vital for sustaining remote contact:

> "There is a tremendous difference in the way that you manage projects on-site and manage remotely. (...) The level of communications will have to be a much higher order (...) and therefore that is where the technical infrastructure becomes extremely critical. (...) Email becomes very important, followed by teleconferencing (...) and videoconferencing too" (Millar, 1999: 12).

Millar (1999) asserts that knowledge exchange between client and vendor staff fluctuates during IS projects. More intensive phases include the front and backend of a project. The intensity of knowledge exchange interrelates with the vendor's preference for working onshore or remotely. Onshore is typically considered more suitable for interlocked client-vendor cooperation:

> "The front end activity, the analysis, frameworking analysis, design up to a certain stage is best done in close co-operation in communion with the end user" (Millar, 1999: 13).

Millar's (1999) research suggests that remote contact - even with the support of electronic media - provides limited support for certain types of work during a project. These includes activities that require knowledge exchange, are unstructured and tightly interdependent. Typically, project participants face these tasks at the front-end of a project in the analysis phase.
Millar (1999) further expands on the properties of remote collaboration that underpin this notion. She explains that remote communications lack the suppleness and low threshold of collocated exchanges. As a consequence, documented communications (like specifications) tend to substitute for interpersonal exchanges and must therefore extensively cover a topic:

> "(for offshore telework) the specifications need to be a lot more comprehensive than when I'm sitting (on-site) and you tell me something, next day I don't understand and I can come back and say 'what exactly do you mean'. But when I'm sitting 10,000 miles away I can't do that" (Millar, 1999: 13)

This substitution process is triggered by distance, not by task uncertainty as contingency theory states (Galbraith, 1973; Van de Ven et al., 1976). But contingency theory can be used to analyze the reverse causal pattern that seems to emerge. As distance brings about a switch to documented exchanges, it limits remote information processing capacity. In turn, this limits actors to take on simple, structured tasks remotely. Onsite liaisons or visits complement these exchanges to cater for complex work.

Chapter 7 Conceptual Lens and Framing Literature

This section proposes a conceptual lens for investigating the effects of global distributedness on the coordination and control of IS projects. The conceptual lens is then used for surfacing lines of reasoning that emerge from current research as reviewed in the preceding section. This concludes the theoretical framework, and provides a basis for empirical research.

§ 7.1 Gaps

The research question - in particular sub question 2 - that guides this study includes global distributedness as independent construct. Building on our literature review, we provide a refined definition by using the concept of gaps. Global distributedness is considered to introduce gaps or differences between people involved in global IS projects. We propose five dimensions to conceptualize gaps: geographical distance, time zone differences, governance differences, cultural differences, and infrastructural differences. These are elaborated below.

§ 7.1.1 Geographical Distance

Since the late 60s, distance - or physical proximity, remoteness - has become part of theorizing and empirical research in the organization sciences. A research group around T.J. Allen has related distance to work dependencies, communication patterns and organizational structure in R&D organizations (Allen, 1984; Allen & Cohen, 1969; Allen & Hauptman, 1992). Most studies in this tradition focus on distance in terms of office shape and the number of feet or meters between people's rooms. Distance appears to reduce the frequency of exchanges, in particular informal communications (Kraut & Galegher, 1990). This limits information processing capacity, and suggests that the further people work apart the less they can handle interdependent and uncertain tasks (McCann & Galbraith, 1981; Van de Ven et al., 1976). While these findings are useful, they apply to relatively proximate settings where physical distance may be changed gradually. It thus results in recommendations like collocating people working on closely intertwined tasks (McCann & Galbraith, 1981).

Advanced and affordable transportation and information technologies change this traditional notion of distance. All of a sudden, people may work not a couple of doors or floors away, but a couple of miles or kilometers, like with teleworking. This process started with projects that involved multiple sites in the same country, like the Polaris project (Sapolsky, 1972). Another example is collaboration in the context of European integration, like the ESPRIT research programs, Airbus Industries, and the European Space Agency (ESA). Distance between co-workers contributing to the same project was further stretched when companies spread across the globe (Andres, 1992), or outsourced to remote partner firms (Solomon, 1995). These two forms of distributedness - within the same company or between two or more firms - also apply to IS projects. An example of intra-firm distributedness is multi-site operations and IS implementations that require integrated information technology infrastructure (Markus et al., 2000). An example of inter-organizational remote collaboration is offshore outsourcing by firms from the US and Europe to countries like India, China, or Ireland (Rajkumar & Dawley, 1997).

From an empirical research perspective, distance in global projects differs from physical proximity as a construct. While it appears useful to define a gradual scale of distance in the latter case, this approach seems not suitable for situations where sites are thousands of miles or kilometers apart. This is because dependent constructs - like coordination and communications modes - are not likely to shift gradually once people work from sites that make regular face-to-face contact too costly in terms of resources or effort. Instead of investigating distributed projects that range from collocation to those that are geographically dispersed, only the latter are therefore included in the empirical research section. As indicated, we focus on those projects where face-to-face interaction is unfeasible on a frequent basis.

§ 7.1.2 Time zone Differences

'Clock time' is a traditional notion in organizational theorizing that characterizes the temporal dimensions as being linear, objective and quantifiable (Hassard, 1989). Recent studies typically consider this view somewhat mundane, "(…) because, though perhaps useful for practical purposes, it is limiting for gaining a comprehensive understanding of time in organizational settings" (Lee & Liebenau, 1999: 1039). Yet within this tradition, one area has not yet received the attention from researchers it deserves. It is the situation of actors working on different clocks, like night shifts of blue collar manufacturing employees or medical professionals (Blau & Lunz, 1999).

Another example concerns east - west collaboration across geographical boundaries (Boutellier, Gassmann, Macho, & Roux, 1998; Sanchez & Mahoney, 1996). The earth is divided in 12 time zones that run north-south. The zones have different shapes because each country can decide which time they want to be on. This depends on their degree of latitude and local preferences. Standardization of world time has resulted in the Coordinated Universal Time (UTC), replacing the earlier GMT or Greenwich Mean Time in 1986. Geographically UTC is in time zone 0 (see Table 11) that starts up north from Greenland and goes all the way south across the UK, Ireland and west from Africa to the South Pole. In the summer period, time is adjusted by adding 1 hour for daylight saving. This is called Daylight Saving Time (DST) and applies to North America, Europe and Russia. UTC is independent of DST settings, so Paris at UTC +1 becomes UTC +2.

For any time zone the local time can be simply calculated by taking the current time in UTC and adding or subtracting the number of time zones east or west from UTC. Going eastbound from the UTC zone (like London - Singapore) means adding one hour for each zone. Westbound (London - New York) implies subtracting one hour per zone. For example, the US East Coast Time (EST) is UTC -5 (no daylight saving). Using the 24-hour system common in Europe and Asia, this means that when it is 15:00 in the UTC zone (e.g., London), it is 15:00 minus 5 = 10:00 in New York. Similarly, Melbourne is UTC +10. So UTC 9:00 in London means 19:00 in Melbourne (same day).

East - west collaboration means that people contributing to the same process or project work at different hours. People may work in New York from 9:00 to 17:00 local time, while for co-workers in e.g. London this means 14:00 to 22:00 local time (Table 11).

In Table 11, the second row shows the number of hours that should be subtracted from or added to UTC to yield local time. It also provides examples of cities or regions that are in the particular time zone, like New York, Sao Paulo and London. From the next row onwards, local time is indicated following the 24-hour system. Scrolling down the columns implies moving ahead in time for each zone. Colors indicate day or night hours: from 23:00 until 5:00 dark gray for the night, 6:00 until 7:00 for the morning period, 8:00 until 19:00 for (extended) working hours, and 20:00 until 22:00 for evening hours. The table facilitates comparison of hours across time zones. Horizontally the table shows the same moment across different time zones, and provides an overview of one complete day that 'proceeds' westbound. The color shifts reinforce that idea.

At the opposite side of the globe, UTC has the International Date Line as its counterpart, which runs from the Bering sea (up north) down to the Aleutian Islands and east from New Zealand. Passing the date line from east to west (like Auckland - San Francisco) requires subtracting 24 hours (hence a full day). Going in the opposite direction (e.g., Vancouver - Tokyo) implies adding 24 hours. Apart from this date line, local dates switch of course at 12 o'clock at night. The DiskCo case - with sites in the Far East and US - elaborates on this notion.

Remote collaboration often bridges multiple time zones, unless people are only working north-south in the same 'vertical' zone, like Europe - South Africa, North America - South America. In all other cases, time zone differences between sites are important for determining the 'window' between sites. This refers to the period available for synchronous remote collaboration.

Table 11 - Example of time zone differences

∢ Direction in which day & night proceed ∢

UTC -5 New York	UTC -4	UTC -3 Sao Paulo	UTC -2	UTC -1	UTC London
1:00	2:00	3:00	4:00	5:00	6:00
2:00	3:00	4:00	5:00	6:00	7:00
3:00	4:00	5:00	6:00	7:00	8:00
4:00	5:00	6:00	7:00	8:00	9:00
5:00	6:00	7:00	8:00	9:00	10:00
6:00	7:00	8:00	9:00	10:00	11:00
7:00	8:00	9:00	10:00	11:00	12:00
8:00	9:00	10:00	11:00	12:00	13:00
9:00	10:00	11:00	12:00	13:00	14:00
10:00	11:00	12:00	13:00	14:00	15:00
11:00	12:00	13:00	14:00	15:00	16:00
12:00	13:00	14:00	15:00	16:00	17:00
13:00	14:00	15:00	16:00	17:00	18:00
14:00	15:00	16:00	17:00	18:00	19:00
15:00	16:00	17:00	18:00	19:00	20:00
16:00	17:00	18:00	19:00	20:00	21:00
17:00	18:00	19:00	20:00	21:00	22:00
18:00	19:00	20:00	21:00	22:00	23:00
19:00	20:00	21:00	22:00	23:00	0:00
20:00	21:00	22:00	23:00	0:00	1:00

Daylight Saving Time (DST) not applied

So far, research on distributed collaboration has not considered time differences as an explicit construct. A few studies offer insights in people's experiences with time zones, but more as a peripheral theme (Cramton, 1997; Jarvenpaa & Leidner, 1998). Yet the potential implications of time zone differences on the way distributed projects are coordinated and controlled are important to consider. For instance, they may enforce sequential interdependence where reciprocal or team dependence would be preferable. Also, the fact the working hours do not (completely) overlap may impede traditional coordination and control mechanisms that rely on synchronous interaction between actors. (E.g., mutual adjustment (Thompson, 1967), and behavior and clan control modes (Ouchi, 1977)).

§ 7.1.3 Governance Differences

A third dimension of global distributedness is the governance gap. In a collocated setting, collaboration within firms and across organizational boundaries is embedded in an organizational hierarchy or lateral contract (Hennart, 1993). Within the same organization, people adhere to a consistent control structure and develop a common jargon (Williamson, 1975). Between firms, contractual and implicit rules common to a geographical or business area govern exchange relationships (Powell, 1990).
Global distributedness introduces differences for these governance forms. Multiple sites of the same organization may have adapted to local conditions and rules. When they connect for a project - e.g., implementing a distributed network infrastructure - differences in management structure and approach may surface. Remote collaboration between firms may reveal different contractual regimes and implicit practices. Connecting staff from both sides requires attention to communication structure and division of responsibilities (Kumar & Willcocks, 1996).

§ 7.1.4 Cultural Differences

Globally distributed collaboration is likely to involve people with different cultural backgrounds. Cultural diversity encompasses norms for behavior, values, and language. Scholars have proposed dimensions that capture these differences (Hall, 1988; Hofstede, 1991; Trompenaars, 1993).
This study perceives culture as a form of common knowledge (Grant, 1996b; Krauss & Fussell, 1990). People absorb and apply common norms of behavior while including over time in various geographically constrained communities, and in organizations and other (professional) groups.
Interaction across cultures can then be interpreted in accordance with the (cross-functional) diversity construct as defined by Lawrence and Lorsch (1967) and Dougherty (1990, 1992). Their research perceives functional diversity as differences in professional outlook, perceptions and work procedures. Within a department, people become used to particular behaviors and attitudes that may differ from those common to another unit.

Like with cross-functional diversity, cultural differences increase information processing needs (Dougherty, 1992; Krauss & Fussell, 1990). Dissimilar 'common' knowledge translates in diverse repertoires of behaviors that are not self-explanatory across communities. Complementary efforts becomes necessary to anticipate and enable re-interpretation of actions. For remote communications, this view can be integrated with media expansion theory as earlier introduced (Carlson & Zmud, 1999). Cultural differences imply that people lack insight in their counterpart's cultural background and language (nuances). They will therefore need relatively rich media or preceding face-to-face contact to contextualize exchanges.

§ 7.1.5 Infrastructural Differences

Finally, technical infrastructures may differ across sites. This includes access to basic facilities like electricity and telecommunications (capacity) in some parts of the world. But also different (versions of) hardware, platforms, and applications. Even within the same firm, units may have adopted different infrastructures that are not compliant. This becomes apparent when people start collaborating across sites and often results in implementing common technology across sites (Dickson et al., 1997). Between firms, vendor and client organization may deploy different infrastructures that constrain collaboration between IS professionals from both sides (Smith et al., 1996).

§ 7.2 Conceptual Lens

The research question guiding this study is How global distributedness affects the coordination and control of globally distributed IS projects. The conceptual lens that is used for empirically investigating this question draws on results from the preceding sections. It combines (1) general coordination and control theory, (2) research on distributed work, and (3) the gaps, as shown in
Figure 37. The conceptual lens incorporates the relationship between contingencies and coordination and control portfolios as earlier elaborated (see also Figure 28)

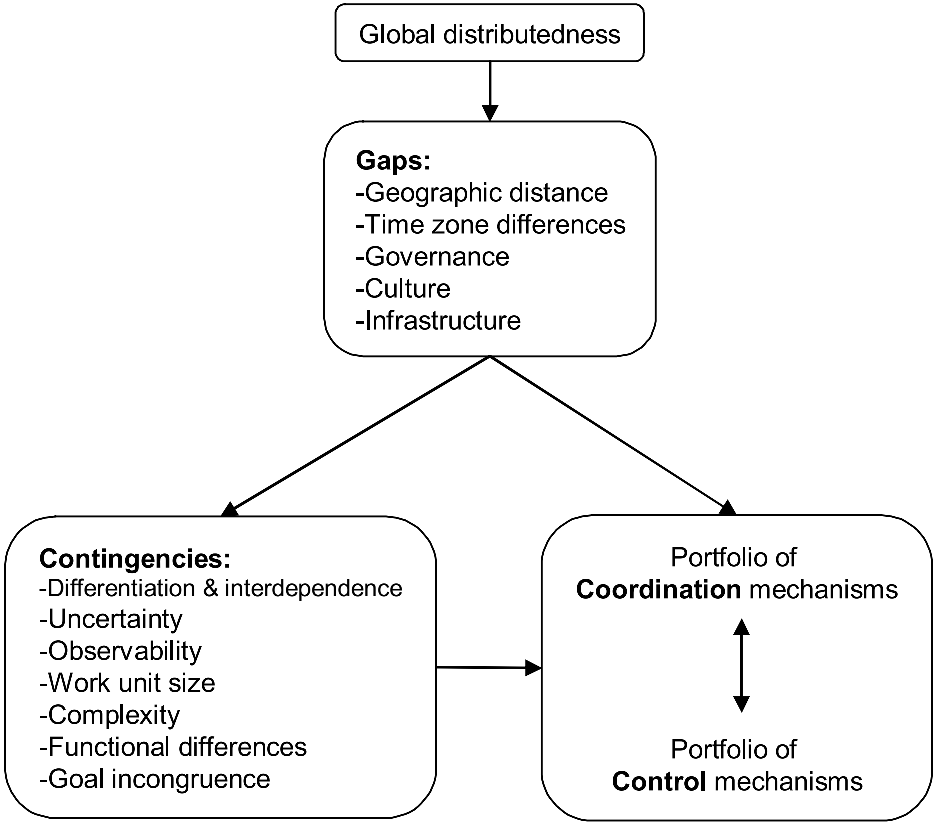


Figure 37 - Conceptual lens of the study

Starting at the top of the figure, global distributedness results in five gaps that, in turn, impact (a) the contingencies (bottom left), and (b) coordination and control portfolios (bottom right). In a sense, the gaps can be seen as a new set of contingencies.
The conceptual lens allows for different patterns of explanation. An example of (a) is that cultural differences extend functional diversity. This translates into a portfolio of coordination mechanisms that reflects the need for contextual communications. An example of (b) is the fact that geographic distance affects the control portfolio since it makes direct observation unlikely.

§ 7.3 Framing the Literature on Distributed Work

This section summarizes research on distributed work earlier introduced. It uses the conceptual lens to assess and frame current insight into the effects of global distributedness (i.e., the five gaps) on coordination and control of (IS project) work. The result serves as a form of propositions in subsequent phases of the research. For illustration purposes, some quotes are included from a Rotterdam School of Management student research project on

Global Virtual Teams at Shell Deepwater Services (SDS), part of Royal Dutch Shell Group (Brasz, 2000).

§ 7.3.1 Geographical Distance

> "The reduction of spatial-physical barriers between highly interdependent people can reduce response times and coordination costs by substituting more personal, flexible forms of communication for impersonal forms, and can help prevent conflict by encouraging friendships" - McCann and Galbraith (1981).

As the quote suggests, one strategy to handle work interdependencies is to reduce distance between co-workers or departments (McCann & Galbraith, 1981). This view resulted from research on the effects of proximity on communication patterns (Allen & Cohen, 1969). The findings are confined to spatial environments like office floor plans, and refer to an era before advanced communications technologies became widespread. But one could apply them analogically to global distances. Reversing McCann and Galbraith's (1981) quote, this implies that distance would:

1. Increase response times
2. Increase coordination costs
3. Result in impersonal and inflexible forms of communication
4. Increase the likelihood of conflicts due to limited friendships.

With these statements in mind, the effects of distance on coordination and control are assessed here. Research on distributed work has shown that physical or geographical distance accounts for particular issues, effects and responses. An attempt is made to elicit lines of reasoning around the following themes: polycontextuality, electronic communication media, groupware, distance and the interpersonal connection, remote management, and control.

§ 7.3.1.1 Polycontextuality

An initial consequence of distance is that two or more physically separate sites are involved in some form of joint effort. Each site can be considered a context on its own, with unique local actors, activity processes, and events (Engeström et al., 1995). Without deliberate effort, these local contexts remain separate and 'unshared' (Hinds & Bailey, 2000). This can be traced to the stickiness of local information, in particular information that remains non-explicitated in collocated settings (von Hippel, 1994). A primary effect of distance is therefore that people working from different sites are basically unconnected (Vaughan, 1997). If they are supposed to accomplish work with cross-site dependencies, they must therefore move beyond their local setting by engaging in some form of bridging. Modes for connecting contexts include representatives, common knowledge, boundary objects, and direct contact (Engeström et al., 1995).

§ 7.3.1.2 Electronic Communication Media

> "People make jokes that don't come across and are received as being dishonest. Email is very user-friendly, but only when you know the team members and they know you, otherwise misinterpretation of the intentions is just as easily done." - Interviewee in Brasz (2000: 96)

Distance induces reliance on electronic media like e-mail, v-mail, fax, phone and videoconferencing to sustain remote communications. These media not only extend inter-personal communications from co-presence to distributedness. Some of them also offer complementary opportunities for documenting and sharing messages (Markus, 1994). More specifically, people can broadcast and forward messages, and include prior exchanges to reveal communication chains (Dimitrova & Salaff, 1998; Maznevski & Chudoba, 2000). Asynchronous communication modes - like e-mail and v-mail - can prepare synchronous inter-personal exchanges and economize on the duration of these (Markus, 1994).

§ 7.3.1.2.1 Issues

While electronic media extend inter-personal encounters beyond co-presence, they do not seamlessly substitute for these. Research has surfaced a number of issues relating to the use of electronic media for remote collaboration.

First, people become highly dependent on technologies used for maintaining remote contact (Abel, 1990; Staples, 1997). Work progress thus relies on the quality of inter-linked technologies to sustain communications, like network quality, satellite connection, computer hardware reliability, and the extent to which operating systems and applications are bug-free and compatible. Reliance on technology also implies that users need training and support to familiarize and integrate technology in their work environment (Staples, 1997).

Second, a substantial stream of research has elaborated on the fact that electronic media support only a limited level of interactivity and number of cues (Daft & Macintosh, 1981). 'Richer' media like videoconferencing and phone transmit a more comprehensive communication experience than textual and asynchronous media like e-mail and v-mail. Yet still, technology cannot transmit a person's 'presence' like in face-to-face settings (Lombard & Ditton, 1997). As a consequence, salience and nuance of communications suffer when people attempt to interact electronically (Cramton, 1997; Vaughan, 1997). This compromises communication quality, typically defined in terms of interactivity and number of sensory channels involved (Kraut & Galegher, 1990).

At the same time, more recent approaches emphasize that a medium's richness is not a static property (Lee, 1994; Markus, 1994). For instance, Channel Expansion Theory suggests that common experience bases between remote participants enhance their communication experience. These include experience with the channel, experience with the messaging topic, experience with the organizational context, and experience with communication co participants (Carlson & Zmud, 1999). In particular, face-to-face encounters prior to remote communications appear to enrich mediated exchanges (Abel, 1990; Meadows, 1996b).

Third, from a, individual behavior point of view, remote communications require more effort than face-to-face encounters (Kraut & Galegher, 1990). Remote communications are more deliberate and intention-dependent than collocated exchanges that may rely on a rather impromptu pace (Hinds & Bailey, 2000). In particular real-time encounters like videoconferencing require careful advance planning (Maznevski & Chudoba, 2000).
Remote exchanges require also more effort as people are expected to transmit and digest communication intentions within the constraints of the technology in use. Limitations in channel richness and interactivity may conflict with task demands. This may lengthen the cycle times of communications, for instance when people use e-mail for complex tasks or sensitive issues (Kraut & Galegher, 1990).

Fourth, people are often not familiar with the nature of remote communications. Communications tend to become more task-oriented and formal than common in a collocated work setting (Staples, 1997). This reduces the feasibility of building social connections and, hence, more complex coordination processes (Perin, 1991; Wiesenfeld et al., 1998).
Throughout the collaboration process, people often fail to describe their local context, assuming that their background and current situation is known to their counterpart (Cramton, 1997). As it seems, people transpose their mode for maintaining contact with local people to the distributed setting. However, as earlier indicated, in a polycontextual environment, people are included in settings with their own local actors, events and processes (Engeström et al., 1995). Experiencing different events and coming from diverse backgrounds, they cannot assume commonality with remote counterparts.
Furthermore, when people act as a sender in remote exchanges, they appear not skilled in crafting salient messages with lean media (Jarvenpaa & Leidner, 1998). And as a receiver, they do not digest electronic messages with sufficient precision, and respond in a rapid manner (Staples, 1997). To local people, their behaviors are self-explanatory and logic. But on a meta-site level, these behaviors tend to result in infrequent and irregular communication patterns (Meadows, 1996b). Distributed contributions to a common task are no longer interwoven, but fall apart in multiple individual actions without apparent coherence on a collective level (Adler & Borys, 1996; Weick & Roberts, 1993).

Finally, remote electronic communications result in inclusion problems. On the one hand, local people may not be included in cross-site exchanges (Cramton, 1997). For instance, they do not receive a cc of emails, and remain unaware of dynamics at a remote site (Staples, 1997).
On the other hand, local interactions may remain separate from remote exchanges. In the Challenger case, the teleconference was interrupted for a local caucus (Vaughan, 1997). When the teleconference was resumed, remote counterparts were granted only limited insight in the caucus process and results. In her study of , one of Brasz' (2000: 90) interviewees reports: "I get very confused sometimes. I know that it is wonderful that we can work together even if we are globally dispersed but I have a continuous feeling that I am missing out on something as my team members are not nearby and communication doesn't always go smoothly."

§ 7.3.1.2.2 Effects

A number of effects can be derived from the issue areas introduced above.

First, the use of electronic media requires more deliberate effort and other 'costs' (Kraut & Galegher, 1990). Part of these costs comes from using lean - possibly asynchronous - electronic media for demanding inter-personal tasks. For instance, trust building, conflict resolution or collaborating on unstructured, knowledge-intensive tasks (Jarvenpaa & Leidner, 1998).

Second, these constraints translate into infrequent communications between sites, and they stretch cycle times (Kraut & Galegher, 1990).

Third, they also impede information sharing across sites. Local information remains locally, contributing to its 'stickiness' (von Hippel, 1994).

Fourth, on a meta-site collaborative level, this has significant consequences. Limited remote contact results in information asymmetries, and incomplete insight in counterpart sites (Cramton, 1997; Vaughan, 1997). People connect imprecisely and lack the capacity to handle delicate and sensitive issues. They may attribute miscommunications, silence, or delays incorrectly. This increases the likelihood of conflicts and communication breakdowns. And it suggests that people do not easily perceive counterparts as being reliable and trustworthy.

Finally, as local perceptions, assumptions, events, and constraints remain unknown for counterparts, conflicts easily arise, yet without being surfaced. And if they are surfaced, remote resolution takes longer than in collocated situations (Hinds & Bailey, 2000).

§ 7.3.1.2.3 Adaptation

> "Orchestrate for the members to meet face-to-face for instance twice a year. Virtual communication goes so much better when you know the faces with the names'. 'Face-to-face meetings are required to develop a real sense of team and team alignment. It's the people that make it work not the infrastructure. (...)
>
> Face-to-face meetings can clear the air when tensions are created by misunderstanding'. 'Sometimes misunderstanding just happens, you can't see the other persons facial expressions and can't feel the intentions, when this happens frequently the team dynamics will deteriorate. (...)
>
> Crystal clear roles and responsibilities are a requirement." - Interviewees in Brasz (2000: 92, 93, 91)

As people start to realize the issues and effects tied to distributed collaboration and electronic media, they develop modes for dealing with these. Research reports on the following strategies.

First, people tend to alternate different types of media and - possibly - visits. This blending combines beneficial properties of media, while counteracting their disadvantages. For example, instead of exclusively relying on email, they call each other once in a while to maintain the 'personal connection' (Markus, 1994). And before making a phone call, people send emails to communicate basic information (Markus, 1994; Maznevski & Chudoba, 2000). Alternation also means that remote collaboration is often preceded and punctuated by visits (Abel, 1990).

Second, remote communications require specific skills and attitudes. People are expected to behave more proactively. They should take initiative to update others, request clarification, and describe their local context and constraints (Jarvenpaa & Leidner, 1998). Deliberate inclusion of people in communication loops becomes important to avoid information asymmetries (Vaughan, 1997). When sending electronic messages, attention to comprehensive and clear shaping of messages is important to address loss of salience (Abel, 1990; Cramton, 1997). On the receiving end, people should pay special attention to digesting incoming messages, and responding in a rapid manner (Staples, 1997). Since perceptions across sites easily divert, more attention is required for feedback loops and cross-checks (Meadows, 1996a). An interviewee in Brasz' (2000: 89) research mentions: "Repeat back what you have heard as to ensure that you have understood what the speaker intended to communicate."

Third, selection of contributors to a distributed work setting is an anticipatory strategy. Common knowledge in relevant areas (like language and work-related competence) facilitate remote contact (Jarvenpaa & Leidner, 1998) and enriches peoples' perception of electronic media (Carlson & Zmud, 1999). Also, distance means that people are expected to work more autonomously. Participants in distributed collaboration are therefore selected on criteria like on-the-job experience, and capability to work independently (Perin, 1991; Wiesenfeld et al., 1998).

Fourth, distance makes collaboration more formal and documented (Meadows, 1996a). In collocated situations, incomplete documentation may suffice as people can ask for clarification. Remoteness enforces more extensive specifications (Millar, 1999) to compensate for remote 'myopia'. As a consequence, organizations shift to prototypes to elicit user requirements and subsequent feedback (Meadows, 1996b). Expectations and processes are made explicit upfront as far as possible by means of rules and procedures. Work progress is documented and shared to obviate the loss of face-to-face contact (Staples, 1997).

This process of documentation facilitates inclusion of multiple actors. Each person can be asked to contribute, submit, and comment on their counterparts' work (Jarvenpaa & Leidner, 1998; Majchrzak et al., 2000a).

At the same time, formalization may contradict intricate coordination demands of unstructured and interconnected work (see Figure 19 and Figure 21). Another problem of formalization resides on a meta-communication level (Watzlawick et al., 1967). Limited common knowledge and working relationships imply that people have difficulty establishing workable protocols for remote collaboration. This adds to inefficiency of remote communications. It reduces the scope of remote collaboration to simple, loosely coupled tasks that remain constant (cell 1 in Table 8). Researchers found that groups are unable to agree upon or adhere to protocols if they did not engage in social exchanges upfront (Jarvenpaa & Leidner, 1998) or tasks are unstructured (Majchrzak et al., 2000a). On the other hand, cohesive groups seems to rely on implicit group norms that substitute for explicit structuring of exchanges (Goodman & Darr, 1998). This suggest a relationship between group cohesiveness and use of formal protocols.

This suggests that low-cohesion reduces the effectiveness of impersonal coordination mechanisms. Such groups lack both main categories of coordination mechanisms (Van de Ven et al., 1976), and are unable to achieve even basic collaborative results (Jarvenpaa & Leidner, 1998).

Fifth, people compensate for reduced inter-personal effectiveness on a distance by moderating the division and structure of the work itself. They simplify and reduce dependencies across sites, and divide work in recognizable ‘chunks’. Lockstep stages are formulated with formal sign-offs to make tasks more transparent and understandable for remote partners (Meadows, 1996a).

Finally, distributed contributors become heavily dependent on technology (hardware, software, network) to connect and integrate their efforts. They need reliable, compatible technology that includes training and support (Staples, 1997). Permanent electronic links - like video walls, lease lines - reduce communication effort and simulate co-presence. This may increase communication frequency and information sharing between sites (Abel, 1990). As an emerging form of quasi collocated collaboration, some of the abovementioned issues - like the need for formalization - may thus loose relevance.

§ 7.3.1.3 Groupware

Groupware offers a coherent set of functionality that allows for transmitting, storing, categorizing, and retrieving information. It consists of communication tools, workflow applications and shared databases.

For people working in a distributed setting, groupware offers a central virtual platform for planning, interacting and documenting work (Goodman & Darr, 1998; Majchrzak et al., 2000a). It facilitates sharing of explicit, formalized information (Ciborra & Patriotta, 1996).

§ 7.3.1.3.1 Initial Use

Researchers found that initially people assume that groupware could exclusively facilitate distributed collaboration processes (Majchrzak et al., 2000a). The collaborative technology was to be used for “all communication and knowledge-sharing needs” (Majchrzak et al., 2000a: 11).[31] Similarly, Ciborra and Patriotta (1996) found that groupware was intended to

[31] Page numbers refer to the 1998 working paper version of the paper.

comprehensively capture and 'funnel' interactions related to new product development projects.

§ 7.3.1.3.2 Issues & Effects

Having started from this perspective, groups encountered a number of issues. First, groupware mainly supports asynchronous exchange of textual and visual data. These lean media appear less suitable for facilitating rich and interactive exchanges. The latter is needed when people collaborate with different backgrounds (Goodman & Darr, 1998). Or when groups work on innovative design tasks that change regularly and require simultaneous brainstorming (Majchrzak et al., 2000a). Technology thus increases the costs of communicating in terms of effort and time (Kraut & Galegher, 1990). People must textualize and visualize contributions that remained implicit or verbal in a collocated setting (Ciborra & Patriotta, 1996; Majchrzak et al., 2000a).

Second, groupware systems impose a formal structure on work processes. It enforces work sequences, procedures, and sign-offs. This may burden people used to more informal, impromptu ways of collaborating (Ciborra & Patriotta, 1996; Majchrzak et al., 2000a). It increases the burden of communicating as people attempt to channel their collaboration patterns through the system.

A more specific example of this issues is the fact that groupware supports extensive categorization and search functionality to organize collective work. For example, communications can be numbered, coded, and identified with keywords. This seems useful for ex-post information retrieval, or updating people who join a project at an intermediate stage. However, for the current work processes, this implies that communications must be labeled and structured in accordance with the documentation system. Since people cannot or do not want to spend additional effort in this area, they leave parts of the groupware functionality unused (Majchrzak et al., 2000a).

Third, people may start to connect off-line, even in situations where groupware was supposed to channel exclusively collaboration processes (Majchrzak et al., 2000a). This creates an inclusion issue similar to the one earlier discussed for electronic media. Off-line communications - like discussing work over the phone or lunch - are often not included in the system. This results in information asymmetries for people who did not participate in off-line exchanges. An implication is that people cannot rely on groupware as a central, comprehensive resource for making the collaboration process transparent.

Finally, groupware cannot (yet) cater for intensive, unstructured group communication needs, like design teams have (Majchrzak et al., 2000a). Typically, in a collocated setting, these groups engage in dynamic discussions that include drawings, modifications and so forth. Similar to experiences with videoconferencing (Abel, 1990), technology cannot (yet) facilitate these 'rich' meetings because of the complex information processing demands. The intricacy stems from (1) the fact that multiple channels should be supported real time (audio, video, documents), (2) communications require use of digital media (instead of plain drawings for instance), and (3) the need for simultaneously adapting documents. This results in a complex environment for capturing, transmitting and representing multiple cues remotely.

§ 7.3.1.3.3 Adaptation

People collaborating on structured tasks benefit from groupware functionality since work processes and deliverables are mainly represented in (digital) documents (Dimitrova & Salaff, 1998). Groupware plays a less central role for more interactive, complex tasks. In these cases, its documentation features support only part of the collaboration process (Majchrzak et al., 2000a). For rich and synchronous communication needs, groupware would enforce a more sequential and text-based interaction process that becomes strenuous. Instead, people revert to teleconferences or collocated meetings (Majchrzak et al., 2000a).

§ 7.3.1.4 Distance and the Inter-personal connection

Working from different sites means that people use electronic media, and possibly meet each on occasional visits (Hinds & Bailey, 2000). This implies that they have less social contact and opportunities to socialize with remote counterparts (Sia et al., 1998). Infrequent and lean contact make it more difficult to establish and maintain working relationships (Gabarro, 1990; Hallowell, 1999). As a consequence, coordination of intricately connected tasks becomes challenging, see also Figure 19 and Figure 21 (Meadows, 1996b).

Researchers found several ways for dealing with the potential loss of interpersonal contact. First, prior on-site collaborative experience is considered important. People acquire local insight and build common knowledge that facilitates subsequent remote exchanges (Carlson & Zmud, 1999; Meadows, 1996b). With offshore outsourcing, vendor representatives spend an initial on-site period (at the client site) to become acquainted with local people and their ways of working (Millar, 1999). Second, firms may station more permanent representatives as liaisons to maintain close contact with counterparts. Finally, paced visits during the project strengthen cross-site contacts, and facilitate discussion on the collaboration process (Meadows, 1996b).

§ 7.3.1.5 Remote Management

> “For managers of distributed teams it’s impossible to supervise employees the old-fashioned way - by scouting the office floor to see who showed up for work and whether or not the person is busy. People who don’t work in the same office space every day aren’t as likely to know who is having a bad day, or whether the message a colleague sent through the e-mail is a rebuke or a joke.” - Saccomano (1999).

Distance introduces a challenge for management relationships, here referring to the situation that person A is responsible as a manager for person B’s performance. Managers cannot observe their subordinates’ behaviors. They experience infrequent, more cumbersome communication processes that result in incomplete insight in subordinates’ context and experiences. They also hinder building and maintaining working relationships and trust (Kurland & Egan, 1999).

Since some form of management is usually still required, research shows several strategies to deal with distance. First, a local manager is appointed to manage subordinates. He or she reports back to the initial manager (Meadows, 1996b). The local manager substitutes for or complements the initial manager's contact with subordinates.

Second, managers pay more deliberate attention to initiating communications with remote subordinates compared to local ones (Kurland & Egan, 1999). They may formalize a regular and frequent pace of meetings to maintain contact. Permanent communication links like video walls may sustain quasi-local exchange and observation patterns for managers (Abel, 1990).

Third, before subordinates start working remotely, expectations on their work is made explicit and formal in close detail (Perin, 1991). This substitutes for the loss of face-to-face contact and observational control. It also facilitates reporting during the accomplishment process.

Fourth, managers can shift their focus to (intermediate) outputs instead of process (Perin, 1991; Wiesenfeld et al., 1998). Assessment is based on deliverables, supposing that these sufficiently reflect desirable performance.

Finally, managers can reduce subordinates' need for managerial involvement. They can select workers who are trustworthy and capable of working autonomously (Perin, 1991; Wiesenfeld et al., 1998).

§ 7.3.1.6 Control

Distance interferes with cybernetic control cycles underlying control modes (Figure 13 and Figure 23). Control is considered here in a broad sense: it applies to the relationship between manager and subordinates, and also among peers. (Vendor - client control is discussed in the section on governance gaps). The impact of dispersedness on control is summarized here in three stages: issues, effects, and adaptation.

§ 7.3.1.6.1 Issues

Distance has two initial effects on control modes. First, it means that controller and controllee loose opportunities for direct work observation common to collocation. Managers cannot supervise subordinates' task accomplishment (Sia et al., 1998; Staples, 1997), and peers remain unaware of their counterparts efforts (Kurland & Egan, 1999).
Second, remoteness makes establishment and maintenance of working relationships more difficult (Meadows, 1996b). This questions the viability of clan type of control modes (Ouchi & Johnson, 1978) in remote settings (Wiesenfeld et al., 1998).

§ 7.3.1.6.2 Effects

As observation processes become constrained, information asymmetries between controller and controllee emerge (Cramton, 1997). Controllers lack insight in controllees' efforts,

context and constraints. Used to frequent exchanges in collocated office environments, this knowledge and information gap makes controllers uncomfortable (Perin, 1991).
Loss of social contact - the second issue - ties in with this effect. Distance interrupts not only information flows and observation processes between controller and controllee. It also affects their working relationship and trust levels (Wiesenfeld et al., 1998).

§ 7.3.1.6.3 Adaptation

Several patterns of adaptation have been distinguished in literature. (For teleworking these have been summarized more extensively in an earlier section.) These affect work input, processes, and outputs. Since distance impacts observation of work processes in particular, a stronger emphasis on input and output control modes has been observed (Meadows, 1996b; Perin, 1991).

Input control implies that controllees are selected based on trustworthiness, dependability, and capacity to work on their own (Sparrow & Daniels, 1999). This substitutes for the loss of inter-personal exchanges while working remotely. Another strategy is to arrange for a period of intensified face-to-face contact prior to distant collaboration (Millar, 1999).

Loss of ***process***-observation and involvement leads to two forms of adaptation.
First, some researchers found that work processes are more extensively clarified, documented and formalized upfront. They are even simplified to facilitate remote recognition of work progress (Meadows, 1996b). Supportive technology like groupware materializes this approach. It makes task accomplishment processes more transparent by planning, funneling, documenting, and categorizing the work. However, since people are used to less explicit collaboration processes in collocated settings, they may feel uncomfortable with this level of transparency (Ciborra & Patriotta, 1996; Perin, 1991).

A second approach attempts to retain communication openness and information flows remotely (Meadows, 1996b). People set a regular pace of interacting, even when there is not an apparent work-related need for exchanges. Managers encourage subordinates to update them at a frequent pace (Kurland & Egan, 1999). They may even schedule regular tele-meetings to avoid that contacts become impersonal (Markus, 1994: 520). In general, participants in dispersed projects are expected to display proactive communication attitudes. They should initiate exchanges while reporting on their local context, work progress, and possible impacts of their work for counterparts (Jarvenpaa & Leidner, 1998).

A final strategy emphasizes work ***outputs*** (Olson, 1982). Controllers receive and check (intermediate) deliverables that represent controllees' efforts so far (Perin, 1991). Remote control of outputs has an advantage over process control (Ouchi, 1978). The latter requires the controller to gain insight in a remote context with local events and issue. But work output often consists of documented deliverables - like reports - that are easily transmittable in electronic format.

§ 7.3.1.7 Development Methodology

Meadows (1996) briefly elaborates on development methodology in the context of offshore outsourcing. She found that offshore vendors were sometimes not involved in the requirements analysis process. This meant that they could not build know-how on the customer organization, and requirements from the user or IT departments. The offshore team thus lacked vital input for the development process. Their task became much more uncertain, and they remained dependent on the inputs from the 'onshore' organization.
Preferably, they would like to be involved early on in a development project. They could gradually grow into the project as it evolved, instead of jumping onboard in a later stage. Offshore vendors appreciated prototyping/ RAD approaches. They could visualize a product and receive feedback, instead of depending on elaborate specifications. The prototype functioned as a sort of boundary object that elicited feedback and showed improvements on consecutive stages (Karsten et al., 1999; Star & Griesemer, 1989).

§ 7.3.2 Time Zone Differences

Collaborating across different time zones is a relatively new phenomenon. While scholarly work on the effects of distance abounds since late 60s (Allen & Cohen, 1969), only few studies have addressed the impact of time differences. These studies quote time zone-related experiences from their field studies mainly as a side theme of globally distributed collaboration (Cramton, 1997; Meadows, 1996b). As a starting point, these findings are useful and summarized here from this research's perspective.

§ 7.3.2.1 Issues & Effects

Time zone differences imply that working days at 2 or more locations do not perfectly overlap if people stick to local office hours. It is supposed that some form of task interdependence exists or may emerge across sites. This section discusses effects of time differences.

A first effect of time differences is that people have a limited window at their disposal for real-time communications. Their opportunities to connect remote counterparts are constrained (Hinds & Bailey, 2000). If a task requires involvement of a remote site outside the window, it must be delayed until the next opportunity for synchronous contact (Meadows, 1996b). Among the factors that influence the delay is the east-west positioning of sites. This is illustrated with Table 11 which suggests that an office in London (closing at 17:00) interacts with an office in New York (starting at 9:00 in the morning). The dark square shows the window between both sites. If the New York office (westwards of London) must be involved in the work process in London, the delay is limited to the time people wait until the window opens at 14:00 London time. On the other hand, when London (eastwards of New York) must be contacted after the window, New Yorkers must wait until the next office day.

Second, time zones induce people to switch to asynchronous communication modes. Using the same example mentioned above, New Yorkers could send email or voice mail so that staff in London is informed when their office day starts. Asynchronous media have usually a limited number of cues, and are by definition not interactive. Time differences may necessitate the use of these media even when richer and more interactive channels would be preferred (Jarvenpaa & Leidner, 1998).

Finally, people often do not realize the zone of their counterpart, and fail to communicate their time constraints and preferences (Cramton, 1997; Meadows, 1996b). Unawareness of time constraints at both sides may result in confusion, conflicts and wrong attributions of behaviors (Hinds & Bailey, 2000). It means that limited opportunities available for collaboration are not fully utilized. This lengthens cycle time of work processes, especially with interactive tasks in which people from multiple sites are involved (Jarvenpaa & Leidner, 1998).

§ 7.3.2.2 Adaptation

Research suggests several modes for addressing the impact of time differences.
First, people are expected to communicate their time-related constraints and expectations to counterparts. Explicitness of this contextual information fosters mutual understanding and collaboration effectiveness (Jarvenpaa & Leidner, 1998).
Second, people become dependent on asynchronous media for their communication needs. Since opportunities for interaction are limited, they must anticipate their counterparts' existing knowledge and information needs. This calls for messages that explain issues in detail so that receivers can start working without having to consult senders (Meadows, 1996b). With reference to Table 11, New York staff could send an asynchronous message to London for issues arising in New York after the window ends. This message should contain sufficient detail for staff in London since they cannot contact New York before the window starts at 14:00 London time.
Third, local operations can be adapted to cater for remote demands. Local tasks can be prioritized such that staff needs at counterpart sites are taken care of. Office hours can be adapted to enlarge the window for real-time exchanges. Using Table 11, this means coming in earlier in New York, or staying later in London. People can be asked to stand-by at home, or participate in conference calls from home.
Finally, staff at one site could remain at the time zone of their counterparts, creating a full working day window. For instance, onshore liaisons in the US work at the offshore team's schedule in India (Meadows, 1996b).

§ 7.3.3 Governance Differences

The governance gap features most prominently in current research on offshore outsourcing of software development (Meadows, 1996b; Millar, 1999). In a collocated situation, outsourcing introduces already issues of project management, trust and control between client and vendor organization (Lacity et al., 1996; Sabherwal, 1999). These are magnified when governance gaps coincide with distance between onshore staff form the client organization, and offshore IT professionals.

§ 7.3.3.1 Issues

First, at the start of a project, vendor IT staff lacks intimate knowledge of the client's business. While this occurs in collocated projects as well, the means for acquiring this insight are more limited with offshore projects (Millar, 1999).

Second, while working on the system, the offshore vendor team needs feedback from onshore professionals at intermediate stages of the project. Dispersion of both teams puts constraints on communications between both groups (Meadows, 1996b).

Third, for local outsourced projects, client IT management may take on the role of overall project management. This model appears unfeasible with offshore outsourcing. The onshore manager from the client organization is not familiar with the remote vendor team, which usually has a different cultural background as well (Meadows, 1996b).

Fourth, task dependencies between onshore and offshore professionals easily result in a myriad of communication lines between sites. Project managers and team members may loose an overview of these exchanges, especially with large projects (Meadows, 1996b)

Fifth, client and vendor staff tend to transpose their local style of collaboration to a remote environment. Collocated outsourced projects usually rely on building rapport between professionals from both organizations, and collaborating in an informal manner (Kumar & Willcocks, 1996). Bridging the governance gap in this way appears less feasible in an offshore project (Millar, 1999). This may result in misunderstanding and conflicts (Meadows, 1996b).

A final issue concerns the process of controlling task accomplishment. Outsourcing relationships are lateral; they lack hierarchical structure and reporting lines common to a single organization (Bradach, 1997). Paired with distance, this makes it difficult for the client to monitor and control performance of a remote vendor team. And for vendor professionals it becomes more difficult to make sure that their needs are met, like receiving information from client staff (Meadows, 1996b).

§ 7.3.3.2 Responses

Investigators found several modes for addressing these issues.

First, offshore managers are installed to head vendor staff. Managing a vendor team from the remote client site appears unfeasible (Meadows, 1996b).

Second, prototyping is favored as development methodology for offshore outsourced projects. Promoting regular interaction across sites, it facilitates information exchange and feedback processes between users and developers (Meadows, 1996b).

Third, stakeholders prefer a more explicit, formalized and documented development process compared to collocated projects. This makes it easier for the client to keep track of work progress. From the vendor perspective it specifies boundaries of the client's expectations. This approach makes project progress and work methodology also less dependent on particular individuals that may leave the project at intermediate stages (Meadows, 1996b).

Finally, contact between sites is encouraged by visits and vendor liaisons at the client site. Visits - offshore to onshore and vice versa - promote face-to-face exchanges and mutual understanding across sites. People build common approaches that facilitate subsequent remote interaction (Millar, 1999).

§ 7.3.3.3 Liaisons

Vendor liaisons (onshore) play a variety of roles to address many of the issues mentioned above. They function as an exclusive gateway for communications between offshore and onshore, see Figure 34. For the vendor, liaisons make sure that requests from the offshore team regarding onsite operations are take care of. For the client, they represent the vendor and offer a local point of presence for handling requests (Meadows, 1996b).

At the same time, routing cross-site contact exclusively through a liaison introduces new issues as well.

First, the liaison substitutes for direct contact between sites. This slows down relationship building between onshore and offshore staff, and makes people dependent on the liaison's interpretation of communications (Meadows, 1996b).

Second, the project becomes dependent on a single person to process all information flows between sites. This may delay inter-site work flows, and poses a risk when the liaison is sick or leaves the project (Meadows, 1996b). Finally, it not likely that the liaison is knowledgeable in all areas of the project; he or she may thus constrain exchanges between specialized staff at the onshore and offshore site.

Some insight exists on how to deal with these liaison-related issues. The vendor can station multiple liaisons onshore, and communications are copied as a backup for the liaison's role, see also Figure 35 (Meadows, 1996b).

§ 7.3.4 Cultural Differences

Cultural differences are perceived here as a lack of mutual knowledge (Krauss & Fussell, 1990). They are framed in accordance with literature on functional diversity (Lawrence & Lorsch, 1967b). Diversity has a variety of effects (Figure 27). For example, it increases the need for information processing since people lack common knowledge, (33) in Figure 27. Using Media Richness Theory and Channel Expansion Theory, it can be argued that people from different cultural background need therefore rich communication media (Carlson & Zmud, 1999; Daft & Macintosh, 1981). Since they lack common cultural norms and familiarity with the same language, multiple cues are needed for shaping and assessing the communication process (Gabarro, 1990).

Electronic media in general and lean media in particular may hinder these rich exchanges. Nuances apparent to people from the same background may be lost when using communication media (Meadows, 1996b). Surfacing this type of miscommunications may take more time than in collocated situations (Hinds & Bailey, 2000). This is caused by a lack of feedback loops, a generic remote communication issue as earlier indicated.

One response to these issues is attempting to maximize common knowledge across sites. This may take the form of selecting people with fluency in English (Jarvenpaa & Leidner, 1998). Or selecting project staff with experience in the business and country of the counterpart site (Meadows, 1996b).

§ 7.3.5 Infrastructural Differences

Infrastructural differences could refer to both diversity of local systems (i.e., each using their own project management software), and the fact that systems are not integrated across sites (local networks are not connected). Current research emphasizes infrastructural differences in case of inter-firm projects (offshore outsourcing) (Meadows, 1996b). International projects within multinational firms can usually benefit from a standardized IT infrastructure.

Infrastructural differences have a strong effect on distributed projects since these rely heavily on technology for communications and sharing documentation (Meadows, 1996b). For instance, offshore developers must prepare and test the system based on the client's infrastructure, or they need data from the client organization. At both sides, technical differences contribute to the costs of communicating in terms of effort (Kraut & Galegher, 1990). People must dial international numbers or adapt local operations to their counterparts' infrastructure. This adds to the perception of distance between sites (Meadows, 1996b).

Several responses are distinguished in current research. First, vendor staff is often granted remote access to the client's network and email system. They are also connected to the client's telephone system so that extensions suffice for connecting across sites. As these measures lower communication efforts, people perceive their counterparts at distant sites as closer. Second, teams at both sides may share a common database with project related documentation. Third, firms may decide to implement similar infrastructures at sites to create a standardized and more integrated environment (Meadows, 1996b).

§ 7.4 Summary

The preceding sections have presented the literature on distributed work. They also contained a reinterpretation of that literature based on the research question and model. Before embarking on the empirical research, it seems useful to summarize our findings (see Table 12 and following). The gaps are listed across the first column. For each of these, the table presents the results of the preceding literature analysis: issues, effects, and analysis. (For some gaps, 'issues' and 'effects' are combined). The second row summarizes findings for geographical distance from McCann and Galbraith (1981). Subtopics are elaborated for geographical distance and governance differences in separate rows.

Table 12 - Summary of literature: geographical distance

Gap	Issues	Effects	Adaptation
Geographical distance	▪ Increased response times ▪ Increased coordination costs ▪ Impersonal & inflexible forms of communication ▪ Conflicts are likely		
Polycontextuality	▪ Unshared contexts, sticky information	▪ Disjointed contexts	▪ Deliberate bridging efforts: representatives, common knowledge, boundary objects, and direct contact
Distance and the interpersonal connection	▪ Less interpersonal contact ▪ Difficulty to build working relationship	▪ Difficulty to handle intricate collaborative tasks	▪ On-site, ftf collaboration preceding remote contact ▪ Liaison at counterpart site ▪ Remote collaboration punctuated by cross-site visits
Electronic communication media	▪ Technology offers new communication capabilities ▪ Dependence on technology ▪ Mediated communications lack richness and interactivity ▪ More deliberate, costly communication ▪ Mismatch electronic media and complex communication needs ▪ More formal, task-oriented communication ▪ Lack of remote communication skills ▪ Inclusion problems	▪ Media cannot support complex task and relationship communications ▪ Infrequent communication patterns ▪ Insufficient cross-site information sharing, information asymmetries, lack of trust building ▪ Collaborative task seems more difficult, people lack the big picture ▪ People work from assumptions ▪ Conflicts likely, yet difficult to handle	▪ Alternating different types of media and visits ▪ Foster reciprocal knowledge ▪ Develop remote communication skills: more proactive, comprehensive, precise, rapid response, and feedback loops ▪ Careful selection of contributors: common knowledge, ability to function autonomously ▪ More formal, documented collaboration ▪ Modify work division, simplify and chunk work ▪ Ensure reliable, available technology

Groupware	▪ Initial assumption that groupware can exclusively mediate collaboration processes ▪ This increases effort for tasks that require rich interaction ▪ Groupware structures and formalizes collaboration; this may hinder fluid, fast, informal interactions ▪ Inclusion of people in communications, risk of information asymmetries ▪ Limited support for multi-actor, multi-media, real-time interactions		▪ Modified use of groupware: enhances task structuring and multi-site documentation ▪ Rich and complex interactions rely on other media
Remote management	▪ Limited ftf contact between manager and subordinate ▪ Less frequent contact ▪ Manager has less insight in subordinate's context, experiences and communication intentions ▪ More difficult to build rapport and trust		▪ Another person, representing and complementing manager at subordinate's site ▪ Manager proactive to initiate more formal, deliberate communication process at regular pace ▪ Control: (1) Explicit, detailed upfront communication of work expectations (input control). (2) Intermediate deliverables, formal controls points. (3) Emphasis on output control. ▪ Select capable, trustworthy subordinates
Control	▪ Loss of process control, direct supervision controller - controllee ▪ Difficulty to build trust and working relationships	▪ Information asymmetries between controller - controllee ▪ Loss of social contact between controller - controllee	▪ Loss of process control leads to adaptations: (1) Process is made more explicit and transparent; it is simplified, formalized and documented; IT is enabler. (2) Structured setup of regular exchanges; proactive attitude; update counterpart on local context and constraints ▪ Emphasis on input and output control modes ▪ Input control: selection; ftf socialization before period of remote collaboration

Development methodology	▪ offshore staff not involved in requirements analysis	▪ Offshore staff lacks know-how on customer's business and requirements ▪ They become strongly dependent on onshore customer organization	▪ Direct involvement offshore staff in requirements analysis process ▪ Use of prototyping as a tool to make the product and development process more explicit

Table 13 - Summary of literature: time zone differences

Gap	Issues	Effects	Adaptation
Time zone differences	▪ Limited windows for real-time communication; outside window risk of delays ▪ Shift to asynchronous (lean) media, even if tasks demand otherwise ▪ Unawareness of counterpart's time constraints and preferences due to insufficient exchanges; risk of confusion, conflict, work delays		▪ Update counterpart on time constraints, preferences, and planning ▪ Comprehensive asynchronous messages so that counterpart can proceed without real time contact ▪ Adapt local task prioritization, working hours, and staff availability to counterpart ▪ Local staff shifts to counterpart site's time zone

Table 14 - Summary of literature: governance differences

Gap	Issues Effects	Adaptation
Governance differences	▪ Vendor staff lacks knowledge of client's business; difficulty to acquire this knowledge remotely ▪ Difficulty for vendor staff to receive feedback from client staff ▪ Assignment of overall project responsibility not clear ▪ Difficulty to manage task dependencies and communication linkages between onshore and offshore teams ▪ Reliance on interpersonal rapport between client and vendor staff less feasible ▪ Reciprocal control challenges because of distance and lateral client-vendor relationship	▪ Installing of offshore manager for vendor team ▪ Use of prototyping to elicit client feedback ▪ More explicit, documented, formalized project process ▪ Vendor liaisons at client site; reciprocal visits
Liaisons	▪ Liaisons channel inter-site communications; their onsite presence facilitates catering for counterpart site's needs ▪ Lack of relationship building between onshore and offshore team ▪ Dependence on liaison's interpretation of communications ▪ Liaison as exclusive gateway may become bottleneck for communications, add little value, and makes project vulnerable for communication breakdowns	▪ Multiple liaisons ▪ Copying communications as backup

Table 15 - Summary of literature: cultural differences

Gap	Issues Effects	Adaptation
Cultural differences	▪ Lack of common knowledge, and reciprocal knowledge ▪ Increases need for information processing, and rich media; this may not be feasible remotely ▪ Risk of miscommunications using lean media; difficulty of becoming aware of this	▪ Increase common, reciprocal knowledge across sites by e.g. staff selection

Table 16 - Summary of literature: infrastructural differences

Gap	Issues Effects	Adaptation
Infrastructural differences	▪ Infrastructural differences surface especially in inter-firm projects (e.g., vendor staff needs client infrastructure for development and testing) ▪ Strong impact because people rely heavily on IT for remote connectivity ▪ Increased perception of distance, and increased efforts to collaborate	▪ Embed vendor staff in client's infrastructure: remote network access (email, phone) ▪ common, remotely shared project databases ▪ standardization of infrastructures across sites

A number of themes recur across the rows. For issues and effects, differences materialize as lack of information, knowledge, and relationships. Research shows that people have struggled with these concerns, and adapted as follows:

- Deliberate attention to some form of face-to-face contact, visits, and liaisons
- Improving people's awareness of remote counterparts; enhancing their communication skills
- Re-thinking the way work is divided, structured, and task dependencies are created
- Becoming more explicit, emphasizing formalization, documentation, and standardization

Our empirical research intends to further substantiate and extend these insights.

PART 3 EMPIRICAL RESEARCH

The empirical section of our research reports on two qualitative case studies. The first case at DiskCo concerns the implementation of packaged software across multiple sites in the Far East region. The second case focuses on a project at CarCo that involved SoftHouse as offshore vendor. We adopted a qualitative case study methodology that is explained in the first chapter. The case studies feature a descriptive part and interpretive analyses that is strongly data-driven. The next part contains our cross-case analysis that is more positivist oriented.

Chapter 8 Case Study Research Methodology

In this section, we outline our approach for conducting qualitative case studies. We reflect on the methodological dimension of our research cycles as indicated in Figure 8. We describe our motivation for adopting a case study research methodology, and elaborate on design and preparation. Next, our field work at DiskCo and CarCo is discussed, followed by techniques for processing and managing empirical data. We indicate our approach to analyzing data per single case and across the case studies. The section concludes with an exposé on quality criteria and their application to our empirical work.

§ 8.1 Motivation for Case Study Research Methodology

> "The motivation for doing qualitative research, as opposed to quantitative research, comes from the observation that, if there is one thing which distinguishes humans from the natural world, it is our ability to talk! Qualitative research methods are designed to help researchers understand people and the social and cultural contexts within which they live." (Myers, 2001)

Empirical research connects an investigator in some form to a real-life setting. His methodology for this process depends on a number of factors. First, his preferences and capabilities. Myers' (2001) quote at the beginning of this section frames qualitative research in terms of relating to human beings as objects of study. An advantage of social science research is that the researcher can talk with individuals and groups. This differentiates the field from studies on for instance animals, processes in our natural environment, and man-made artifacts. We liked doing qualitative research, precisely because we could talk to interviewees and analyze their verbalization of experiences. We preferred real-life projects over student teams or experiments (Jarvenpaa & Leidner, 1998). We believed that this would contribute to the validity of our study and its relevance to practitioners.

Second, research constraints scope an empirical methodology. Like any project, our study faced constraints of the researcher, his research context, and resources, e.g., its temporal scope and budget. Especially with dispersed temporary systems, the researcher must make choices as to how (long) he relates to a real-life setting. We would have liked to do a longitudinal investigation with visits to places all over the world, but this is unfeasible. Qualitative case study research enabled temporary interaction with an empirical setting. We could talk to a number of people and ask on their experiences. Since our immersion in a project context was temporarily limited, we could accomplish two large case studies. Long term participation would have resulted in a single case study. This would have limited replication logic.

Third, an empirical research strategy depends on the properties of that study. We discuss here the role of three conditions as distinguished by Yin (1994: 4). These define the choice for different empirical approaches - experiment, survey, archival analysis, history, and case study.

- **Type of research question** - The nature of a research question is defined by the interrogative word used in that sentence. Key words include "Who", "What", "Where", "How", and "Why" (Yin, 1994). Our research questions move from "What" questions to "How". The first three "What" questions ask for descriptions (e.g., "What are coordination and control modes?"). In general, for this type of question one could adopt any of the methodologies earlier introduced. "How" questions are explanatory. Yin (1994) suggests to use case studies, experiments or histories under these conditions. Of these, experiments would not allow us to enter 'real-life' global projects. Historic research appeared a less relevant strategy since we study a contemporary phenomenon.

- **Extent of control an investigator has over actual behavioral events** - An investigator's access to an empirical setting further determines his research strategy. We had the opportunity to conduct on-site research at DiskCo and CarCo. This made it possible to move beyond a completely historic study. Experiments would provide a high degree of control but lack the flavor of a project in the business community.

- **Degree of focus on contemporary versus historical events** - Global software projects constitute a contemporary phenomenon (see also Table 2). Their widespread use started around mid 1990s when organizations in the US and Western Europe outsourced IT services to vendors in e.g. India, Philippines, and Eastern Europe. As Yin (1994) mentions, the case study methodology is an appropriate strategy for these contemporary events. The operational existence of a setting - as opposed to a historic study - implies that the researchers can deploy a broad range of data collection sources, like interviews, observations and (electronic) documentation.

§ 8.2 Case Study Design and Preparation

A case study connects a researcher temporarily to an organizational setting. Case study design defines how he intends to accomplish this. It outlines parameters for the mode of connectivity and the object thereof. We elaborate here on a number of general dimensions. Next, we explain our approach to case study selection and data collection in a dispersed research environment. We pay attention to skills and knowledge required for field work, and elaborate on the specifics of preparing data collection.

The nature of our study is explanatory. We seek to understand how global distributedness affects modes of coordination and control. As context of this phenomenon, we focus on temporary systems. This continues a tradition started by scholars like (Goodman & Goodman, 1972), (Bryman et al., 1987), and (Meyerson et al., 1996). These systems are defined as a collective endeavor that is supposed to last for a limited period of time. It may involve people from different departments, organizations, and sites. We look geographically dispersed projects that concern the development and/ or implementation of software. Our study continues earlier work on offshore software projects that tapped into the first wave of project globalization (Kumar & Willcocks, 1996).

While the temporary system as such is our primary unit of analysis, we take into account what exceeds its boundaries, like a company's transnational management structure. We also pay attention to more fine-grained phenomena, within its boundaries. These include project stages, separate locations, and connections between sites. Our design is therefore embedded as opposed to holistic (Yin, 1994: 41). An assessment of global distributedness concerns predominantly inter-site coordination and control issues. These are the primary point of attention. In addition, we elaborate on events within a single site if these are relevant to understand the temporary system as a whole. For instance, autonomy of staff at one site may reduce remote management and communications needs. Or unique features of operations at one site may complicate the job of people assisting from another site.

On the content side, our research scope could be considered broad as compared to more positivist oriented studies. First, we include a number of gaps to capture global distributedness. Second, adoption of coordination and control means that two large areas had to be integrated and assessed. This decision was made based on the interwovenness of the two constructs in literature. For each construct, we included portfolio's of mechanisms that cover a multidisciplinary range of areas - sociology, organization sciences, communications studies, and cognitive science. Overall, we made a trade-off between broadness with the advantage of covering a large range of factors that could be of relevance to understand the phenomenon. And on the other hand a tight focus which facilitates conceptual coherence.

We decided to conduct multiple case studies. Not in order to generalize our findings to a larger population, but to increase replication logic (see a later section on quality of our case study research) (Eisenhardt, 1991; Yin, 1994). DiskCo and CarCo were our main studies and are reported here. We also conducted a couple of smaller studies while in Singapore. These provided additional insights in important themes. We did not move beyond two large studies because of resource constraints, especially time.

When entering a case setting, we adopted a retrospective-longitudinal perspective. We asked people for their experiences so far in the project they were working on. For DiskCo we were two weeks on-site in May 1999, and collected data on the Oracle project that started for the Far East in 1996. CarCo's Goldd project was followed for a longer period of time. Our co-investigator participated in the project as on-site administrator between September 1996 and March 1997. She logged her experiences during that time and conducted interviews. The author visited the German site in June 1997 for reflective interviews.

§ 8.2.1 Case Study Selection

The case study selection process was defined by a combination of factors. We were looking for software projects that met the criteria outlined above. For reasons of feasibility, they should be medium to large size (about 10 to 30 people), dispersed over 2 to 4 sites. We preferred project with sites in different continents, like the US, Europe, and Asia/ Pacific region. The collective task involving dispersed actors should be complex, i.e., not fixing bugs or a help desk. Our research was funded by Erasmus University - Department of Decision & Information Sciences at Rotterdam School of Management, Erasmus Research Institute for Management (ERIM), and Trustfonds. Participating companies invested time and resources to make the research feasible.

We found our first case study - CarCo - through contacts from our supervisor with a graduate student at Rotterdam School of Management, Erasmus University. The so-called Goldd project involved CarCo units from US and Germany, and an outsourcing partner in the UK and India. We investigated how participating individuals had experienced the project.

DiskCo was our second case. We contacted Kanapaty Pelly Periasamy from Nanyang Technological University (NTU) at the International Conference on Information Systems in Helsinki, December 1998. He used his network of IT firms in Singapore and found DiskCo plus some smaller firms willing to participate. DiskCo Singapore had almost completed a regional roll-out of Oracle ERP as part of a global implementation trajectory. We focused on their local and regional experiences.

§ 8.2.2 Collecting Data in a Multi-site Research Environment

Traditionally, it seems that social researchers were considered to conduct empirical research in a single context. They met people with various role in an organization (Burgelman, 1983; Kunda, 1992), traced the performance of a team (Ancona, 1992; Weick, 1993a), or investigated the role of individuals (Mintzberg, 1994). In today's dispersed work place, researchers must rethink how to connect to an empirical setting if their unit of analysis includes more than one context.
Two questions seem relevant in this respect. First, does the researcher meet people in person or contact them remotely? If he wants to meet them face-to-face, he must arrange for sequential visits to the various locations (Marschan, 1996). Remote exchange reduces travel costs but also the richness of his encounters (Daft & Macintosh, 1981). A second question is whether he connects to people directly, or through other persons. In the latter case, interpretation issues could arise. We explain our approach here and elaborate more on the topic in the section on field work.

For DiskCo, initially we relied on KKP to arrange for contact with the firm. This was convenient in the sense that we did not know yet DiskCo personnel, but we knew Dr. Periasamy and he knew the company. Upon our arrival, we - author and Mr. Diepeveen - conducted on-site interviews. Interviews were conducted with just the interviewee (one at a time) and the interviewers - the author and Mr. Diepeveen. We organized face-to-face interviews with people working at DiskCo regional HQ in Singapore. Teleconferences (audio-only) were held with DiskCo staff working in other areas of Singapore or Malaysia. Afterwards, we maintained some remote, direct contact with the VP IT and his director Applications Development.

In the case of CarCo, most data collection was accomplished by Ms Cijntje, i.e., liaised research. She talked to people face-to-face in Cologne, including visiting Indian team members. Through videoconferencing, she interviewed a person in Detroit. We visited the German site once and conducted together with Ms Cijntje face-to-face interviews.

§ 8.2.3 Skills and Knowledge for Field Work

Qualitative investigation requires extensive preparation to smoothen the transition towards a research context. It encompasses a myriad of dimensions and details, especially when conducted internationally. Several competence and skills areas can be distinguished for which preparation is indispensable (Yin, 1994).

First, we prepared ourselves extensively on the content side. We ensured a solid theoretical background and read professional-oriented literature as well. We sharpened our research focus as much as possible, in particular for the DiskCo case that was conducted about 2 years after the CarCo case.

Second, we enhanced our data collection skills. We consulted various resources on interviewing techniques (Fontana & Frey, 1994; Rubin & Rubin, 1995), and practiced these. Specific skills include managing the interview curve (the process), listening well, and asking questions that are appropriate for a particular interviewee and the stage of an interview.

Third, we prepared ourselves on the case organizations' context, often in cooperation with our co-investigator. We checked learned more about a company and its industry through public resources like articles and internet. With our European background, we collected extensive information on Singapore and its surrounding region. We subscribed to news services, checked internet sites, and acquired cross cultural information.[32]

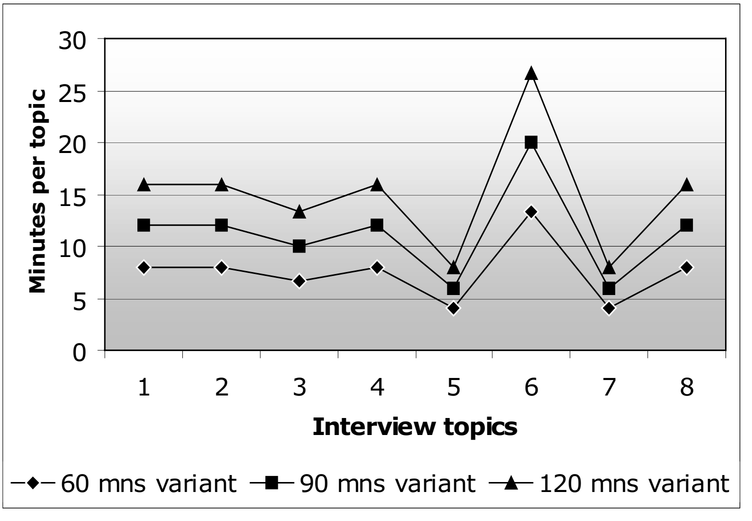
Fourth, time zones of sites involved in a project were checked beforehand. We developed a format for displaying time zone differences, and made print outs for data collection and analysis.

[32] For instance, culturegrams on Singapore, China, India, and Malaysia from Kennedy Center Publications at BYU, www.culturegrams.org.

§ 8.2.4 Preparation DiskCo case

For the DiskCo case we developed several 'Research products'. These were destined for DiskCo or the researchers (author and co-investigator Mr. Berry Diepeveen). DiskCo received first of all a flyer that described the research in detail as a sort of brochure. Upon their request, we developed more specific documents that outlined how participation in our research program worked. This clarified reciprocal expectations. Interviewees received a document with a condensed set of topics and questions they could expect. All these resources were mailed in digital format to Dr. Periasamy and were relayed from there to DiskCo.

We developed an extensive research manual for ourselves, Mr. Diepeveen, Dr. Periasamy and NTU administrative purposes. It defined our research cycle that was organized in stages: field work set-up, preparation of field work, conducting field work on-site, ex post contact and procedures, and analysis and reporting. The manual indicated the types of data sources we would collect, e.g., interviews, documentation, and direct observation. We customized interview duration and topics for different roles, like executives, project managers and users. Figure 38 gives an example of scenario's for interviews with project managers. It shows how many minutes we intended to spend on for 8 topic areas (depending in the overall length of the interview).



Where interview topics stand for:

1. Key Information
2. "Gaps"
3. System & Development Process
4. The Project Team(s)
5. User Connections
6. The Managerial Role
7. Complexity & Uncertainty
8. Key Lessons Learnt

Figure 38 - Interview planning for project managers

We setup an interview protocol to complement the manual on the content side. It followed the research questions, and fit within our conceptual lens. The questions were designed for semi-structured interviews. We tried to balance our focus with the interviewees' story line. This document contained some questions from Mr. Diepeveen that extended the author's perspective.

Before going to interviews, we prepared taping equipment, and other resources like pencils and paper. With Mr. Diepeveen we agreed on procedures and signals to coordinate our actions during an interview. At a later stage, we refined our interview questions. Evenings before an interview we would prepare a separate sheet at the NTU campus. All resources for DiskCo are kept accessible in their original format and available upon request.

§ 8.2.5 Preparation CarCo case

The CarCo case was conducted at an early stage in our research project. We developed documents for empirical research together with Ms Cijntje. Most of the time, the author would submit a first version to Ms Cijntje and receive comments based on her experiences in the CarCo context. This process was repeated until we had a satisfactory protocol. A first round of (semi-structured) interviews was conducted late February 1997. We developed an interview protocol around four areas: overall project tasks, individual project tasks, working with others/ communications, and achievements/ crises. A second round of interview took place in March and April. By that time we had a much more refined set of questions structured in a systematic fashion in six sections: coordination mechanisms, gaps & coordination mechanisms, role of IT, control mechanisms, gaps & control mechanism, and role of IT. In a separate document we outlined for Ms Cijntje how the various mechanisms and gaps were defined. In some cases, Ms Cijntje could not talk to people face-to-face or remotely. She created forms with open questions and some with a limited number of answering options. The author's preparation for his visit to Cologne in June 1997 included areas mentioned earlier: interviewing skills, company information, and research content and focus. We developed an interview protocol on paper. Resources for CarCo are mostly available as reference material.

§ 8.3 Field Work

Field work refers to the stage of research when the author connects to an empirical setting. In fact, this process starts already during the preparatory phase. But it becomes more immersive at some point. For a geographically dispersed environment, one is confronted with some constraints. Budget-wise, it is unfeasible to visit far-flung locations, or even stay for a longer period at one site. Remote contacting of people in a setting may be difficult too. They may not understand the objectives of a research project. And the researcher cannot visualize what a context looks like, and how his field work may fit in. Together, these factors require some choices, each with pros and cons. Two important dimensions include on-site research versus remote contact, and direct interaction between the researcher and interviewees versus liaised contact. Table 17 depicts these dimensions with four resulting options. In terms of pros and cons, face-to-face (rows) contact yields rich date and allows for interactive discussions (Daft & Lewin, 1984). Yet it requires traveling on the side of the researcher to meet the interviewee. Direct contact (columns) reduces interpretation layers but demands time and effort to connect to another context. Liaisons may smoothen this bridging by means of their familiarity with both the researcher and interviewees (Engeström et al., 1995; Galbraith, 1973). We discuss our approach briefly here and elaborate for each case in the next sections.

Table 17 - Research modes

	Direct contact	Liaised contact
Face-to-face, collocated research	Cell A - DiskCo: ▪ On-site research Singapore site A	Cell B - DiskCo: ▪ HHT on-site research coordination
	Cell A - CarCo: ▪ Ms Cijntje participant-observer ▪ On-site research Cologne	Cell B - CarCo: ▪ Ms Cijntje empirical research Cologne
Remote, electronically mediated research	Cell C - DiskCo: ▪ Teleconferences Singapore, Malaysia ▪ Email CPW, HHT	Cell D - DiskCo: ▪ Preparation through Dr. Periasamy
	Cell C - CarCo: ▪ Contact with Ms Cijntje while she was in Cologne	Cell D - CarCo: ▪ Ms Cijntje empirical research Detroit

DiskCo fieldwork relied mostly on face-to-face interviews with members of the Oracle conversion team in Singapore site A (cell A). The author conducted these with Mr. Diepeveen, graduate student at that time at Erasmus University, Rotterdam School of Management. During our stay there, we setup up conference calls to a person temporarily stationed at another plant in Singapore, and staff in Malaysia (cell C). After our on-site field work, we stayed for other research projects in Singapore and exchanged a few emails with CPW and HHT (cell C). In the preparatory stage of our field work, we worked not directly with DiskCo personnel, but through Kanapaty Pelly Periasamy from Nanyang Technological University (NTU) (cell D). He liaised with CPW (VP Information Technologies) to explain our research and relay questions from DiskCo to the author. HHT (Director Applications Development) connected to potential interviewees. As far as we know, she explained our research and setup up interview times (cell B).

For CarCo, Ms Amanda Cijntje (graduate student at that time at Erasmus University, Rotterdam School of Management) participated in the Goldd project. At the same time, she worked with the author on joint research (cell A). The author visited Cologne once for on-site interviews (cell A). Ms Cijntje conducted multiple collocated interviews with CarCo and SoftHouse staff in Cologne (cell B). She set up twice a videoconferencing session with a CarCo staff member in Detroit (cell D). The author interacted with Ms Cijntje during her stay in Cologne through phone calls and mostly emails (cell C).

§ 8.3.1 DiskCo case

For fieldwork on the DiskCo case, the author and co-investigator Mr. Diepeveen flew from Amsterdam to Singapore early May 1999. They stayed for a month at visitor accommodation on the campus of Nanyang Technological University (NTU), in the western part of Singapore. The first several days were used for acclimatizing and meeting with people from Nut's School of Accountancy & Business who supported our research. Most notably, Dr. Periasamy who had arranged access to case study companies, and Christina So head of the Strategy and Information Systems department that hosted our visit.

On May 11, 1999, we paid our first visit to DiskCo site A in Singapore. During an hour's meeting, the author, Mr. Diepeveen and Dr. Periasamy met the Vice President Information Technologies Mr. CPW, and the Director Applications Development Information Technologies, Ms. HHT.[33] We discussed the background of the Oracle project, and outlined the contours of our fieldwork investigation, consisting mainly of interviewing people involved in the Far East implementation. The Oracle project concerned a roll-out of Oracle ERP at DiskCo sites around the world. We focused on the Far East implementations (China, Malaysia, Singapore) with the exception of Thailand. The case is elaborated in detail in a later section.

From May 12, 1999 onwards, the author and Mr. Diepeveen commuted regularly to DiskCo site A for interviews and collecting other sources of data. We collected a broad and deep set of data, covering the Oracle implementation project that took from late 1997 until mid 1999 (see project time line Table 25). We entered the project in its final stage, so most of the local implementations in the Far East had already taken place. This meant that the nature of our data collection process was reflective, i.e., people telling about their experience during earlier months.

We interviewed people from the IT department in Singapore site A, Singapore site E, and Malaysia site A. In the latter site, a separate task force for data conversion was setup to cover that area in the Oracle project. We also talked to key users from departments in Singapore site A and Malaysia site A. Key users represent a larger user group of a certain department (like Finance). They were part of the so-called core team, a cross-functional group that was responsible for Oracle implementations. Table 18 gives an overview of interviewees. The table is setup as a matrix of sites (Singapore site A and Malaysia site A), and people's functional area (IT or user departments). Names have been abbreviated for maintaining confidentiality. CPW, head of the IT group, worked with HHT as on-site director for Applications Development. She in turn steered the Oracle core team consisting of IT members OBT, GP, JPL, SCC and a few others. From user functions, JLL and ST participated in the core team as liaison for their department. JNL headed the data conversion team in Malaysia site A, with MC as one of the key members. SKL, ET and some of ET's colleagues who participated in our interview represented two user departments in Malaysia site A.

[33] Names have been abbreviated to maintain confidentiality.

Table 18 - Interviewees DiskCo Oracle project

Functional area:	Interviewee work location: Singapore (site A)[34]		Malaysia (site A)	
	Interviewee name:	Interviewee role:	Interviewee name:	Interviewee role:
Information Technologies (IT)	CPW	Vice President IT	JNL	Project Manager Data Conversion Team
	HHT	Director Applications Development IT	MC	Member Data Conversion Team
	OBT	Member Oracle Conversion Team		
	GP	Member Oracle Conversion Team		
	JPL	Member Oracle Conversion Team		
	SCC	Member Oracle Conversion Team		
User departments	JLL	Key User, Material & System	ET and some colleagues	Key User, Inventory Control
	ST	Key User, Finance	SKL	Key User, Finance

Our on-site work commenced after the kick off meeting on May 10, 1999. Table 19 provides an overview of our interactions with DiskCo personnel. It includes all interviews, and most informal conversations and email exchanges. The columns show from left to right: (1) interviewee name (abbreviated), (2) date and location (NL stands for The Netherlands, NTU stands for the campus of Nanyang Technological University), (3) interviewers (author and usually Mr. Diepeveen (BD) as co-investigator), and interview mode ("ftf" stands for face-to-face interviews). DiskCo teleconferencing facilities were used from Singapore site A. (4) Data processing refers to the way we handled interviews and conversations afterwards. All interviews have been fully transcribed by the author. We noted down interesting thoughts from conversations, and saved email messages for later reference. Column (5) of Table 19 gives a unique code assigned to each data source per row. The letter after DiskCo identifies all sources related to an interviewee. For instance, an "A" for CPW, and "B" for HHT. The number shows the sequence of data collection per interviewee.

[34] At the time of our study, GP was stationed at Singapore site E.

Table 19 - Interviews and conversations DiskCo Oracle project

Interviewee	Interview Date & Location	Interviewers & Interview mode	Data Processing	Code
CPW	May 10, 1999, Singapore site A	Author, BD (ftf)	Ex post report	DiskCo-A-1
	May 11, 1999, Singapore site A (lunch)	Author, BD (ftf)	Ex post report	DiskCo-A-2
	May 12, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-A-3
	May 14, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-A-4
	May 21, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-A-5
	May 24, 1999, Singapore site A - NTU	Author (e-mail)	Full transcript	DiskCo-A-6
HHT	May 11, 1999, Singapore site A	Author, (e-mail)	Full transcript	DiskCo-B-1
	May 17, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-B-2
	May 20, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-B-3
	June 9, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-B-4
	July, 1999, Singapore site A - NL	Author, (e-mail)	Full transcript	DiskCo-B-5
OBT	May 13, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-C-1
JPL	May 17, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-I-1
SCC	May 17, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-J-1
ST	May 14, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-H-1
JLL	May 14, 1999, Singapore site A	Author, BD (ftf)	Full transcript	DiskCo-G-1
GP	May 13, 1999, Singapore site A - Singapore site E	Author, BD (teleconference)	Full transcript	DiskCo-D-1
JNL	May 13, 1999, Singapore site A - Malaysia site A	Author, BD (teleconference)	Full transcript	DiskCo-F-1
MC	May 13, 1999, Singapore site A - Malaysia site A	Author, BD (teleconference)	Full transcript	DiskCo-E-1
SKL	May 18, 1999, Singapore site A - Malaysia site A	Author, BD (teleconference)	Full transcript	DiskCo-L-1
ET & some colleagues	May 17, 1999, Singapore site A - Malaysia site A	Author, BD (teleconference)	Full transcript	DiskCo-K-1

We started interviewing with HHT on May 11th, and talked during that day also to CPW over lunch. From then on, we maintained a rapid pace of interviewing with sometimes 2 or 3 interviews on a day. Some rows refer to email exchanges as indicated in the "Interviewers & Mode" column. We held teleconferences from DiskCo's Singapore site A to GP in Singapore site E, and a couple of people in Malaysia site A. DiskCo-A-6 stands for an email exchange with CPW when the author and Mr. Diepeveen were working at Nanyang Technological University (NTU) towards the end of their stay in Singapore. DiskCo-B-5 refers to an email exchange with HHT when the authors where back in the Netherlands (NL). In total we conducted 18 interviews of which 15 were face-to-face at Singapore HQ, and 3 remotely to another site in Singapore and Malaysia.

Over the course of the interview sessions, we sometimes refined our focus to zoom in on relevant aspects of the Oracle conversion. Typically, on evenings before a session, the author and Mr. Diepeveen would discuss how to enhance the usefulness of an interview.

We prepared interview notes geared to an interviewee's position (executive, manager, IT project team member, or key user), and the status of our inquiry process. The refined interview protocols are retained as reference material by the author, as are all tapes, notes, and transcripts.
Interviews were always conducted by the author and Mr. Diepeveen. We used the research manual and a print-out from HHT to check names. Interviews followed a standard procedure of mutual introductions. The author and Mr. Diepeveen occasionally switched roles, from lead interviewer and observer. This promoted recuperating, and a fresh look at the interview pattern. Interviews lasted between 1 and 2 hours and were taped from beginning to end. We managed the interview in terms of process and content, following specific resources on these skill areas (Fontana & Frey, 1994; Rubin & Rubin, 1995).

Other data sources
While working on-site at DiskCo, we collected all sorts of data in addition to taping the interviews. During interviews we made notes and had blank sheets of paper available. Sometimes we asked people to draw an organization chart, or to clarify a point.
The author and Mr. Diepeveen were granted access to DiskCo's global intranet from a computer at Singapore site A. From the standard access page, we followed numerous links. We visited sites that were related to topic areas, specific technologies, sites, or functional areas. Queries were made on specific topics. Data relevant to our study was saved for processing at a later stage.

Paper-based corporate documents were collected or copied. For instance, we received or made copies of Oracle's Application Implementation Method, organization charts, and contact lists. We also picked up copies from an internal DiskCo publication to read about recent achievements and plans. After our on-site investigation, CPW kindly mailed us the master implementation plan. This was an Excel file that listed major implementation steps for all DiskCo site across the globe.
DiskCo's internet sites was accessed from Singapore site A and NTU. Before arriving in Singapore we had already checked information on DiskCo and its industry from database queries. We now looked for more specific information and updates, like a recent annual report. We also checked sites from companies involved in the case (SysCo), or whose products were used at DiskCo (Oracle, Lotus Notes, CCC/Harvest).
Dr. Periasamy kindly provided us with a book from NTU that contained a case study on DiskCo (Lee & Palvia, 1996). He also provided us with tapes from Mr. Lee's research on DiskCo some years earlier. Portions from these were copied and later transcribed.
The author took several pictures at DiskCo - from the building, videoconferencing room, and a white board with drawings from CPW, the author and Mr. Diepeveen.
During one session (DiskCorp-B-2), HHT demonstrated us Lotus Notes databases. She explained different types of databases and ways in which DiskCo used the application world wide. We received print-outs from several screens as reference material.
Being on-site provided us with a unique view on people's physical work space, their local work behaviors, and remote teleconversations. We used DiskCo's restaurant for lunch and looked at the drive manufacturing hall on-site.
After two weeks of on-site research, we processed some of the material and delivered a first cut of the case description (van Fenema & Diepeveen, 1999). It was mailed to HHT and Dr. Periasamy. Their feedback was used to enhance its completeness and accuracy.

§ 8.3.2 CarCo case

The CarCo case was initiated when Amanda Cijntje worked with the author's supervisor on her masters thesis. From September 1996 onwards, she participated in the Goldd project for administrative duties and local coordination. She stayed there until March 1997, logging her experiences on a weekly basis (see data source CarCo-K-1[35] in Table 20). The author's involvement in Goldd commenced late 1996. We worked with Ms Cijntje to develop a research setup that would match reciprocal interests. Our theoretical work had started around October 1996. It was used for a first opportunity to conduct interviews in December 1996 (see CarCo-E-1 in Table 20, and reflections on that interview CarCo-E-3). At that time, SPB from the Indian offshore team visited the German unit on his way back from a meeting in Detroit. Over the next weeks, we designed a first semi-structured questionnaire early 1997 (available upon request). It was refined through interactions with our supervisor and Ms Cijntje. While she worked in Cologne we exchanged emails, or called occasionally. Sometimes she was in the Netherlands for on-site meetings in Rotterdam. Ms Cijntje (abbreviated as AC) conducted a first round of interviews late February 1997 (see interviews in Table 20). Most of these were face-to-face in Cologne with CarCo staff - HH, HN, MB. Because of local constraints, Ms Cijntje used a semi-structured form for parts of her interview with MB (CarCo-C-2). She had a second opportunity to talk to SPB who assisted BJ as temporary onshore liaison. BW had left the project but was willing to fill out and submit electronically a semi-structured form. For JF - a CarCo staff member in Detroit, USA - Ms Cijntje set up a videoconference call. Interviews were processed and analyzed. Ms Cijntje wrote shortly after interviews comprehensive notes and reflections.

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[35] The data code consists of the case study name (CarCo), a letter to identify a member of the Goldd project team, and a number to differentiate data per participant. The column shows abbreviations for Goldd partipants' names, as well as their role. For details see the description of the CarCo case.

Table 20 - Key data CarCo Goldd project

Goldd Participant & Role	Date & Location	Researchers & Interview mode	Data Processing	Code
HH, Project Leader	February 27, 1997, Cologne	AC (ftf)	Ex post report	CarCo-A-1
	March 6, 1997, Cologne	AC (ftf)	Ex post report	CarCo-A-2
	June 12, 1997, Cologne	Author, AC (ftf)	Full transcript	CarCo-A-3
	January 20-24, 1997	PowerPoint	N.A.	CarCo-A-4
	Spring, 1997, Cologne	AC, supervisor (ftf)	Ex post discussion	CarCo-A-5
HN, Senior Analyst	February 20, 1997, Cologne	AC (ftf)	Ex post report	CarCo-B-1
	April, 1997, Cologne	AC (ftf)	Ex post report	CarCo-B-2
	June 12, 1997, Cologne	Author, AC (ftf)	Full transcript	CarCo-B-3
MB, Data modeling	February 27, 1997, Cologne	AC (ftf)	Ex post report	CarCo-C-1
	February 27, 1997, Cologne	AC semi-structured form	Ex post report	CarCo-C-2
	March 5, 1997, Cologne	AC (ftf)	Ex post report	CarCo-C-3
JF, Replacing senior analyst, team leader	February 21, 1997, Cologne	AC (videoconference)	Ex post report	CarCo-D-1
	March 7, 1997, Cologne	AC (videoconference)	Ex post report	CarCo-D-2
SPB, Offshore senior team member, later also onshore liaison	December 17, 1996, Cologne	AC (ftf)	Ex post report	CarCo-E-1
	February 21, 1997, Cologne	AC (ftf)	Ex post report	CarCo-E-2
	December 17, 1996, Cologne	AC reflections	Ex post report	CarCo-E-3
MD, Offshore senior team member, later also onshore liaison	March 7, 1997, Cologne	AC (ftf)	Ex post report	CarCo-F-1
BW, Initial consultant, onshore liaison, Cologne	February 23, 1997, Cologne	AC semi-structured form	Ex post report	CarCo-G-1
	October 5, 1999	CV from Internet	N.A.	CarCo-G-2
	October 24, 2000	CV from Internet	N.A.	CarCo-G-3
BJ, Replacing consultant, onshore liaison, Cologne	April, 1997, Cologne	AC (ftf)	Ex post report	CarCo-H-1
	June 12, 1997, Cologne (lunch)	Author, AC (ftf)	Ex post report	CarCo-H-2
N.A.	Logs until early March, 1997	AC logs	Ex post report	CarCo-K-1
	Summer, 1997	AC thesis	N.A.	CarCo-K-2

After the first round of interviews, we designed a second set of questions to refine our research. Ms Cijntje conducted this series in March and April with HH, HN, and MB from Cologne, and JF through another videoconference session. She returned to Cologne for these interviews since her internship had ended. Ms Cijntje talked to BJ, the new onshore liaison, and MD from the offshore team (temporary assistant to BJ). These interviews were processed soon afterwards. Somewhere in Spring 1997, the author's supervisor went over to Cologne for an extensive meeting with the project leader, HH. Upon his return, he discussed his impressions with the author. In June 1997, the author visited the Cologne site. Together with Ms Cijntje he interviewed HH and HN, and had lunch with BJ. For that day he had prepared a series of questions to expand on the existing data set. The two interviews were taped and literally transcribed afterwards. Impressions from the lunch with BJ were noted soon afterwards. Other data sources include a PowerPoint presentation prepared by the project leader, HH (CarCo-A-4). BW's curriculum vitae was picked up from the internet in 1999 and 2000. Ms Cijntje's thesis on the CarCo case was used as reference material. Finally, Ms Cijntje retrieved corporate documentation and information from CarCo's intranet and internet site. She communicated regularly with the author in her dual role of on-site participant and researcher. This was either remotely from Cologne, or face-to-face whilst she was in Rotterdam.

§ 8.4 Data Processing and Management

The yield of fieldwork depends to a large extent on data processing and management (Miles & Huberman, 1994). Yin (1994) stresses the value of a formal case study database. It represents in an explicit manner information obtained from fieldwork. We explain here how data was processed and organized for the DiskCo and CarCo case. Raw data from fieldwork at DiskCo included large numbers of standard magnetic tapes, a Microsoft Excel file, some printed pictures, and information from the corporate intranet (see Table 19 for interviews). In their present stage, it appeared challenging to maintain an overview of this data volume, and make meaningful connections. We took several steps to make data accessible. First, data was digitized as much as possible. We transcribed each interview word for word, while at the same time entering analytical thoughts in a separate file. This took months for about 18 interviews of each 1 hour to 1½ hours. Pictures were scanned into jpg format. Second, we built a folder structure for each data category: documents, interviews raw (pure transcriptions), interviews coded (we highlighted and entered comments in these files), intranet, pictures and internet. Next, we created on a meta level a portal file called "Data DiskCo Case". In that file, we entered the same data categories, and created hyperlinks to the actual data files. For instance, we included links to the interview transcripts, pictures, intranet resources, and master plan file. We did the same for the CarCo case and created a supra-case file called "Case Control Center". From there, we had access to DiskCo and CarCo as well as data sets from other researchers, and articles. We linked the case portals to facilitate cross-case analysis. Figure 39 depicts this data structure.

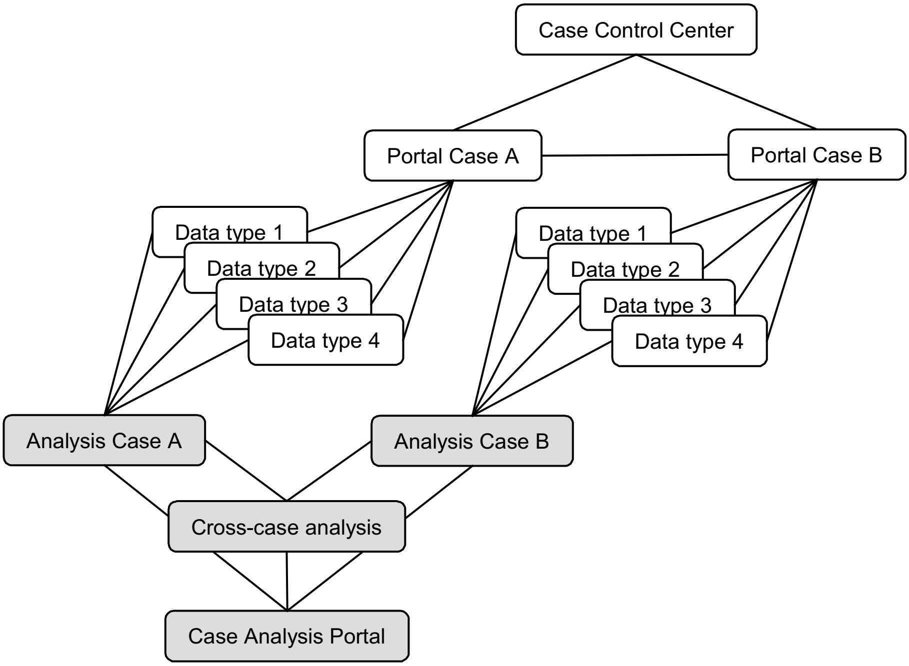

Figure 39 - Organizing for data analysis

The simple logic underlying the environment made it transparent and easily accessible. Hyperlinks created a sort of web surfing experience. Starting from the Case Control Center file, we would click once for any portal; from there we clicked once for full text interview transcripts, PowerPoint files, pictures and so on. Paper based resources were not scanned because of time constraints. This made it more challenging to integrate them in the data analysis process.

We used the environment for highlighting themes in the data sources, and creating links between data files. Separate files were created around promising themes and linked to relevant sentences from interview transcripts. In fact, interaction with data became so convenient that we memorized key pieces.

We linked the database to separate analysis files (light gray in Figure 39) while maintaining its original format. This made it easy to separate the database from our analysis process (Yin, 1994). For each case we setup an analysis portal file that was linked to important data sources. A case analysis portal provided centralized access to the portals, and a file for cross-case analysis.

§ 8.5 Analysis

Analyzing 'data' from a social setting is an intricate process (Yin, 1994). It constitutes a process with cognitive, social, and psychological dimensions. Cognitive because the researcher attempts to conceptualize and understand an empirical setting. The process is social since data is obtained through interactions with an empirical context. And afterwards, the researcher discusses findings with colleagues and others in various settings. Analysis is also a psychological process - it depends on the internal make-up of the researcher. His preferences, mental style and mode of working are indistinguishably intertwined with an empirical study. A few sentences back, we noted data in quotation marks. This is because data constitutes not only explicit notes, tapes, drawings and so forth. It also includes the research's memory, his interpretations and perceptions. We use the term in this broader sense.

The process of qualitative analysis is only in part conscious and deliberate (Stake, 1995). Somehow, the researcher builds a mental world that attempts to understand the empirical setting he has been connected with. This constructing relies on three pillars: research focus, theoretical baggage, and empirical data (see Figure 5 and Figure 40) (Miles & Huberman, 1994). The research focus stems from the overarching objectives of a study, as condensed in research questions. Theory refers to the researcher's immersion in existing literature that is relevant to his study. Empirical data finally encompasses his direct encounters with empirical contexts or representations thereof. For our research, we conducted two major case studies - DiskCo and CarCo - and a few smaller ones. We received data from other researchers (Meadows, 1996b; Millar, 1999), talked with practitioners, and reflected on our own experiences with remote collaboration.

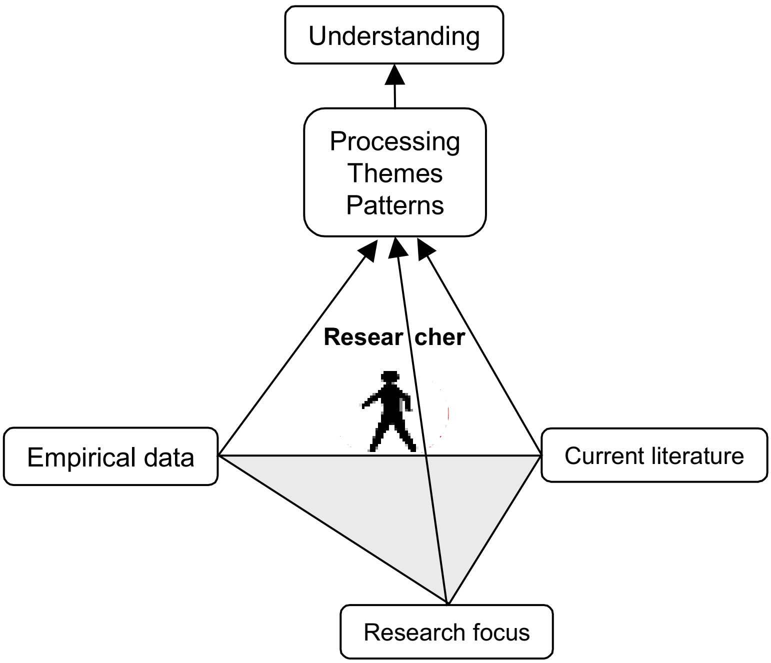

Figure 40 - Researcher and the process of qualitative analysis

In our experience, qualitative analysis is a recurrent process, with multiple cycles. In fact, we interacted with the three pillars Figure 40 countless times. Each time, we somehow made progress in the sense of better understanding our case studies. This means that we developed a conceptual story line that frames what happened in the case studies. A limited set of coherent themes and patterns started to emerge with explanatory power. This conceptual progress interwove data with current literature such that novel insights emerged.

Our description so far of qualitative analysis offers a reflection on the prolonged process we went through. Somehow, this is incompletely captured in techniques, methods and tools that abound in methodological literature (Miles & Huberman, 1994). It is somewhat like preparing a meal - the cooking process and capabilities encompass more than a recipe or ingredients (Kogut & Zander, 1992). Similarly, interaction with 'data' refers not only to manipulation of explicit information. It also implies more tacit processes, like working from memory, flashbacks, brainwaves, and other ad hoc activities. Qualitative analysis is a very intensive process that pulls in the researcher at frequent times and is incompletely controlled. Of course, we supported and channeled it. To this end, we deployed several techniques.

We constructed a digital environment to facilitate data access (Figure 39). It contained mainly Microsoft Office files (Word, PowerPoint, Excel), html files, and jpg files (figures). We maintained original data resources, and used exact copies of the files for analysis. In this data set, we highlighted sections of interest to our research (yellow). For sentences that conveyed important insights we used red or light green. This made subsequent processing of data more efficient. Apart from the data set, we maintained separate files around key themes, like electronic media use, liaisons, and technology. We used Microsoft explorer to query multiple data files, or searched through separate data files using an application's search functionality. The theme files contained multiple hyperlinks to the data set, so that with one click one jumped to data sources like an interview transcript. Hyperlinks made coding of data sources or use of specialized applications largely superfluous. Theme files were organized on a meta level so that our analysis became as accessible as the original data set (Figure 39). With this infrastructure, we deployed common techniques like pattern matching, explanation building and time series (Yin, 1994). With the first technique, we compared patterns from our literature section with those found in our empirical data sets. Explanation building refers to causal links in a data set. We made many drawings with multiple boxes that are connected in a logical manner. Miles and Huberman (1994) describe these as explanatory effects matrices or causal networks. Finally, time series trace the chronology of case studies, this was key to understanding the CarCo case that featured many changes over time. We analyzed what changed, and why, thus recognizing overarching themes. We kept all results from our analyses approaches as reference material.

Together, these procedures helped us define a case's story line while working towards a more generic understanding (Lee, 1991). On an interpretive level, we worked on our understanding of the two cases by going back to the data sets time and again. In the end, we had memorized key sections. This facilitated our writing of case descriptions and single case analyses. Intentionally, we included an extensive amount of data excerpts to make our analysis as transparent and reliable as possible (Kunda, 1992). Getting familiar with the data set was required for developing more generalizable - positivist - understanding (Lee, 1991). We leveraged our intrinsic understanding for a meta-empirical goal (Stake, 1995). In order to accomplish this, we tied our insight into the data sets to the conceptual model. This way, we assessed the extent to which we could use our conceptual lens to explain the cases' story line. If it exceeded our initial framework, we investigated how we had to extend our original understanding, still within the overall research focus.

§ 8.5.1 Cross-case Analysis

Multiple case studies offer a form of generalizability. Not in the statistical sense, but to deepen our understanding of a phenomenon (Miles & Huberman, 1994). A number of case studies strengthen the underpinning of generalizing statements, or what Lee's (1991) calls positive understanding. This leaves a question however. We can develop for each case separately a description, interpretive understanding and positivist understanding. But at which point do we connect the case studies?
Table 21 depicts two dimensions that seem central here. On the one hand, the analytical process of describing a case study, and developing interpretive and positivist understanding (Lee, 1991). And on the other hand, the unit of analysis - one or more single cases, versus a meta-case level. We expand here on the right hand column to answer the question raised above. Light gray cells and arrows show the path we followed.

Table 21 - Philosophical perspective and single versus cross-case analysis

	Single case analysis	Cross-case, integrative analysis
Positivist analysis	Positivist analysis per single case	Positivist cross-case analysis ↗
Interpretive analysis	↗ Interpretive analysis per single case ↑	Interpretive cross-case analysis
Case description	↑ Single case description	Comparison of single case descriptions

First, one could relate descriptions of multiple case studies, but this seems to add little value. Each case presents a unique environment and period of time that does not easily compare to other situations. This applies in particular to research designs with diverse studies. In our case, the DiskCo and CarCo case concerned different types of projects (implementation versus development), and involved different companies and geographical locations. The cases lacked similarity along many dimensions which made comparison not useful. We merely structured the case descriptions in a similar manner.

Second, a researcher could compare interpretive understanding of different cases. This seems to contradict in a sense the nature of this type of analysis. It is closely intertwined with people's subjective understanding of an empirical setting. Interpretive analysis sticks as closely as possible to empirical data to render a credible storyline. Integration across interpretive analyses would jeopardize this quality. The researcher could twist his understanding to achieve artificial connections. We therefore abstained from this approach. Still, our research focus promoted consistency across the interpretive analyses. Many themes recurred in both interpretive analyses. At the same time, we left room for case-specific features and data sources. For instance, the CarCo case has strong process data from Ms Cijntje's logs. We elaborated these to enhance our understanding of people's experiences and adaptations during that project. This would be less interesting for DiskCo.

Third, positivist analysis is by nature more extra-case oriented. It has been described as instrumental research (Stake, 1995), outside oriented (Burell & Morgan, 1979), and focused on the discovery of general laws (Luthans & Davis, 1982). Looking from a positivist angle, the researcher deliberately moves beyond a specific case situation to identify generalizable insights. These factors encourage cross-case analysis. Abstraction from the cases facilitates an integrative comparison of findings from different cases. We adopted this approach and included an integrative chapter. Here, we present our findings from the DiskCo and CarCo case studies. These are preceded by applicable notes from our literature study. The chapter connects insights from our empirical research with current literature, all within the overall research focus (Figure 40). This was facilitated by the coherent theme structure of our interpretive analyses. In this chapter we answers the research questions and show how our empirical work push current know-how a little bit further. We elaborate on this at the beginning of the chapter containing the integrative analysis.

§ 8.6 Reporting

Reporting on case studies is a vital component of the case study methodology (Yin, 1994). It provides not only added value to audiences, but helps the researcher better understand his empirical work. We communicated on the DiskCo and CarCo cases with peers, students, and practitioners. Apart from my work, the co-investigators wrote their own version of the case studies, Mr. Diepeveen for DiskCo (Diepeveen, 1999), and Ms Cijntje for CarCo (Cijntje, 1997). The author published a first short piece on the CarCo case for the International Conference on Information Systems (van Fenema, 1997). On the DiskCo case, the author and Mr. Diepeveen wrote a first cut whilst in Singapore (van Fenema & Diepeveen, 1999). It contained mainly descriptions of the case, and was verified by the Director Applications Development.
After we had transcribed and analyzed the interviews from DiskCo, we wrote a digital white paper. This was the first time that we identified a number of themes that recurred in our interpretive analysis. The paper was finished in April 2000 and loaded on a server. We made it accessible - password protected - to participating companies and a few peers. The author wrote another case study on DiskCo, and used both cases for teaching assignments at Florida International University. We learned from the preparatory process, and received valuable feedback from students. Examples from both cases returned in a conference paper for Erasmus University (van Fenema & Kumar, 2001). Each communication opportunity helped us look at the cases from different angles. This enhanced our understanding and craftsmanship.

§ 8.7 Quality of Case Study Research

With empirical case study research in the social sciences, the investigator temporarily connects to a 'real-life' setting (Yin, 1994). In this interaction process, he obtains impressions that are interpreted according to his frame of reference. The quality of this endeavor is usually defined by four tests: construct validity, internal validity, external validity, and reliability (Kirk & Miller, 1986; Yin, 1994). Yin (1994) operationalizes the tests with several tactics, and relates these to four phases of case study research: research design, data collection, composition of case report, and data analysis (Table 22). We elaborate on these quality criteria in the context of our case study research.

Table 22 - Quality criteria for case study research

	Phases of case study research			
Tests:	Research design	Data collection	Composition	Data analysis
Construct validity		▪ Multiple sources of evidence ▪ Establish chain of evidence	▪ Key informants review case study report	
Internal validity				▪ Pattern matching ▪ Explanation building ▪ Time series analysis
External validity	▪ Replication logic in multiple case studies			
Reliability		▪ Case study protocol ▪ Case study database		

Adopted from: Yin (1994: 33) and modified

§ 8.7.1 Construct Validity

Construct validity refers to the quality of a measurement instrument. More precisely, it concerns the relationship between a construct or theoretical paradigm and their empirical measurements (Kirk & Miller, 1986). Validity is not easily achieved in qualitative research. With this approach, investigators do not have something like the statistical verification procedures common to survey based research. Still, some tactics have been proposed to approximate construct validity in qualitative inquiry (Yin, 1994): multiple sources of evidence, establishing chain of evidence, and having key informants review a case study report. We discuss these for our empirical work.

- ***Multiple sources of evidence*** - For data collection the researcher should obtain data from different sources. This promotes analysis of a phenomenon from different angles (triangulation). We attempted to vary our repertoire of data categories within the overall constraints of our empirical research. In the case of DiskCo these included interviews, electronic communications, corporate documents, intranet/ internet information and pictures of white board drawings and some DiskCo facilities (e.g., videoconferencing room). For CarCo, we relied on our co-investigator's participant-observer role. We conducted interviews and received corporate documentation. We picked resources from the internet on CarCo, the vendor firm (SoftHouse), and one of the independent consultants working on Goldd.

- ***Establishing chain of evidence*** - Results from a case study should be traceable to the original data set. External researchers should be able to identify connections across stages of a case investigation. We achieved this chain transparency by referring to data sources with codes, and including quotes from interviews and other data sources. Data codes uniquely identify a data source and show details like location, time, and data collection mode. We followed protocols for collecting data, and maintained files used for interpretation (Yin, 1994). Together, these techniques promoted the integrative quality of our case research process.

- ***Key informants review case study report*** - Yin (1994) proposes to have key informants from a case context review the eventual report. For DiskCo, we submitted an early version of the case study description to that company. It was reviewed by the Director Applications Development. She provided us with comments that were incorporated in later versions. Corporate PR screened the documents and requested a couple of changes. Others may also have looked at the initial report, like the VP Information Technologies and core team members at Singapore site A. In the case of CarCo, Ms Cijntje had her report checked by the project leader HH. It was used as reference material for our work. We provided Ms Cijntje and Mr. Diepeveen with the opportunity to read the final manuscript.

§ 8.7.2 Internal Validity

Internal validity applies to the analytical phase of case research with causal claims. The investigator attempts to explain the status of a social situation from a number of factors. As Yin (1994) proposes, these explanations be wrong or incomplete. With incomplete information at his disposal, the researcher makes inferences. Internal validity means that he underpins his causal claims as strongly as possible. Yin (1994) suggests three approaches to accomplish this: pattern matching, explanation building, and time series analysis. We elaborate here on what was mentioned in a preceding section on analysis.

- **Pattern matching** - Pattern matching means that a researcher compares predicted patterns with those found in an empirical case. We accomplished this first of all by developing a strong theoretical base. We summarized existing research and drew initial conclusions on patterns likely to be found in actual cases. Having elaborated and analyzed our cases, we included an integrative chapter that brought together expected and actual patterns.

- ***Explanation building*** - Building an explanation implies that the researcher constructs a plausible chain of evidence. Yin (1994) describes the challenges of making theoretical statements that are refined through iterative processes. He suggests that the researcher - while interacting with data and theory - may drift off from his original focus. In order to obviate this risk, the researcher should keep referring back to the original outline of his study. He should also use a case protocol and database. We tried to balance the potential tension between the original focus and conceptual lens, versus new insights derived from the cases. Either extreme would reduce the value of the eventual result. To sustain consistency, we adopted Yin's (1994) proposed techniques for both case studies. These were earlier explained.

- ***Time series analysis*** - Case studies represent social phenomena that change over time. As researchers, we usually pick only a limited time frame for reasons of feasibility and interest. For DiskCo, we entered the project towards the end and asked people to look back on their experience. In our analysis, time played appeared mostly of interest to the descriptive part. The project itself did not change much over time from a process analysis point of view. With CarCo, we traced a longer period of time because our co-investigator worked on-site. Time was very relevant to this case study since people adjusted important properties of their social system such as the organization of communications. We included a separate process analysis to this case to elaborate on these changes and explain them.

§ 8.7.3 External Validity

The third test concerns external validity, i.e., the domain for which findings can be generalized. One could ask whether results from a study have relevance outside its boundaries (Yin, 1994). Results obtained with methodologies like case studies and experiments cannot be generalized in a statistical sense. Unlike survey research, these approaches are not based on an empirical sample that represents a larger population. It is therefore unfeasible to make inferences on that population (Figure 41).

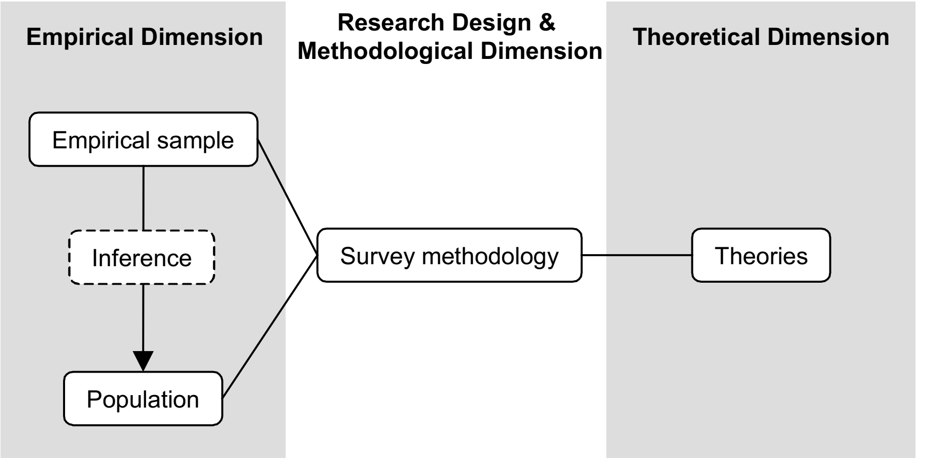

Figure 41 - Statistical generalization

Case study research supports another form of generalization that is analytical. The researcher can suggest broader applicability of his findings when results are confirmed across multiple cases (or experiments). Consistency of conceptual insights derived from more than one case suggest replication logic (Figure 42). This remains on a theoretical level. It does not refer to sample logic which is on a data level.

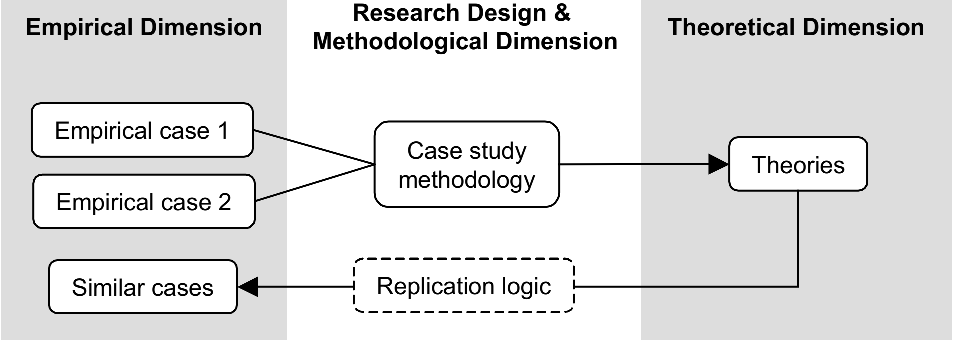

Figure 42 - Replication logic: analytical generalization

Replication logic has played an important role in our research. Starting from our research questions, we have developed a conceptual lens that was consistently used for analyzing empirical research from other scholars. These results were presented and summarized in the theory section. From there, we conducted two large case studies to assess replication of our findings. As a final step, we compared results from our studies with those from other scholars. This enabled identification of recurrent themes.

§ 8.7.4 Reliability

The final test points at the idea that another investigator would come up with the same results if he were to repeat the case study. It makes the results of a case study less dependent on the original researcher, and contributes to objectivity (Kirk & Miller, 1986).[36] Yin (1994) suggests two approaches to ensure reliability: case study protocol, and case study database. Both apply to the data collection phase. We elaborate on their role in our empirical investigation.

- ***Case study protocol*** - For the DiskCo case, we developed an extensive research manual that guided our field work. It covered topics like data sources, field work cycle, and a myriad of details concerning the interview process (supplies, timing, priorities). On the content side, we used an interview protocol that outlined step-wise the topics that we wanted to discuss. At several points, it included questions from Mr. Diepeveen on some complementary areas. During our field work, we slightly modified interview questions and procedures to enhance our effectiveness in that setting. The CarCo case was conducted earlier in our research process. We used several resources on interview and research skills but did not yet have a research manual. We developed protocols for two subsequent rounds of interviews. These were discussed with Ms Cijntje and modified. The protocols described here are available upon request.

- ***Case study database*** - For the DiskCo and CarCo case we set up an integrated digital environment. It contained most data resources that were linked to a case portal file. On a meta-case level, we had a central file for accessing our case studies and empirical data from other investigators. Copies of this environment are maintained and available upon request.

[36] One could argue that repeatability as common in the natural sciences is challenging to achieve in social case study research. The latter focuses on human interactions which seem bound in their unicity to a certain time frame. A hypothetical researcher returning to an earlier case study context may find another firm, other people, and novel interaction patterns.

Chapter 9 DiskCo Case: Multi-site ERP Implementation Far East[37]

This case study deals with DiskCo's implementation of an ERP package in the Far East region. The company converted multiple sites to Oracle ERP and worked closely with US counterparts. We describe the context and setup of this project, and continue with a data-drive analysis.

§ 9.1 Description[38]

The DiskCo case description outlines the context and setup of the Far East Oracle implementation project. It contains information on companies, individuals, and sites involved, and the project timeline. After these basics we elaborate on the situation before the conversion project. The section concludes with an exposé on various dimensions of the project's setup.

§ 9.1.1 Companies, People and Sites

DiskCo is the focal organization of this study. The company offers solutions for data storage and processing to individuals and business. DiskCo's activities include two main categories: physical products (disc and tape drives), and software. We focus on the former category that is organized around disc drive and media operations. The company relies on tightly integrated vertical supply chains that start at production facilities in the US, Europe and Asia for large volumes. Distribution and sales rely on a global network of DiskCo sites and partner organizations. R&D is located in Singapore, and a couple of sites in the US.

Our study zooms in on DiskCo Far East and their role in the global project to implement Oracle ERP. Table 23 shows organizations and people tied to our study. We conducted research at DiskCo's regional HQ for the Far East in Singapore (site A). The right hand column shows whom we interviewed, including their role. Names are represented by 2 or 3 letter combinations to maintain confidentiality.
We interviewed DiskCo employees in Singapore and Malaysia from the Information Technologies function. CPW was the project champion for the Oracle implementation in the Far East except for Thailand. HHT worked for CPW. She guided the local IT team, and provided support for IT staff at sites in China, Malaysia and Japan. In Malaysia, a separate data conversion team - headed by JNL - was set up to assist other sites.

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[37] The author gratefully acknowledges cooperation from DiskCo Singapore and Malaysia, Nanyang Technological University (NTU) - especially Dr. Kanapaty Pelly Periasamy, Dr. Christina Soh, and Mr. Kenny Lee - and from Erasmus University co-investigator Berry Diepeveen. The case study is intended for generating knowledge on distributed work, rather than to illustrate either effective or ineffective handling of an administrative situation. DiskCo and SysCo are not real names but used for reasons of confidentiality.

[38] Based in part on an earlier version of the case description (van Fenema & Diepeveen, 1999).

We also talked with DiskCo people who were key user in the Oracle project. They were selected from their department (like Finance) to function as a linking pin between IT project team and other users in their own department.

Table 23 - Companies, sites and actors involved in DiskCo case

Company	Unit & Site	Functional Area	People & Role*)
DiskCo	Singapore site A (HQ)	Information Technologies	CPW, Vice President
			HHT, Director Applications Development
			OBT, Member Oracle Conversion Team
			JPL, Member Oracle Conversion Team
			SCC, Member Oracle Conversion Team
		Finance	ST, Key user
		Material & System	JLL, Key user
	Singapore site B		No interviews
	Singapore site C		No interviews
	Singapore site D		No interviews
	Singapore site E	Information Technologies	GP, Member Oracle Conversion Team. Temporarily stationed here from Singapore site A
	Malaysia site A	Information Technologies	JNL, Project Manager Data Conversion Team
			MC, Member Data Conversion Team
		Finance	SKL, Key user
		Inventory Control	ET and some colleagues, Key users
	Malaysia site B		No interviews
	China site A		No interviews
	China site B		No interviews
	Thailand sites		No interviews
	Japan site		No interviews
	US site: HQ West coast		No interviews
	US site: Central time zone		No interviews
Oracle	US, Singapore, Malaysia		No interviews
SysCo	US, India, Singapore		No interviews

On a broader basis, DiskCo engaged Oracle locations in the US and Far East for training and support. SysCo is a global software house from India that was contracted to assist DiskCo IT staff with development tasks.

§ 9.1.2 Time Zones and Windows DiskCo Sites

The Oracle implementation project was a truly global effort in the sense that sites in different continents and time zones were involved (Table 24). For the Far East region, this was not really an issue, since most sites are located in UTC +8. This applies to Singapore, and sites in Malaysia and China. Japan is located in UTC +9, and SysCo's site in UTC +5.[39] Time zones did play a role between sites in the Far East and the US. Staff in Singapore and Malaysia frequently consulted their counterparts in the US. This was to tap into their experience with the Oracle implementation that was initiated at an earlier stage at US sites. DiskCo US sites are located in the Pacific time zone (UTC -8), and Central time zone (UTC -6). Table 24 shows for each of the regions involved bold rectangles that represent an extended working day from 8 o'clock in the morning until 19:00 hours.[40]
The bold dotted vertical date line officially splits the time zone that is both UTC +12 and UTC -12 (in total planet earth is divided in 24 zones, with UTC 0 as starting point). Here it is shown as right from the UTC +/- 12 zone for practical reasons. The date line implies that e.g. Tuesday morning 8:00 hours in Singapore matches 16:00 hours in US Pacific time zone the previous day - Monday. Absolute time differences from Singapore are shown in one of the top rows. This is because there the Far East regional HQ is located.

[39] Although the site in India is UTC +5.5, we use UTC +5 for practical reasons.
[40] For lay-out rasons, working days in US Central (UTC - 6) are shown between 9:00 and 19:00 hours. In India, days are depicted until 17:00 hours.

Table 24 - Time zones DiskCo sites

UTC +5½	UTC +6	UTC +7	UTC +8	UTC +9	UTC +10	UTC +11	UTC+/-12	UTC -11	UTC -10	UTC -9	UTC -8	UTC -7	UTC -6
SysCo India			DiskCo Singapore	DiskCo Japan	Going eastward: Subtract 24hrs ➢		International date line	➣ Going westward: Add 24hrs			DiskCo US Pacific		DiskCo US Central
20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00
21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00
22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00
1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00
2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00
3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00
4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00
5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00
7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00
13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00
14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00
15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00
16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00

Daylight Saving Time (DST) not applied

§ 9.1.3 Project Timeline

In 1994, firms across the globe like DiskCo initiated projects to investigate the impact of the Y2K problem.[41] The need for system modification or replacement was often used to implement more advanced information technology like client/server environments and Enterprise Resource Planning (ERP) systems (Markus et al., 2000). At DiskCo, US sites and representatives from the Far East and Europe initiated an evaluation process for ERP software. In 1995, DiskCo selected Oracle ERP from the final set of 2 vendors (SAP and Oracle), to be implemented across its worldwide operations (Table 25).

Preparations for the actual implementations started in 1996. While US sites would implement before Europe and the Far East, representatives from these regions were involved to accelerate their learning curves. Singapore HQ setup an IT development organization in December 1996 to become a key resource for the Far East implementations. Over 1997, Oracle was implemented in the US, and Singapore site A. Table 25 shows for sites in the Far East[42] turn live dates, i.e., when the system is ready for operational launch.

The initial master schedule dictated a tight sequence of implementations based on the fixed end date: the Y2K problem. In reality, implementations had to be delayed to cater for learning effects and site specific needs, see most right hand column in (Table 25). The final site - Japan - was ready just in time by June 1999. The Y2K problem would already start to have an impact form July 1999 onwards. Actual turn live dates show a more spread-out, sequential implementation pattern than the original plan. Local IT and user groups needed more time to deal with the complexity and novelty of Oracle ERP. In addition, Singapore site A hosted the so-called core team that assisted remote sites. This team included IT professionals and key users from various functional departments. Their capacity for helping simultaneously multiple sites was limited. As the project proceeded, urgent local constraints were communicated to the upper management echelon. The master plan was adapted accordingly and communicated backwards to local management. Communicating the global implementation master plan relied on a straightforward Excel file. On a regional and local level people use Microsoft Project to plan the work in close detail. In addition, some functional user groups posted more specific outlines on their section of DiskCo's globally accessible intranet.

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[41] The Y2K (year 2000) problem refers to information systems from the 70s and 80s that contain only 2 digits for years in the date field. From the year 2000 onwards, year digits represent combinations that could also refer to the year 0 or 1 AD. This makes computer hardware and applications stop operating, or function improperly.

[42] Thailand is not included here. Since local requirements were very specific, it was decided to organize the Oracle implementation there separately.

Table 25 - Timeline DiskCo Oracle implementation Far East

Date		Project events	Turn live date	
Year	Month		Planned	Actually realized
1994		DiskCo US starts working on Y2K problem		
1995		ERP project definition and vendor selection process		
1996		Implementation preparation US, Far East and Europe Singapore site A kick-off IT development team in December		
1997	January	Singapore IT development team follows US implementations, and prepares for Far East implementations	Implementations DiskCo sites US and Europe	
	February			
	March			
	April			
	May			
	June			
	July			
	August			
	September			
	October			
	November	Far East implementations	Singapore site A	
	December			
1998	January			
	February		Singapore site B	Singapore site A
	March		Singapore site C	
	April			
	May			Singapore site B
	June			
	July		Malaysia site A	Singapore site C
	August		China site A	
	September		China site B	
	October		Malaysia site B	Malaysia site A
	November		Japan	China site A
	December		Singapore site E	
1999	January		Singapore site D	China site B, Malaysia site B
	February			Singapore site D
	March			
	April			
	May			Singapore site E
	June			Japan

§ 9.1.4 Situation before the Project

DiskCo initiated a re-evaluation of its global IT infrastructure in 1994. This project touched systems for key business processes like product design, manufacturing and distribution. So far, DiskCo used a system called MANMAN (Manufacturing Management). Local IT readily customized this application according to user expectations. This resulted in a heterogeneous IT infrastructure that was expensive to maintain. Sites kept their own data center, leading to a situation of hundreds of small local data centers. Data feeding into Management Information Systems was mainly available locally.

The Y2K problem made reconsideration of this situation urgent. It enabled DiskCo to assess implementation of advanced IT to leap forward strategically. Around 1994, ERP software introduced a new era of standardized and integrated computing. This promised improvement on operational parameters like costs, customization, flexibility and speed (Davenport, 1998). ERP seemed to fit DiskCo's organizational model well. The company did not outsource activities that other firms in similar industries may consider peripheral, like manufacturing PCB's.[43] DiskCo rather relied on integrated intra-organizational supply chains to achieve speed and agility. About daily, planes with product components arrive in Singapore to be assembled there and flown to markets in across all continents. Considering this international nature of DiskCo's operations, standardized global ERP system appeared very attractive (Kay, 1998; Markus et al., 2000). It would make centralized data centers feasible, and simplify global enhancement of applications through a single source code. Standardized IT infrastructure facilitates connecting and exchanging IT staff across sites.

DiskCo executives from around the world were involved in selecting a vendor and package. At the end, Oracle ERP was selected because of its strength in client/server technology. DiskCo selected 4 main modules: Engineering, Finance, Manufacturing, and Order Management. DiskCo now faced the challenge of implementing the ERP system across its global operations. There was not much time: since FY 2000 starts by the end of June 1999, systems have to be replaced by that time. The challenge was also to move the current IT and user organization into a new era of enterprise computing. ERP was new to the entire organization. It would require major efforts to embed ERP know-how across the globe. And to change the mindset from local control to centrally maintained software, since Oracle ERP relies on a single source code that is replicated to local sites. The challenge was also to ensure user buy-in of the new system, and even get them involved as key users in the implementation process. Finally, a project of this magnitude required project management skills and international collaboration beyond the IT group's experience so far. Most sites had operated in a somewhat independent fashion with IT staff providing support to their local user groups.

At the same time, other factors made the implementation easier in the Far East. First, the Singapore HQ had considerable experience with sites in China and Malaysia. Many sites were originally from another company [StorCo] that merged with DiskCo in the late

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[43] PCB stands for Printed Circuit Board, a semi-conductor product that connects disc drives with the Central Processing Unit (CPU) of a computer.

1990s. after the merger, Singapore HQ replaced the partner's local systems with their own infrastructure. This standardized IT to some extent, and helped build relationships with IT staff and users at sites in China and Malaysia. The VP in Singapore for the Oracle project hand-picked new IT staff members in China. Second, across sites with similar business operations, users had developed extensive contacts to share experiences. These networks could be used to get people involved in the Oracle project. Third, turnover at DiskCo Far East was fairly low, both at staff and managerial/ executive level. This preserved working relationships people established over time. This applies to contacts within the Far East region, and between Singapore and the US. For instance, the current CIO at DiskCo HQ in the US was head of the IT organization at Singapore HQ. Finally, from a technology point of view, DiskCo maintained an extensive network of lease lines. A fixed fee replaces the variable costs of calls, thus encouraging remote contacts. Lotus Notes groupware was installed across all DiskCo sites worldwide. This enables email contacts, document forwarding, and workflow management. About twice per 24 hours, local Lotus databases are replicated across the world to minimize interference with local operations. The global DiskCo intranet offers a more static communication medium. Here, sites and local functional groups present themselves. They provide contact information, news updates, and resources like manuals, presentations, and templates.

Across DiskCo's sites in the Far East sites, people leveraged these factors to collaborate remotely in the Oracle project.

§ 9.1.5 Project Setup

Global implementations of packaged software like ERP are complicated and challenging endeavors (Kay, 1998; Markus et al., 2000). ERP enforces commonality of IT infrastructure and business processes that often meets with local resistance. For global firms like DiskCo this can be especially painful since local sites have - or think they have - different requirements (Horwitt, 1998). This section describes how DiskCo approached their project. We focus on project organization, processes and planning, and technology.

§ 9.1.5.1 Project Organization

Two basic decision parameters for multi site implementations concern timing and responsibilities. Table 26 shows a matrix of these dimensions and 9 strategies as we explain below.

First, timing refers to the temporal sequence of local implementations. With multiple sites, one option is purely sequential implementations. That is, first site A until turn live, then site B and so on. A second option is parallel implementation, where all sites go through similar steps simultaneously. This is also referred to as a big-bang approach. As CPW, Vice President Information Technologies in Singapore HQ remarked:

> "Are we going to do a big bang meaning that all the plants are going through the implementation process at the same time? But how are we going to build up the knowledge? Because all of us had no knowledge." - CPW, DiskCo-A-3

Apparently, a sequential approach offers the advantage of allowing some time for learning the novel application. A final possibility is to mix parallel and sequential approaches. DiskCo adopted this approach. On a meta-regional level, implementations were overlapping: Far East and Europe started when some US were still in progress.

> "Of course we are not waiting for all the US plants to convert before we start. We kind of started halfway. So by then some of those programs are already (really) there, even though they may need some further modification such as those data conversion programs." - CPW, DiskCo-A-3

Within regions, here the Far East, implementations were sequentially but with a twist: the first implementations were done sequentially until sufficient experience was acquired. Then, for some sites parallel implementation became feasible and desirable to save time.

Table 26 - Multi-site implementation: organizational choices

		Implementation responsibility and resources		
		Central	Local	Mixture
Timing of multi-site implementations	Sequential	Sequential, centralized implementation	Sequential, local implementation	Sequential implementation with mixture of central and local resources
	Parallel	Parallel, centralized implementation	Parallel, local implementation	Parallel implementation with mixture of central and local resources
	Mixture	Centralized implementation with mixed timing	Local implementation with mixed timing	Mixed timing and resources

A second choice relates to the division of responsibility and resources. A purely centralized approach implies that HQ is responsible and provides resources for the local implementations. On a global level, this could mean that a team from the US takes care of local projects - in person and/ or remotely. Regionally, it could mean that Singapore HQ takes on that role for the Far East sites. Finally, a mixture means that responsibilities and resources are divided between central HQ and remote sites.

Initially, DiskCo US suggested adapting a centralized approach on a global level, where US staff caters for all sites. That concept was abandoned however as CPW explains:

> "The assumption that the US will have a team that go around all the sites to do a conversion is wrong. Because as we completed one plant we realize "Hey there is a lot more that need to be done, and a lot of post conversion support that need to be done. And there is no way that they can go." If we need to convert a few plants at the same time, that one whole team cannot make it. So then it is decided that OK Far East you have to start working on your team with all your capabilities with the help of the US to do the conversion for the rest of the Far East." - CPW, DiskCo-A-3

Some form of parallel implementation was a necessity to meet the aggressive schedule. On a global level, however, this could not be combined with centralized responsibility and resources. Singapore HQ therefore took the responsibility for Far East implementations with the exception of Thailand. They were assisted by the US, resulting in a mixed strategy on a global level.

Within the Far East region, Singapore HQ sometimes took full responsibility. This applies to small sites, like the ones in Singapore and Japan that do not have (extensive) local IT resources (see Table 23). In other cases, it adopted the same role on a regional level as US HQ adopted on a global level: local sites are responsible for their own implementations but receive support from the central organization. CPW compares the role of his core team in Singapore HQ, with the responsibility of local IT directors:

> "Each of the sites (in the Far East - author) are self-sufficient. They have a network engineer, they have the infrastructure they all report to the IT director, he reports back to me. And he is responsible for his conversion. The Singapore HQ team is the additional resource to help him. So he has to coordinate get the local infrastructure ready, he is the one going to work with Telecom to make sure that this lease line is up and running. He is the one to work with my Singapore telecom group to make sure that all the telecommunications are ready.
> My coordination role is more on a higher level in the sense that when we coordinate with all these people, they have issues, constraints, resource issues they come to me and report to me. (...) if it is everything coordinated out from here (Singapore HQ - author) it is going to be very difficult. I mean how are you going to make sure that the infrastructure is ready. Every area has its local IT, and all of them report back to me" - CPW, DiskCo-A-3

As the quote suggests, local IT organizations replicate Singapore HQ organizational setup for their local project. Contacts between people with similar roles in different Far East sites are setup to share experiences. From Singapore HQ, people connect to their counterparts in the US for the same reason.

Locally, DiskCo adopted a "core team" approach. This group consists of IT specialists and key users (user representatives). Their membership of the same team promotes cross-functional collaboration. Key users liaise between the core team and users in their functional area. They also maintain contact with (key) users at other sites. For instance, (key) users in Finance .

Thus, multiple distributed communities of people with similar responsibilities and backgrounds emerge. They keep each other updated through Lotus Notes email distribution lists, and intranet environments dedicated to their community. Singapore HQ is the central node in these networks for the Far East. People there also route communications for their respective community between the Far East and the US. Across communities, connections rely on the local core teams. The organizational setup of distributed Oracle implementation thus relies on remote contacts for intra-function, homogeneous communications. Heterogeneous collaboration is organized locally.

Figure 43 applies this setup to IT and two other functions (Finance and Manufacturing). As a conceptual example, the figure shows communications setup from 1 site in Malaysia and

1 in China towards Singapore HQ, and from there to the US. Solid lines show intra-community linkages across sites (bold for IT), while dotted lines illustrate local, cross-functional contact.

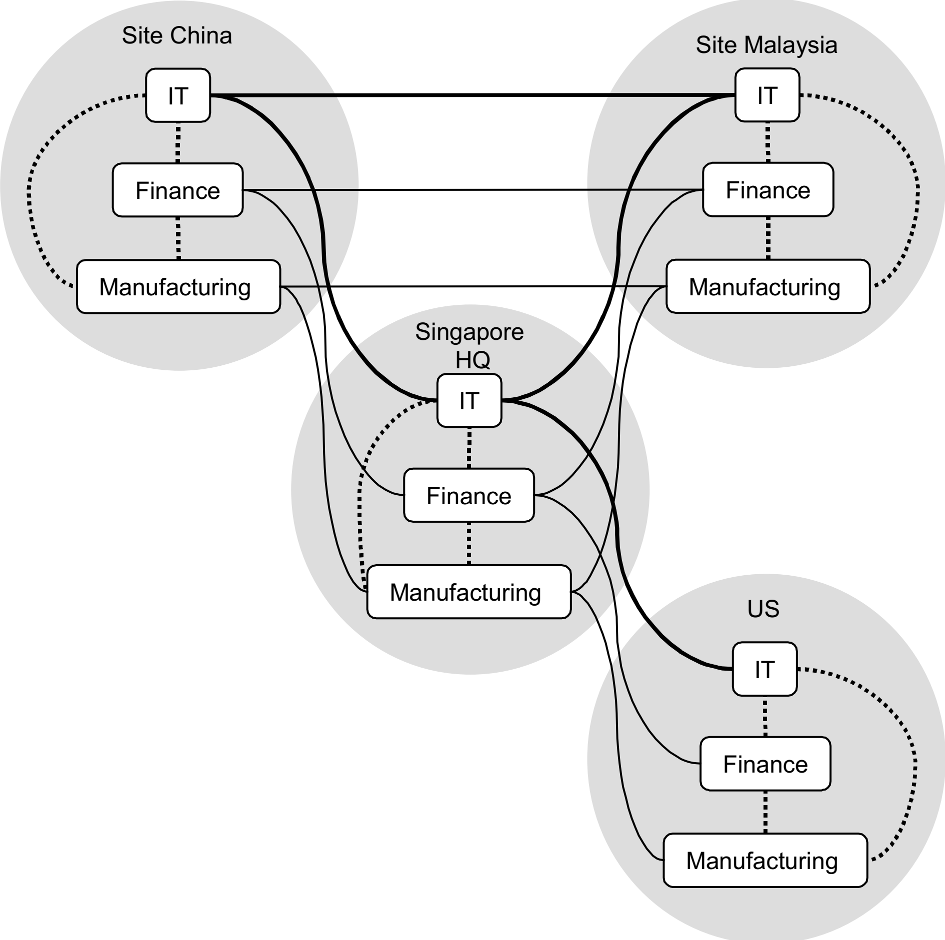

Figure 43 - Multiple distributed communities: communications setup

From outside DiskCo, Oracle consultants and trainers were involved. In Singapore and Malaysia, they trained local IT staff and key users. Other sites relied on Singapore for training as local Oracle facilities were not available at that time. Oracle consultants assisted the core team at Singapore HQ during the first 6 months of the project. Later, SysCo consultants worked on site in Singapore HQ. They did programming and development work, and helped DiskCo core team members who lacked experience with Oracle ERP and development tools.

§ 9.1.5.2 Project Processes and Planning

ERP software usually comes with a method for business implementations. It offers a road map for implementation process. DiskCo adopted Oracle's Application Implementation Method (AIM), and later the Software Development Life Cycle (SDLC).

Packaged in a handbook, the AIM method prescribes team roles, sequential phases and activities. AIM distinguishes 7 project phases: Implementation Strategy, Operations Analysis, Solution Design, Build (Conference Room Pilot (CRP), Business test, Integration test), Custom Documentation, Transition, and Production.
The first phase - Implementation Strategy - is prior to the actual conversion project. It consists mainly of planning and training sessions for IT staff, key users and executives. Training modules are designed for specific roles and Oracle ERP modules. First, it introduces executives to Oracle ERP on an overview level. Second, IT staff and key users are trained on the applications modules. And finally, a technical in-depth workshop is held for IT staff. In the Operations Analysis phase, IT staff and key users conduct interviews with users to identify current business process and applications used. During the third phase, IT staff implements results from this analysis in a test environment. The Build phase consists of several tests to verify the correct functioning of modules and interfaces. This is to ensure that users approve the proposed system. A Conference Room Pilot (CRP) is conducted with key users per module to identify so-called gaps. These are differences between user needs and system functionality. Gaps are recorded in a Lotus Notes database, and analyzed to determine small enhancement 'projects' per gap. Upon incorporating these modifications, a Business Test is conducted to check the system again against user requirements. Finally, real-life business processes are simulated for the integration test. Transition and Production cover the week and weekend before the system turns live. In these phases, sites receive extensive help from Singapore HQ. People who come down include the VP Information Technologies, the Director Applications Development and core team members (IT staff, key users). All these people work on-site with the local team to ensure smooth transition to the new system.
For each of these phases, Oracle's AIM Advantage Implementor's Handbook outlines inputs, activities and deliverables, often supported by templates.

Well into the project, DiskCo shifted from AIM to the Software Development Life Cycle (SDLC). SDLC is a generic - Oracle independent - method to structure the design and implementation of information systems. DiskCo's CIO seemed to prefer this generic IS project approach over a method that caters specifically for an Oracle ERP implementation (HHT, DiskCorp-B-1). Compared to AIM, SDLC is more detailed and comprehensive. It is based on standards from the IEEE Computer Society and originally developed by IBM in the late 50's for the development of large Transaction Processing Systems. DiskCo's Software Process Engineering Group (SPEG) in the US modified the method and implemented it as a corporate-wide standard for managing IS projects. SPEG communicated DiskCo's approach to the method through the corporate intranet. The SDLC consists of 7 phases: Business Analysis, System Requirements Specification, Software Requirements Specification, Design Specification, Test Plan, System Turnover, and Review Summary. For each phase, the methodology describes its purpose and specifies optional and requisite activities to be performed. The method emphasizes documentation of each step. People can download document templates for each phase from the DiskCo intranet, and use them for their project role and task.

Planning the Oracle roll-out was top-down. On a global level, DiskCo US defined 4 separate trajectories for the US/Mexico, Europe, Far East, and Thailand. Per trajectory, sequencing of sites and major phases were identified (see Table 25 for Far East). Financial reporting regulations in the US constrained opportunities for preparing and executing site conversions. The VP Information Technologies in Singapore HQ explains:

> "We have some criteria or constraints that the last month of a quarter we will not change anything because the nature of the business is thus that first 3 months of a quarter the production volume is normally (not at maximum - author). Because everybody in the US reports by quarter results. So it always comes to the last month that we push too many drives out of the factory. And that is a time when you cannot afford to have any changes in the system, i.e., major changes or hardware changes. So in last month of the quarter we don't do anything. (...) Because near to the quarter report things are so busy, that you cannot organize training, people won't come.
> But when the quarter closes, then you do the conversion. It is difficult but we have to do it because we don't have much time. So every quarter we can only convert 2 plants, 1 at the beginning and 1 at the end." - CPW, DiskCo-A-3

DiskCo US maintains the master Oracle schedule, a document in Microsoft Excel format. It is shared with regional executives and directors and details sequencing of sites and phases from December 1996 through mid 1999. The generic plan approximates duration of the different phases as Table 27 illustrates.

Table 27 - Planning Oracle ERP implementation phases

Phase	Description	Estimated duration
Pre-conversion training	Directors and senior management are introduced to Oracle Application Core team members attend Application Module Training to become familiar with Oracle ERP. Key users are responsible for training users in their department at a later stage. IT members of the project team attend a technical workshop.	
First trial conversion	The project team analyzes current business processes and prepares a first configuration of the system. They also test data conversion.	Assume 2 full weeks
CRP Training	Key users are trained for the CRP	Assume 1 week min.
Conference Room Pilot	The first setup is presented to users for feedback on each module. Gaps resulting from this session are analyzed and processed in a Gap Notes database. Depending on their importance, gaps result in enhancement projects.	Assume 2 weeks
Business Test	Upon processing enhancement requests, a second test similar to the CRP is organized with users to ensure that their	Assume 1 week min.

	requirements are met.	
Second trial conversion: Integration test	When separate modules are tested and verified, business processes are simulated to check integration between modules.	Assume 2 full weeks
User training	Infrastructure is installed, including network, servers, and client installation. Users are trained under the responsibility of key-users.	1-2 weeks
Final conversion before going live	Shortly before the go-live date, a final data conversion and user verification is carried out to ensure proper functioning of the system and hardware.	Assume 1 full week prior to conversion weekend
Week one on new system	Users start to employ the new system in their daily work, and receive support from the project team.	

Source: DiskCo's Oracle ERP implementation schedule

The master plan is elaborated on a regional and functional level. The regional fine-tuning for each site is done by project executives and directors. At the same time, functional communities - like Finance, Engineering - coordinate implementation of modules on a global level. The plan is a living document: when sites cannot meet the schedule, they will contact local managers, who will escalate requests for a delay to regional executives. These people will contact the DiskCo CIO in the US to consider adjustments.

§ 9.1.5.3 Technology

Information Technology plays multiple roles in an international IT project like the DiskCo implementation of Oracle. The project itself is aimed at building a new IT infrastructure that consists of applications, hardware, and networking. At the same time, the process relies on technology for automated coordination and remote collaboration. We elaborate here on these themes.

First, with the Oracle application, DiskCo takes a major step towards a globally standardized application environment. Local customizations of the previous MANMAN system had led to a diversified IT infrastructure with many local data centers. In the new setup, only 4 data centers remained: Europe, US, Singapore and Thailand. Multiple sites in these respective regions are linked through lease lines to the data centers.

The same Oracle source code runs from these 4 centers, with the default code in the US. Since the application is world wide the same, any local modifications have potentially global impact. The form of dependence that emerges here is not easily defined. What comes close is Thompson's (1967) definition of pooled dependence: "We can describe this situation as one in which each part renders a discrete contribution to the whole and each is supported by the whole. We will call this pooled interdependence." However, this concept remains somewhat vague. The form of dependence here concerns the situation that multiple actors may work simultaneously on the same resource. We refer to this as resource modification dependence. (A related form is resource utilization dependence where people want to use the same resource at the same time, but individual usage excludes others' access. This not an issue here since an information resource like software is easily replicated to multiple sites).

Coping with resource modification dependence requires tight coordination, especially during the implementation. Simultaneous modifications at different sites could lead to different versions and undermine the effectiveness of single source code operations. To ensure consistency, DiskCo relied on formal approval procedures. For the actual change process, they used a tool for application life cycle management called CCC/Harvest from Platinum, Inc. With that tool, three environments were setup to separate phases of source code modification: development, testing, and production. A local developer in for example Singapore must check-in at the development environment. The code is then locked for any other developer and available for local development work. Once the code has been modified, it is promoted to the test environment. Local IT staff and users can test and simulate working with the modified code. The local test environment is also replicated about weekly to similar facilities at other sites for testing there. Upon approval, the code in the testing environment is promoted to production and again replicated across the world.

On top of these automated procedures, Oracle developers in DiskCo maintain contact through dedicated Lotus Notes mailing lists. They communicate updates and requests punctuated by the procedure described above.

Lotus Notes is a key example of how technology enables remote inter-human collaboration. This multi-site groupware application supports email exchanges, email broadcasts, document management, calendar features and workflow management. The environment can also be used for databases that are replicated and accessible across international DiskCo locations. When the US started the Oracle implementation, they built a database to track issues and experiences from multiple sites there. Initially, DiskCo Far East started their own issues database, but it was integrated with the US database after a couple of months.
In addition to the issues database, a knowledge database was started after a couple of US implementation. It logs in a helpdesk format resolutions to problems that may occur in the various conversion projects. Lotus Notes databases (like the issues and knowledge databases) can be accessed from multiple angles, such as type of issue, contributors, locations, and urgency of a task.

Lotus Notes communications rely on an international leased network infrastructure that allows for instantaneous fixed-fee electronic communications, as well as phone conversations and faxing. For teleconferencing (audio), people can use either desktop telephones in larger rooms, or book a meeting room equipped with audio conferencing facilities, like a telephone with separate speaker and microphones. Staff can receive and send facsimile messages from a fax that is available for a number of people working at the same floor at close distance.
Sites have a limited number of rooms equipped with video conferencing facilities (except for China). These are booked in advance through local Lotus Notes arrangements. The video conferencing facility relies on a package offered by the local telecom company, and includes 2 video cameras, a television set, and audio conferencing tools. Video transmission relies on ISDN connections. For calling other sites, people can use one-touch,

pre-defined numbers. Audio communications rely on integrated equipment with multiple microphones (e.g. Polycom products).

Members of the project can use on their individual desktop machines common packages like Microsoft Office. They have access to Oracle applications and documentation, and can use Microsoft Netmeeting and similar packages for sharing applications while working remotely. In particular NetMeeting was used for real-time collaboration on a distance. People can show screens related to their questions, and discuss the application while talking to each other on the phone.

DiskCo staff has access to the internet and the company's global intranet. The intranet offers an extensive and diverse environment with links to local sites, departments, and projects. Concerning the Oracle project, it offers information on the application, servers, and implementation methods. The intranet also provides password-restricted access for DiskCo IT professionals to special servers, applications and information.

Finally, in most developed countries, people have pagers and mobile phones to stay connected while not in their office.

§ 9.2 Thematic Interpretive Analysis

Data collected at DiskCo was analyzed for eliciting themes. This was an interpretive process that relied on a sustainable data focus while keeping our research objectives in mind. Our conceptual lens provided an overarching interpretation scheme without constraining the emergence of novel themes. This section reports on a number of themes, all related to the impact of global distributedness on coordination and control processes. A few key examples include: the role of ex ante coordination and control mechanisms; modes of planning, managing, and controlling; organizing for distributed collaboration; Learning, documentation and technology; face-to-face versus remote, electronically mediated collaboration; time zone differences; and cultural and lingual differences. In the next part, these results are re-considered in a more positivist manner while being integrated with results from the CarCo case.

§ 9.2.1 Ex Ante Coordination and Control Mechanisms

"(...) this is not a new organization" - CPW, DiskCo-A-5

When interviewing people at DiskCo, we asked about their experience in a geographically distributed project. We knew from literature and other cases that people usually find it quite challenging to depend on and collaborate with remote counterparts. Surprisingly, in this case, it appeared that people did not have much difficulty. They emphasized the fact that prior to the Oracle ERP project, they had worked already with colleagues from other sites. This established for instance working relationships, common knowledge, and insight in the way DiskCo operates at different sites. Together, they could be referred to as coordination and control ‘capital’. Like financial capital, people leveraged coordination and control practices from the past. Building on these experiences greatly reduced the effort of remote collaboration during the project.

An implication is that we must consider the temporal dimension of coordination and control. Looking at existing literature, time has been mainly related to planning and work dependencies.

First, planning and procedural mechanisms constitute an ex ante form of work division, coordination and control. At the beginning of a project, people spend time conceiving how the work should be done. This concept then integrates actors’ efforts and can be used for control purposes during or after task accomplishment (Blau & Scott, 1962).

Second, temporal sequencing of work determines how complex coordination will be (Blackburn, Hoedemaker, & Wassenhoven, 1996; Terwiesch & Loch, 1999; Thompson, 1967; Van de Ven et al., 1976). It requires planning and other mechanisms to ensure integration at some point. In that spirit, Bardram (2000) defines temporal coordination as: “(…) an activity with the objective to ensure that the distributed actions realising a collaborative activity takes place at an appropriate time, both in relation to the activity’s other actions and in relation to other relevant sets of neighbour activities. Temporal coordination is mediated by temporal coordination artefacts and is shaped according to the temporal conditions of the collaborative activity and its surrounding socio-cultural context.” (Bardram, 2000).

But here, the temporal dimension does not refer to planning since it concerns the phase before planning. Nor is it related to work contingencies (like task dependence) and their relationship to coordination and control mechanisms. It concerns these mechanisms themselves: their use at t0 determines how work is coordinated and controlled at t1. This phenomenon is elaborated for the DiskCo case in the next sections.
Before doing that, we sought to embed and extend our understanding of this temporal dimension of coordination and control mechanisms. To this end, we reverted to the literature reviewed for this research. We found the work of some authors insightful, even though ‘capital’ or the temporal dimension are often not explicitly mentioned. We discuss findings of our reinterpretation effort here, and then continue with the role of ex ante coordination and control mechanisms in the DiskCo case.

§ 9.2.1.1 Literature Revisited

First, channel expansion theory claims that various experiences enhance the perceived richness of electronic media (Carlson & Zmud, 1999). These so-called knowledge bases include: experience with the channel, experience with the messaging topic, experience with the organizational context, and experience with communication co-participants. Applying the temporal perspective here implies that people can perceive lean media they use during a project as rich because they have collaborated before the project. An email that the VP for the DiskCo project sent us may be understood along these lines. When we asked why people did not use the videoconferencing room frequently, he replied:

> "We use teleconference much more than video conference. There is no need to have video conference because we don't really need to see each other face-to-face." - CPW, DiskCo-A-6

Second, Bryman (1987) describes for projects in the construction industry the importance of working with "a "known" site manager and a familiar "team" on whom they are able to rely" (Bryman et al., 1987: 262). The complexity of coordinating construction projects encourages contributors to rely on ex ante mechanisms, like prior relationships and collaborative experiences. This implies that people "are more readily "tuned in" to the culture, methods, and practices of the main contracting organization" (Bryman et al., 1987: 267).

Third, Gabarro (1990) suggests that working relationships impact communications in terms of efficiency, mutual knowledge, and capacity. Similarly, more recent discussions have emphasized the fact that working relationships - or more generally speaking social capital - facilitate and economize interpersonal exchanges (Adler & Kwon, 1999; Locke, 1999; Nahapiet & Ghoshal, 1998).

Fourth, a related stream of literature emphasizes the organizational advantage, often compared to market-based governance modes (Moran & Ghoshal, 1996; Williamson, 1981). Organizations foster working relationships and commonality. They develop procedures and bureaucratic control mechanisms that allow for idiosyncratic and fast information processing capabilities (Williamson, 1975).
Relating that to the temporal dimension, it can be argued that people from the same organization bring this organizational advantage to a project. They may know each other, but more likely, they have a common set of standards, norms and ways of working.

Fifth, Grant (1996) lists several forms of common knowledge that help people collaborate and integrate their specialized knowledge domains. As an example of what we could be referred to as cognitive capital, language is believed to "enhance the efficiency and intensity of communication" (Grant, 1996b). For instance, mastering English is a prerequisite for participating in remote student teams (Knoll & Jarvenpaa, 1998). Ensuring this cognitive capital at the start of a project facilitates communications later on.

Finally, literature on remote collaboration gives some relevant examples for the temporal dimension of coordination and control. The Mars Climate Orbiter Spacecraft was lost when two teams used different standards for maneuvers, i.e., English versus metric units (NASA, 1999). Imprecise coordination upfront led to misaligned remote communications that passed unobserved.
Other researchers of distributed collaboration have repeatedly pointed at the importance of establishing interpersonal contact face-to-face before working remotely (Meadows, 1996b; Nemiro, 2000). This makes subsequent remote communications for instance "easy and natural" (Abel, 1990: 505).

For our research, this implies that in order to understand coordination and control during a global project, we must take the ex ante situation into account as well. To this end we present next insights from interviewees that illustrate how DiskCo staff benefited from various forms of coordination and control capital that existed already before the project.

§ 9.2.1.2 DiskCo's Ex Ante Coordination and Control Mechanisms

In our interviews with DiskCo project members, we probed for differences between remote and local collaboration. Here, 'remote' implies working with counterparts from other Far East sites or the US. 'Local' refers to on-site collaboration within a department for instance. Time and again, interviewees mentioned how collaboration and resources from before the Oracle ERP project facilitated remote collaboration during the project itself. It helped them deal with many of the constraints of distributed collaboration. We explore in this section the existence and effects of ex ante coordination and control mechanisms. We look at how they support remote collaboration during the project. Our discussion is grouped around three players: VP, Director Applications Development, and staff.

VP perspective

At DiskCo Far East, many people stay within the same career track for a long time. Collectively, this implies that collaborative relationships evolve over the years. As people work together in hierarchical relationships, they carve out norms for communicating, reporting and managing. After a while, these form the backbone of new collaborative endeavors, even though they remain implicit. This section reflects our discussions with managers and executives on this topic. They focused on three forms of managerial relationships: lateral with peers, and hierarchical with superiors or subordinates.

To start with, the VP in Singapore site A summarizes his perspective on ex ante coordination and control mechanisms:

> "In the Eastern environment (DiskCo Far East - author) we have been working together for a long time, so that we have already established some reporting mechanisms and some expectations. Like for example, when you talk about the conversion, I will expect my director to give me voice mail at every stage of the conversion. They will give me a voice mail and report the status. And as I say, every week we have a meeting. We check the status and cover all areas. And they all know very well that if they have issues and they don't bring it up, in the end, they are responsible, not me. If you bring up an issue that I didn't help to resolve it, then that passes back to me. So, that is why it is important that the team members have been working with each other for some time already. Some of these thing are like a norm.
> Like myself and my boss - the CIO now, he worked here for 2 years - we had a norm that during my conversion (an earlier IT implementation project - author) every 2 -3 hours I will leave him a voice mail. Whether it is good news or bad news, I definitely will. And he will also feel very uncomfortable if I leave him a voice mail and say "Yeah, I won't give any more status reports, because everything is going on fine, so no news is good news." He wouldn't feel comfortable. It's the same for me. And because of that, every time with my staff we do some major project, and they never leave me any messages or anything, I don't fire them but I will remind them many times. And they know, they will be very upset, when they don't give me the status. So that is a standard practice, a procedure we need there" - CPW, DiskCo-A-3

From an executive's point of view, the common practices described here facilitate the managerial process, i.e., the relationship between boss and subordinate. Basic expectations are clear from the outset. This frees up resources for issues that are truly novel and demand attention. Because of successful past collaboration, people trust each other and communications are easily setup. The VP explores these dimensions of his relationship to American expat executives (his superiors) who worked for some time in the Singapore site A.

> "I have a director from the US who worked in Singapore before Oracle. He was in Singapore for 7 years working with me, so he knows me very well. And they already see all the results, how we work here, and things that we get done. Then after that, the ex-boss went away and we have this new boss who came over. I worked with the new boss. And he is now the CIO (at DiskCo HQ in the US - author). He was my direct boss for 2 years in Singapore, and then he got promoted from senior Director all the way to CIO in Singapore and went back to the US. So that in terms of from an IT high level standpoint, I know him very well, he knows me very well. So for anything, I can just pick up the phone and call him up and say "I got this issue"." - CPW, DiskCo-A-3

The relationship leads to mutual knowledge and trust. This impacts the (remote) collaboration process. The threshold for setting up communications and assigning work is very low. Subsequent exchanges and controls are minimal and efficient, while still achieving the desired results. The VP comments on the same relationship with the US expat executive:

> "We know each other so well. And the trust level and confidence level are all there. So that when he passes a task on to me, he knows that we can make it. And also when I tell him that I need this and this and this, he knows that I've really done all the necessary things before I ask for it. So he will not question me, like "Oh have you checked this, have you checked that". He will just approve it. And that's a lot easier for us." - CPW, DiskCo-A-3

Laterally, the VP maintains rapport with buddies in similar positions whose help he needs for the Oracle ERP project. His relationships with directors and executives in user departments implies that minimal effort suffices to coordinate project activities. Similarly, in his monitoring role, the VP easily connects to these people for updates.

> "(…) Over the past ten years (…) not many people changed at the management level. So I know them (managers of user departments - author). I can walk in their office and it's just like: "Hey how do you feel about the preparation, what do you feel about this conversion, do you think there is any issue"." - CPW, DiskCo-A-3

The VP describes similar experiences with his subordinates. Locally, he has been working with the IT team at Singapore site A for a long time. Remotely, he and his staff have shaped IT other Far East sites. For instance, after the merger with StorCo they selected local staff in China and helped them replace local systems with DiskCo standard IT infrastructure. The effect of past collaboration is that people have local and remote relationships, or at least know 'who does what'.

> "We have one advantage over here and that is the whole history. We start off with only this plant (Singapore site A - author). Then we go to China and start this [China site A] plant. We are the one who go there and pick the IT people, good IT people. We train the people, set up the infrastructure, everything, and it all handover to local IT. So the good thing about the IT team here (Singapore site A - author) is that on average they are about 8 years with [DiskCo]. I have very old staff with me for a long, long time. And that helps a lot, because their knowledge and what they know, who are the

> people they know, is all there. (...) Our advantage is really all these things: Our setting, our factory, all these things of mergers, work with the people there (China - author), and they fly over there and work there work a while, and they come over here (Singapore site A - author). With all this, one of the key success factors is the interaction. Not just on a higher lever, but on a lower level. Like for example China - they send people over here for training. In fact the whole IT group was trained here in Singapore when we first started the factory, not for the Oracle conversion (but before that - author). For Oracle conversion itself we send 2 more persons (form China - author) over here, who had been here before and work on this project with our people. And it turned out to be a great team, everybody knows each other pretty well, knows their environment." - CPW, DiskCo-A-3

Specifically, the VP commented on the role of collaborative experience and knowledge for the initial phase of the Oracle ERP project. One of his responsibilities is assigning work to his subordinates. To this end, he needs clear insight in their capabilities. This applies especially to a distributed project where people must work to a great extent on their own. Here, the VP comments on the importance of knowing people at other sites. He describes the role of this knowledge for assigning data conversion work to the IT group in Malaysia site A:

> "I think that makes a lot of difference. If you know them, not so much like knowing a friend, but knowing the person, you know what he's good at, what he's capable of. Like for example this data conversion team (this part of the Oracle ERP project was assigned to the IT group in Malaysia site A - author). The manager that we picked to take care of data conversion, she's a very detailed, very organized person. And it's very important for us whether you find that person. Because for data conversion what we want is 100% integrity. We want everything mapped over correctly." - CPW, DiskCo-A-3

Combined, we could use the term social-cognitive capital to note the organizational relationships and mutual knowledge that has been built up prior to a collaborative effort. (See also in the theory section the inter-personal coordination mechanisms box in the integrated coordination 'diamond' figure). This capital can be seen as a root system: At any time it can bring forth new branches at surprisingly little effort. Similarly, for DiskCo case, a first advantage of collaborative history is that it simplifies the start-up phase of a new project, such as the Oracle ERP implementation. The collaborative history makes group building efforts at the beginning of a project superfluous:

> "There is no need for teambuilding because we trained them, taught them, they come over here for a few months stay with us here to work together. And that kind of relationship is already there. Then we acquired [StorCo] and their 2 plants. They are all using an old system. When we acquire them, we also take over their IT organization. And we send some of their people home, and there are some people we keep. And because they are all using their own different hardware, we have a project to convert all this to our system. (...) And then these people (from China and Singapore - author) work with each other very closely. And the guy who manages China IT is formally from here (Singapore site A - author), he is recruited from here, he knows the people here very well." - CPW, DiskCo-A-3

A second advantage of prior collaboration is that it lowers the threshold for (remote) communications. People know already whom to connect to, and they are comfortable discussing challenges that they face (Gabarro, 1990). This smoothens communications, a particular advantage in distributed projects where communications rely on electronic media with limited richness (Carlson & Zmud, 1999).

> "I always believe before the project starts, these people have to know each other, they will need to have some working relationships beforehand. That will help a lot because once you know each other it will be very easy to talk over the phone. And they also feel very easy to pick up the phone and just call you to say: "Hey, there is an issue how are we gonna deal with it". The relationship is very important because that helps to improve the communications. Many times we hesitate to talk to somebody we are not familiar with. Especially you feel very uncomfortable telling them that you have a problem because you don't know what he is gonna think of you. But we really know each other so well since we were involved in all these projects. They all know that this guy is a master in this area, and this guy always helps us when we bring up an issue, and so forth. So that kind of understanding is already there, and that helps a lot because the communication flow is very smooth." - CPW, DiskCo-A-5

Third and finally, collaborative history impacts the VP's role as a manager of distributed resources. He can trust the people he has been working with, and quickly assign and coordinate work:

> "The team and all the directors have reported to me for many years. And it is very easy for me to manage them. Whether it is a team or not, they all report to me. It is very easy for me to say: "OK, I assign this to you, I assign this to you". And we won't need to talk to settle it. It is all very well controlled." - CPW, DiskCo-A-3

Prior collaboration thus establishes trust that substitutes for monitoring mechanisms. Temporally, trust has been built before it is needed in a project. This complements Ouchi's (1979) observation that "(P)eople must either be able to trust each other or to closely monitor each other if they are to engage in cooperative enterprise". We add here the temporal dimension of trust, and the process that underpins its evolution.

To conclude the VP's perspective, we further focus on the relevance of our discussion so far for geographically distributed projects. The VP stresses that ex ante working relationships and mutual knowledge are in particular necessary in these environments. This is because during the project, limited opportunity exists to connect people and build socio-cognitive capital:

> "I'm a very hands-on man. That means I work with them together and I also know what they need. Management is supportive. They can communicate with me. I worked with them for many years, and the style and support I give to them is very clear. They all know. Every organization may be different. But I believe that establishing the trust with management, establishing the relationships among the team members is one of the important factors for any project. It's not just this kind of project. But for a cross-country, I mean a remote project, this is even more important. At least within the same organization (i.e., collocated - author) you see each other, you know each other fairly well. When you start working together you see each other every day. But when working remotely, we 'see' each other through the phone, we don't really see each other every day. So if we don't have that kind of relationship which is built up beforehand, then it's kind of difficult." - CPW, DiskCo-A-3

For geographically distributed projects, socio-cognitive capital becomes important in two ways. First, remoteness impacts communication patterns. Often the frequency is lower, and exchanges are electronically mediated instead of face-to-face (Meadows, 1996b). This makes it difficult to establish capital remotely. Second, if it exists already before the project, it facilitates and economizing on (remote) communications. This makes it easier to deal with distributedness.

Director Applications Development perspective
The Director Applications Development - HHT - supervises the local IT team at Singapore site A, and manages indirectly (dotted lines) IT development staff at other locations. She reports to the VP - CPW - and has been working at DiskCo for a long time in staff and managerial positions. Before looking at her perspective, we let the VP describe her position in the organization.

> "There is a time you have to establish a so-called relationship in the sense of who is the leader. Who is the guy who does the execution. Not everybody can be the leader in a team. There always has to be only one person finally who makes the core. And I think that kind of establishment is already there like in such a way that HHT has been around for many years. She has been involved in all these various projects with people from all the site. So when she is the project leader for the [Singapore site A] team and helping the rest of the sites, they all look towards there because they know that she can do it, she is the leader for them. She knows everything much better than them. So that kind of thing is there." - CPW, DiskCo-A-3

A consequence of her track record is that reciprocal knowledge and working relationships exist in the organization: people know her and vice versa. On top of that knowledge, people respect and trust her in the role she fulfills for the Oracle ERP project. In fact, this project is just another opportunity for her to leverage this socio-cognitive capital:

> "I would say the trust is already there in the sense that these people have been working in the IT organization for quite a while. They are not new to us. Even prior to the Oracle conversion project we already have the working relationships. So this is just another project that we have to work together on to achieve the goal that we want to go" - HHT, DiskCo-B-3

These close bonds exist in particular in the Far East:

> "Because the IT manager there we have worked before the Oracle conversion before. They are not people that are new to me. And in fact the China IT director is Singaporean. They do come to Singapore for meetings quite often. I would say they normally do a ½ yearly visit to this region, (...) and Singapore is one of the places he will come. So we also get to meet each other at least ½ yearly. So I would say, we know each other quite well. It's not only by name but also by face." - HHT, DiskCo-B-1

With the US, contacts were mainly established and maintained through electronic media. This resulted in minimal relationships. For the Oracle ERP project, face-to-face meetings with US staff extended working relationships. In turn, this facilitated remote communications:

> But (the existence of working relationships - author) is less the case with US. Before I attended the first Oracle meeting in the US we already have communicated through mails and maybe through phone calls. So we only know them by name and maybe by the voice. Now you meet them, so I think it is very different. If you get to meet the people and next time when you talk to them even through the phone or by mail, I think

it's different because it's after that you know the person in person. So I think it helps to communicate better.” - HHT, DiskCo-B-1

On a more pragmatic level, HHT emphasized the role of DiskCo’s technical infrastructure (e.g., networking, groupware). It was already built up and standardized before the Oracle ERP project. This facilitated remote collaboration forms like teleconferencing:

“Distance wise, for Malaysia and for China I think the communication is not really a problem because for us it is just a phone call away. It is quite convenient because we have all the infrastructure set up. (...) Before we have Oracle turned on, I would say all the networking infrastructure are all in place, and it's all standardized across sites. So it's quite convenient to have like a conference call with a few sites at the same time.” - HHT, DiskCo-B-1

Staff perspective

Having looked at the VP and Director’s point of view, we explore here how staff perceives the role of ex ante coordination and control mechanisms.

First, a key user in the Material & System area from Singapore site A - JLL - describes how she worked with key users at DiskCo locations in the Far East. She helped them install and maintain local systems that are also used at regional HQ. To her, the Oracle ERP project did not represent a novel challenge in terms of working remotely:

“I don't feel a big difference because basically for other sites when they first set up their inventory control system and system on departmental time, I'm the one who trains them, who also transfers the subsystem over there. So they follow pretty closely the subsystems that [Singapore site A] is using. So it's quite close. When I go there (Far East sites - author) and tell them "OK, now we are gonna convert to Oracle, these are the subsystems that [Singapore site A] are using, you can use the same,” they follow quite closely.” - JLL, DiskCo-G-1

Before the Oracle project, she maintained close contact with her remote counterparts. Before requesting customizations to their systems, she channeled distributed key users’ requests:

“Before the Oracle project came in I used to contact them. For any change to the subsystem that we use in [Singapore site A], I make sure that everyone agreed to it, or that there is no impact on their side. So if everyone agreed then I say OK, go ahead IT, I want to change or enhance the system. So we have very close communications.” - JLL, DiskCo-G-1

Over the years, she and her colleagues have gone through an evolutionary process that provides her with intimate understanding of local organizational context, work practices, and technical infrastructure. Communicating in this network then becomes very easy, especially since many people stay in the DiskCo organization. As Gabarro (1990) claimed - the effect of common knowledge and working relationships is that “intended meanings are transmitted and understood rapidly, accurately, and with sensitivity to nuance”.

“I know them, and I know the way they are working. (...) We have gone through so many things. From the basis of no system, to the system (before Oracle ERP - author), and enhancements. And now there is a new system (Oracle ERP - author) again. We have the history of that. When I talk of something they know what I mean.

So that part plays a very important role. These key users that I deal with they have been with me for so many many years. So it makes the communication easier in that sense. But one day if let's say these people change, any new person is coming in, I might face (a) problem." - JLL, DiskCo-G-1

Another key user - also from Singapore site A - points out that people 'roughly' know the organization because of prior visits. They know representative aspects of local contexts, like names and roles. This expedites setting up remote communications:

"If there is any issue we will contact the manager, that's the final person. If we cannot get anybody, we will look for the manager. (...) We know the local manager, we know roughly the organization, because I visited them before. So I know them, I know their manager, and who is doing what in their sections. It's a sort of knowing whom to communicate to when I have any issues and so on." - ST, DiskCo-H-1

There are two other effects of this socio-cognitive capital. First, people can anticipate the needs of remote counterparts when working on system modification or new systems, like Oracle ERP. This simplifies back and forth communications. A second, more control oriented effect is that socio-cognitive capital facilitates ensuring consistency of the multi-site IT infrastructure:

"When they first start up the plant or setup the department, at that time I'm the one who tells them OK this is how [Singapore site A] is doing things. So subsequently, if let's say I have a new project that I need to develop for [Singapore site A], I will take into consideration their operation. Because I understand some of their operation. So I will take that into consideration, I will come up with some request or spec and discuss these with them. If they have no issue on that, then I say OK, go ahead we can do it. And we can use it for all the sites, all the drive plants in the Far East.
(...) I know them, and I know the way they are working. (...) So those people I just tell them one time and they can do the rest of it (...)" - JLL, DiskCo-G-1

The trust factor mentioned here was echoed by an IT staff member from the same site. Establishing trust takes time. It is rooted in successfully collaboration with known counterparts:

"You hardly can have trust in new people. For people you have been working with for a long period of time, normally there will be some trust between us. But for new people you still have to develop that kind of trust." - SCC, DiskCo-J-1

To her, working with people she knew made the international dimension of the Oracle ERP project easier:

"I have already experience in the MANMAN (former DiskCo business application - author) time, we dealt with US people. So it's not very difficult for me." - SCC, DiskCo-J-1

Finally, an IT core team member from Singapore site A comments on the fact that even though Oracle ERP is a new system to them, their knowledge of the existing MANMAN infrastructure remains relevant. This technical know-how makes it easier to connect with users who have always worked with MANMAN. In Grant's (1996) words, "(T)he importance of common knowledge is that it permits individuals to share and integrate aspects of knowledge which are not common between them." The shared MANMAN background thus equips IT and users with the same terminology and concepts.

> "To us, Oracle is completely new. (...) Of course if you have a MANMAN background it helps you a lot. (...) Because in our project team, 2 persons don't have a MANMAN background. So I noticed that they may have some difficulties to understand some terms. When you talk to users - they are also from MANMAN - you may not be able to understand their terms. So you need some time to pick up. For us if we have a MANMAN background, we know what they are talking about. It is easy to understand."
> - OBT, DiskCo-C-1

To conclude, ex ante coordination and control mechanisms include working relationships, mutual knowledge, and technical infrastructure. Past collaboration opportunities shaped this 'capital'. This has a multifold impact on remote coordination and control mechanisms during the ERP project as summarized in Figure 44. The capital reduces the need for remote communications and control. For remaining collaboration needs, it facilitates processes of connecting, communicating and controlling.

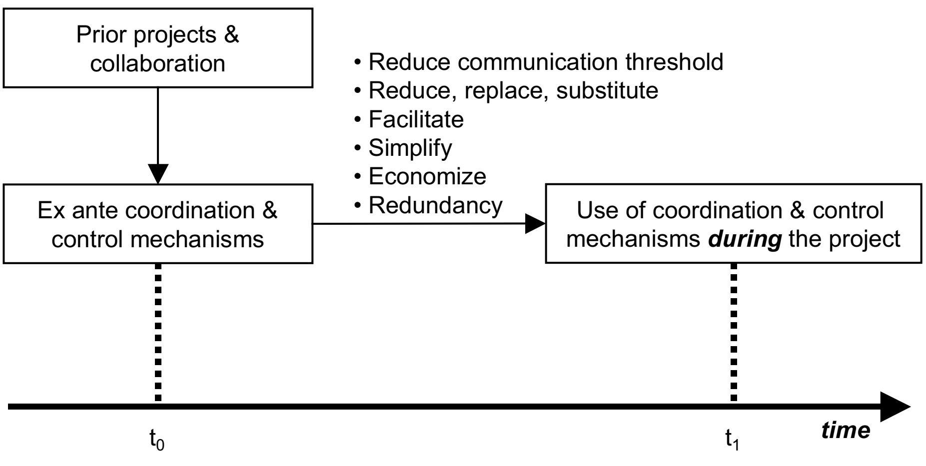

Figure 44 - Source and impact of ex ante coordination and control mechanisms

§ 9.2.2 Planning, Managing, Controlling

This section reports on three themes that seemed closely intertwined in the DiskCo case: planning, managing, and controlling. 'Managing' is considered here in the context of hierarchical relationships between boss and subordinates, or a boss and his boss. On top of that relationship, a project manager enacts a role in his day-to-day mode of operating that encompasses behaviors like communicating, relating, planning and controlling (PMI, 1999). We analyze the role of these themes in a distributed project like DiskCo's implementation of Oracle ERP. The section is structured as follows. We start with the VP's role in the project, and his emphasis on centralization. We then look at the setup of local implementation projects, and subsequent ways in which CPW manages and controls project progress. Next, delays in the project are analyzed, and the use of nonhierchical control modes. We conclude with control modes that rely on representation of work processes and technology.

§ 9.2.2.1 The VP's Role

We start our analysis of distributed project management from the perspective of the VP (CPW) Information Technologies at DiskCo, Singapore site A. He is the main supervisor for DiskCo's IT organization in the Far East, except for Thailand. This responsibility is split into two groups: Singapore site A and remote sites. At Singapore site A, CPW heads HHT, Director Applications Development, and the Director Computer Operations. Remote IT organizations are located in other Singapore sites, China, Malaysia and Japan. They are usually headed by an IT director who reports to CPW.

Until the Oracle project, CPW's involvement in IT projects was often minimal. These projects concerned mainly software maintenance and modifications, and did not have a broad impact on business operations:

> "Last time with the smaller project, I don't really have to be involved. (...) We always organized our support by manufacturing support, financial support, HR payroll support, and operations support. That was before Oracle. So like manufacturing we had some projects with manufacturing, this team of people (IT from Singapore site A - author) will work with their counterparts to get it done. And they don't have to involve things like infrastructure, they don't have to involve operation, nothing. It's mostly a software project. A software project means: today I introduce another new function, we need to transfer the program, we need to be trained on that function, and how to teach the user to install that. But those projects were very small. It was on a small scale, which means you only need a manager and a team to work with them (users - author) directly. We don't even need to know anything at all. (...) And my involvement used to be (...) neglectable." - CPW, DiskCo-A-3

These projects were almost completely delegated. The project manager hardly contacted IT executives like CPW. He worked with a small project plan that sufficed:

> "With the small projects, (...) you have some small plan, and the manager will manage and I don't even need to know. I only need to know when he will finish it. If he never come back to me with any issue I assume that he is OK." - CPW, DiskCo-A-3

The Oracle project changed all that. It encompassed software and hardware/ infrastructure, had a major impact on the business, and involved many user departments. It was a completely novel IT environment. Like, now for the first time key business applications used Graphical User Interfaces:

> "But this (Oracle ERP - author) is different. This is a whole plan. You are converting something totally different. And now with the mouse, with windows, it's totally different. And the users themselves have been using their old method for a long time. And now they have to switch." - CPW, DiskCo-A-3

This impact and visibility challenged the existing IT organization, including its leadership. From VP's point of view, it meant strong involvement in the project's setup and operations. Project success or failure was his ultimate responsibility. There was no back up in case the new system would fail. And the time line was tight to meet Y2K readiness requirements. All this meant a very engaged, supportive role for the VP:

> "You can't just sit in your office, waiting for something to happen. Because the impact is so great, when you turn on and it fails, there is no way to go back. And in our conversion, there is no such thing as a parallel run (i.e., running simultaneously the old MANMAN system and new Oracle ERP - author). It's cut. So when they cut, you move on from one week, there is no way to move back anymore.
> Since the consequences are a lot more serious, I cannot just sit there and wait for people to tell me all the good news. I have to be in there to see it. And also an important thing is our conversion schedule is so tight. It's all 24 hours or sometimes 2 days, 2 nights continuously." - CPW, DiskCo-A-3

In fact, this approach constituted a new project management layer. The VP oversees and guides the project on a meta-site level, in addition to local project leaders (usually the IT director). These leaders focus on their site and their implementation. They do not concentrate on the big, regional picture since that is not their primary responsibility. However, local implementations are embedded in the Far East and global environment. They are interdependent in the sense of sharing resources, and ensuring consistency and commonality. The VP complements the local leaders' role by focusing on that inter-site connectivity:

> "When you come to a global project like this, you have to have a person to oversee the whole thing. Because everybody oversees only their part. I'm another layer on top who sees the important things. Not all the details, but I can see everything. And I think that helps a lot." - CPW, DiskCo-A-3

The VP relies on local management to bring up issues that feed into his role. He does not setup and steer local processes, that remains a local responsibility. His added value is ensuring the conditions for successful local implementations. He signals local needs and supports these by involving different groups. To this end, the VP maintains close ties with IT and user communities whose help or approval is needed:

> "My coordination role is more on a higher level, in the sense that when we coordinate all these people, if they have issues, constraints, resource issues, they come to me and report to me. And then I have to go see different groups. Some of them report to me, then it's easy. When they are not reporting to me I have to go talk to their boss. And that is how we coordinate. (…) My role is looking at resources, (…) looking at the overall picture. (…) And at the same time working with the US counterpart to tap their knowledge, organize the support from the US to support our team here. (…) If it is everything coordinated out from here (Singapore site A - author) it is going to be very difficult. I mean how are you going to make sure that the infrastructure is ready. Every area has its local IT, and all of them report back to me." - CPW, DiskCo-A-3

The VP meets regularly with local IT directors through on-site visits or teleconferences. Within the framework of the master schedule, they elaborate on local needs and constraints. If need be, the VP can arrange his resources at Singapore site A to support local implementations.

> "For my role, I have to cover all the plan make sure that all the plants are converted on time and according to the schedule. For example [Malaysia site A] - all these people there, my director there they have the master plan. They know when it is their

> turn, and when what they need to do what. We have weekly meeting so that we know when they are supposed to send somebody for what, and when they need to make sure that all the infrastructure is ready. And they also coordinate and work with their local key user to organize training. And if they need any help from here to conduct the training, that is when we have a meeting or even before the meeting they all talk to me very regularly. And then over here (Singapore site A - author) I will coordinate the resources to help them." - CPW, DiskCo-A-3

Building this distributed support web was a departure from the way IT operated in the Far East before the Oracle project. So far, local IT cared for their own business. They supported local users and were authorized to customize the MANMAN program according to local user requests. Now with Oracle, sites need expertise from others, in particular from Singapore site A.

> "In fact this whole Oracle project, make all the IT people work much closer than before. Before this project, they hardly see each other. Before they are very independent in the sense that they care of all local issues, they have the right to change the program (i.e., MANMAN - author). But because of Oracle, they work as a whole IT group, as a total resource. And the good thing is that all of them report to me." - CPW, DiskCo-A-3

Interwoven with the supportive side of the VP's role is control. The VP compares work progress at the various sites against pre-set expectations. He connects closely and frequently with directors and the team in Singapore site A to get a feel of task accomplishments:

> "My role is also to monitor the progress of the project. I have briefings with [HHT] and sometimes with the team (local IT team at Singapore sit A - author) to see how things are going, and to monitor the project schedule and all the tasks. Whether we are meeting the schedule or there are any issues. And of course I also communicate with the local management and update them. (...) I update the local management (...) and work with my boss back in the US to make sure that all the preparations are done." - CPW, DiskCo-A-3

Underpinning his control role is the global Oracle ERP master plan that schedules local implementations over the period 1997 - mid 1999. It groups these into four regions: US-Mexico, Europe, Thailand, and other Far East sites (Figure 45). The figure shows a partial screen shot for US and Mexican sites (left from the first red vertical bar), European sites, and some Far East sites (right from second red bar). For each implementation, major milestones are identified with abbreviations. These are explained in the legend (Figure 46). The rows in yellow depict the first week of a fiscal month.

9/1/97								T1				T2								
9/8/97								T1				T2								
9/15/97								T1												
9/22/97			FINAL					T1				BT						T2		
9/29/97			FINAL									BT						T2		
10/6/97						T2	T2					UT							T1	
10/13/97						T2	T2					UT							T1/CRP	T1/CRP
10/20/97				FINAL		BT	BT					FINAL								T1
10/27/97						UT	UT		CT			FINAL						BT		
11/3/97					T1	UT	UT		CT			W1	T1					UT		
11/10/97	X				T1	UT	UT	BT	CT				T1/CT					UT	T2	
11/17/97						FINAL	FINAL		CRP				CT					UT	T2	
11/24/97						FINAL	FINAL		CRP									FINAL		
12/1/97						W1	W1	T2										W1		T2
12/8/97	X				CRP			T2												
12/15/97								T2			CT								BT	
12/22/97								BT												
12/29/97																				
1/5/98								UT	T1				T2							
1/12/98	X				T2			UT	T1	CT	CRP		T2/CRP						UT	

Figure 45 - Master plan global Oracle ERP implementations (partial screenshot)

GENERAL SEQUENCE	EVENT	Description	Comments
1	T1	First trial conversion	Assume 2 full weeks
2	CT	CRP Training	Assume 1 week min
3	CRP	Conference Room Pilot	Assume 2 weeks
4	BT	Business Test	Assume 1 week min
5	T2	Second trial conversion	Assume 2 full weeks
6	UT	User training	1-2 weeks
7	FINAL	Final conversion before going live	Assume 1 full week prior to conversion weekend.
8	W1	Week one on new system	
		Rows in yellow are the first week of a fiscal month.	

Figure 46 - Master plan global Oracle ERP implementations (legend screenshot)

The schedule is a basic Microsoft Excel file. DiskCo HQ in the US developed and maintained the file. It is shared with top management across the world to update them on project planning and progress. The schedule defines only major steps and sequencing of local implementations. It can be seen as a condensed boundary object (Star & Griesemer, 1989). That is, the schedule communicates minimal information that is sufficient for those with leadership responsibility in the project. Its task is to coordinate and control on a global level the embeddedness of local activity contexts.

> "Everything is followed from the master plan. The schedule tells which plant will go first, that one will go later. And then in between what are the activities that need to be done for all these plants to be prepared for the conversion. (…) Basically it only indicates some of the big milestone tasks that need to be done, but not in detail." - CPW, DiskCo-A-3

Details for local implementations are filled in by the VP and local directors. They work backwards from key milestones to ensure on-time performance:

> "From [the master plan] we know like for China when to send people up to Singapore for training. (…) But there is always a lead time that we need to consider. For China especially, they need at least 3 months to get their passport, visa everything. I know

> that (when) China needs to convert at this time, I know that before that these are things that need to be done, and this guy must be here to Singapore by when. So then we have a lead-time of 3 months to get a visa. So we work backwards in that sense. So in terms of impact, in terms of how we organize it, basically it is all based on a schedule, and we work backwards. And then we initiate all the so called plans to bring them over and for how long and ticket and everything. (...) When people must come and all these things is really based on the master plan and works according to the timeframe that we have" - CPW, DiskCo-A-3

The schedule structures the relationship between the VP and his directors. It demarcates overall boundaries and identifies key dimensions for local leadership (Star & Griesemer, 1989). During the project, the schedule helps the VP to monitor progress.

> "We have a project schedule. Every meeting (with local IT directors - author) we will look at the update, where we are now, what is the update. The IT director decides to update whether these task have been completed (...). So I think that is really good enough to monitor them. And I also believe in empowering the local IT directors. I have given them this (responsibility for their local implementation - author). How you break this down in smaller tasks, the people below who need to do it etc, he has the responsibility to make sure that it is all carried out. Of course he is also being assessed, performance appraisal etc." - CPW, DiskCo-A-5

Locally, the schedule is translated into detailed activity plans. This is done by the IT director as a key user in Finance reports from Malaysia site A. Local staff works from the detailed planning, and not so much from the global master plan:

> "They (local project leadership - author) just set the guidelines, like this month what are the things that we have to achieve; this is the timeline (...) that we have to follow. What the framework is that they use I am not very sure. (...) I guess he has his resources and input from [Singapore site A] as well as [US HQ] how they do about it. I think that sort of timeline is perhaps already worked out at the corporate level" - SKL, DiskCo-L-1

§ 9.2.2.2 Centralization

ERP software offers an integrated platform of business applications. It supports - at least in theory - processes that cut across functional, organizational, and locational boundaries. Achieving this degree of commonality and integration is not always easy (Davenport, 1998). Companies may operate in a way that does not fit the assumptions underlying ERP packages (Soh, Kien, & Tay-Yap, 2000). They may have a tradition of laissez-faire, leaving adoption and modification of IT infrastructures to local sites. This results in a collection of IT infrastructures that operate fairly independently and differently.
Implementing ERP in these distributed and diverse environments is a major challenge from a project management point of view (Markus et al., 2000).

One response to this challenge is centralized, hierarchical control. In a sense, this facilitates the transition towards a common though distributed environment. Control has been perceived as one of the advantages of bureaucracies from a Transaction Cost Economics point of view (Arrow, 1974; Williamson, 1975). Barney (1996) claims: "Disputes are less likely to occur because the hierarchy is able to establish joint goals which lead to convergent expectations between those in a transaction. Additionally, hierarchy facilitates the development of codes and language that are unique to a firm which allow for more accurate and efficient communication" (Barney & Hesterley, 1996: 119).

For DiskCo, the VP repeatedly emphasized how easy direct hierarchical control was in a geographically distributed organization. It enabled him to assign and shift resources on a regional level with minimal effort. He did not have to liaise with others for his own resources, that is, the IT organization in Singapore, Malaysia, China and Japan. Direct, hierarchical control thus facilitated meta-site coordination.

> "All of them report back to the same boss (i.e., CPW - author). That means that all the people involved at all the sites, the IT organization report back to the same boss. That is one of the key success factors, because you cut down a lot of unnecessary coordination. And you lead to one dedicated person to make a lot of decisions to make sure that everything is coordinated properly, and to make decisions, and to move the resources to fill the gap. Because all of them now report to one person, all report back to the same organization. The management here can anytime almost randomly move their resources depending on which one is more critical, what is the situation now, how we coordinate that. I think that is very important.
> If we did not have the free hand to do that, it is very difficult. Because, when the project moves forward, always some things happen, something that you never planned, or something last minute pops up. Like we are doing some hardware, then this factory suddenly ramps up, needs more capacity and things like that. So you have to have the overall person who is able to coordinate all this and also make decisions, and make this call. So it's like: "OK you down to there, drop everything, do this". And I'm not talking about just the application, I'm talking about infrastructure, operation, everything. (…) I think it is important that you have one place, one person to make the call." - CPW, DiskCo-A-3

Direct hierarchical control helps avoiding and solving conflicts like Barney (1996: 119) mentions. When conflicts emerge, they can refer to the same boss who emphasizes overall interests. With DiskCo, this helped. The master plan for the Oracle project was considered very aggressive. Time allocated to local implementations was therefore tight. Without a hierarchy, solving these tensions would have been probably very difficult and time consuming. Now, the VP's decision making power smoothened emerging issues. And if need be, he could ultimately refer to his boss:

> "I would say that this whole conversion project is more centrally controlled. But in terms of resources it is distributed across the sites. But in terms of control - dictating how to go about doing it - it is really more centrally controlled. (…) If we leave it to every site to go do it we can never standardize, we never use common resources. Now I dictate how we gonna do it, I dictate that these are the resources to be shared, I dictate when these resources go to here, when these resources go to there. (…) If you leave things to the sites, you have all these conflicts. Because we have this kind of structure, any conflict that people bring up here, I can make a decision and just go. (…) I don't know whether this will work for other type of projects, but it works here because in this one, the thing is commonality. (…) And we have the task to implement Oracle, control the project and try to make sure all processes are standardized. So that gives a lot of help in the sense of any time anybody disagrees I say: "Big boss says"." - CPW, DiskCo-A-5

In CPW's approach, direct hierarchical control is closely intertwined with his enabling role. On the one hand, he uses his position in the hierarchy to enforce the project schedule.

At the same time, he quickly responds to local resource constraints. As earlier indicated, his units in Singapore site A are available as a central, supportive resource to other sites.

> "You have to have a command hierarchy. And they all know who makes the core, the decision. If you leave it open to anybody to make the core, then there is no way that you can really meet that kind of schedule. Because everybody wants things their way. Everybody wants their convenient time. But we have a kind of structure in such a way that the program is already all laid out, the schedule has to be followed. And in the US the big bosses are all following the schedule very closely. So there is nobody below who can say "Hey I don't want to do it." No. So I think hierarchy is very important. You have a strong support there and it is very clear that that must be done. And it's a "don't ask any questions, just get it done" kind of thing. And then we will draw all the plans nicely to help you to meet that plan. But don't change the schedule. We are the ones who can change or don't change." - CPW, DiskCo-A-5

To conclude, centralization and hierarchy underpin coordination and control DiskCo's geographically distributed IT organization. Since people have the same boss, there is probably more goal congruence. Escalation of issues eventually leads to the same person in charge. This clarity fosters cross-site collaboration as the Director Applications Development (Singapore site A) remarks:

> "They are all reporting to CPW except 2 groups. I think the other all report directly to CPW. So it is quite easy in the sense that because I also report to CPW, we work together quite well (with remote sites - author). I mean that is part of the responsibility registered in the beginning that the core team had to help the other sites to do the roll out." - HHT, DiskCo-B-1

§ 9.2.2.3 Local Implementations Setup

When he started to work with local sites, the VP could rely on an existing organization (see section on ex ante coordination and control mechanisms). He had worked with local directors and staff on previous IT projects, like after the merger with StorCo. He selected many IT professionals at local sites. And for the Oracle ERP project, he only pulled in people from the existing IT organization. All this constitutes a form of input control that reduced uncertainty during the project itself.

> "(...) (F)or this conversion project, we never employ new people to do the project. We take from the existing organization." - CPW, DiskCo-A-3

The responsibility for local implementations was clearly delegated to the local level, the IT directors (unless a site was close to Singapore site A, or lacked a local IT organization, like in Japan). This was challenging at times, because user communities did not feel the need for new business applications as strongly as the IT organization:

> "Coming to the ownership of this Oracle conversion project. To the users IT is the owner, not the user. Why? Because all the while the old system has been running, they are used to it, there are no issues, they can do their job. And suddenly somebody says: "I want to change all this". So to them this is an IT project. So this means that IT must push a lot to make it happen. So the ownership is within IT. The IT director, all these people report to me. Whether you feel you are owner of this or not, I tell you that you are responsible, you better be the owner." - CPW, DiskCo-A-5

With the burden of local ownership, the IT director could at the same time rely on the IT organization from Singapore site A as an additional resource. Experience from the US and early Far East implementations was formatted into templates, and provided to remote sites.

> "We (Singapore site A - author) are the resource for them (other sites - author). So we know the plan, we deal with the plan, with the things that we know they will need, we organize all this for them. But the rest they have to organize. Like they have to come up with a check list, they have to come up with a schedule. But for all these things there is a template given to them. They just fill in their own timing, they fill in who are the persons and some additional local stuff. They are responsible but they always have us to support them." - CPW, DiskCo-A-5

The local project organization was replicated from sites that converted at an earlier moment, like in the US or Singapore site A. The local IT director leveraged on this experience when structuring his implementation. His site should be self sufficient, thus in a sense representing the variety of the reference site, Singapore site A (Ashby, 1968). Variety refers to resources and areas in which you need expertise to convert to Oracle ERP and provide support. The VP comments on variety replication at local sites:

> "I have the local IT team here (Singapore site A). So when we have these resources here, correspondingly over there, they also assign a few people to be for the Oracle conversion." - CPW, DiskCo-A-3

Since the system is new to the local IT organization, they are initially strongly supported by resources from Singapore site A and local Oracle presence. This work division shifts over the course of the project. The local team's initial role is to facilitate basics like infrastructure and external training. Later on, they become more autonomously responsible for things like systems operations and support. Local kick-off meetings were held to communicate the project goal and setup. The VP and staff from Singapore site A explained the project to local people impacted by the change.

> "When we first started off, this was very clearly communicated. We always have a project kick-off meeting. Not only just to communicate to the IT people about the project. We also communicate with the management there and tell them: "OK this is how we gonna implement the project, and why you want to convert to Oracle, and what is the role of the local key users and IT persons". So you set the expectation very clear, and also the responsibility is very clear." - CPW, DiskCo-A-3

In a later interview, VP emphasized that during the kick off meetings he communicated to two groups: local IT (management, staff), and management from user departments. The local IT organization would reach staff from user departments:

> "Every project before the site starts, we have a kick-off meeting with all the site management and the key users. I'm the one who goes around and does a presentation to them to explain why we need to convert and what are the steps to be carried out to do the conversion. And how the site prepares, and what are the involvements and what is the schedule. And I'm the one who does the communication. And that is the main communication to the manager level. For the key user level, I use the IT person at the site to communicate with them, prepare them, and go through the schedule: when we should bring a PC, upgrade the PC's, when the users should go for training, and how plan according to that." - CPW, DiskCo-A-5

In our research interviews, the VP and others repeatedly emphasized the same project setup that has been described above. Apparently, the VP communicated his viewpoint in a very clear and explicit manner. This illustrates findings from other students of distributed projects (Jarvenpaa & Leidner, 1998; Meadows, 1996b). Explicit communications reduce uncertainty and, hence, remote communication needs. They avoid misunderstanding, and different assumptions common to distributed work environments (Hinds & Bailey, 2000).

Even though the overall approach was clear, some project participants missed the same explicitness and formality on a more detailed level. It could have sped up the overall process. And it would have made it easier to oversee the project, despite its impressive size. In a sense, the frame of the house was there, but how each room was to be completed remained somewhat vague. Perhaps this was because the project was very novel, and people were not used to working so closely under high pressure. In any case, one of the key users from Malaysia site A comments:

> "The key lessons that I learnt from this project is that whenever you want to do a project of this big scale, we have to plan it very well. Because a good planning can avoid a lot of problems, and can eliminate some of the issues from occurring. That is the first thing that I learnt, that we must work on a detailed plan." - SKL, DiskCo-L-1

The Director Applications Development echoes this concern. Reflecting on the project, she points out that elaborate planning ensures ex ante commitments from the many parties involved. It reduces novelty in an early stage, and cuts down on (remote) exchanges. Detailed plans make it easier to prepare local sites for their local implementation:

> "Maybe we can build up a more formal type of communication channel. Because so far what I have seen it's really quite an informal way. In certain cases if we can do it in a more formal way then sometimes we can get things done better. People can also expect what needs to be done in a more formal way. I would say the problem I have is when I was first putting on the project I didn't really know what to expect. And then a lot of things is like: We do one step and then just take ahead one step of what needs to be done. So if I had an opportunity to do it again, of course with my experience I have, definitely we want to have a more formal type of planning in the sense that we can have a better, complete plan on all the activities that need to be done. So that each site that is responsible for doing certain tasks is better informed beforehand. So I think that is something that I want to do." - HHT, DiskCo-B-3

She emphasizes pre-coordination: coordinating activities and making expectations clear as early on in the project. To her, this applies in particular to groups of people supporting implementations more from the sidelines, and remote IT units. They were not sufficiently briefed and committed in advance.

> "Maybe we will need to have a more structured organization in a sense. Although now I have my core team reporting to me. But some of the other support groups are assisting and there is no formal kind of structure saying: "OK who will be doing what, who will be part of the project". So if I have an opportunity I would want to have specific people assigned to do certain tasks. I would want it to be pre-defined and pre-assigned so that everybody knows they are part of the team in a sense. And then similarly for the remote IT groups also in the same way. So it's like I'd prefer to have a more structured way of running the project. It will help to be able to do a more formal type of communication." - HHT, DiskCo-B-3

According to the director, the IT organization operated in quite an informal fashion. Factors contributing to this include the small size of the IT organization, and the fact that people knew each other quite well.

> "I think CPW mentioned yesterday that we have been working in a very casual way on this (Oracle project - author). Because we work from a very small group." - HHT, DiskCo-B-1

The director indicated that although local groups were often small, the Oracle project joined multiple dispersed groups. She related her emphasis on planning and formalization to the size of the Oracle project, and the fact that it was distributed:

> "(It is) (b)ecause there are so many groups involved and it is cross-country. So I think it will help if you have a more structured way of managing and running the project." - HHT, DiskCo-B-3

Earlier in the theory section, we looked at the impact of work unit size on coordination and control modes. Among the effects are substitution of informal contacts for formalization (plans, standards and so on). A project's size may make it unfeasible to handle too much informality. It could lead to communications overload (Galbraith, 1973; Van de Ven et al., 1976). In Director HHT's view, geographical distributedness further adds to this argument. It may make remote communications more difficult. All this encourages detailed planning to reduce remote information processing needs.

In our interview, HHT clarified the combination of size (number of parties involved), and distributedness. She distinguished two types of implementations: those for which she (and her Singapore site A team) was directly responsible, versus those 'owned' by local IT. The first category was relatively easy to coordinate. She supervised her group that handled the complete implementation process.
The second category is more complex from a coordination point of view. Now, the local IT is responsible for the implementation project. HHT's group supports local IT as they work with users to get the system implemented. In fact, one more party is involved - the local IT organization. This increases the number of linkages, and thus complexity (Haeckel & Nolan, 1993):

> "The local IT is the main coordinator for their projects, because it is their country. So the core team (HHT's team in Singapore site A - author) acts more or less as a resource, as a consultant to them a lot of time. Of course we try to tell them what are things to watch out for, things like that. But it all depends on how they want things to be done, and what are the requirements that they need. So I would say that there is more coordination to be done. Because there is one more channel, one more party to deal with." - HHT, DiskCo-B-1

A key user from Singapore site A describes a similar difference between local versus remote contacts. Locally, i.e., in Singapore site A, she deals with people on the work floor, like a store or shipping supervisor. For remote sites, that contact is channeled through key users on-site.

> "Is slightly different in the sense that when I deal with other sites, my contact point will be my counterpart (key user at remote site - author). Let's say they have inventory control or they have people that are in charge of inventory control. So my contact point is to them. Whereas for [Singapore site A] I deal directly with people like the store supervisor, or for shipping it is the shipping supervisor." - JLL, DiskCo-G-1

In the next section, we expand on the organization of cross-site connections, and the role of key users.

§ 9.2.2.4 Managing During the Project

The VP's close involvement in the setup phase, extended to the main implementation phases. He stays tuned through on-site visits and electronic media. During visits, he talks to a range of people involved in the project, both IT and users. This strengthens his perception of the local situation. He does not confine himself to remote updates, or the most obvious local representative, his IT director. In a sense, he avoids structural holes in his network (Burt, 1993). That is, his becoming dependent on e.g. local IT for maintaining contacts with local user communities. He also avoids too much reliance on remote contact. On-site presence makes it easy to connect with different people, and allows for on the spot problem solving:

> "It is important that we have a lot of these staff meetings, weekly meetings for the project. And I personally go down there and feel the ground. And every conversion, the actual conversion, I'm always there 1 week before. And I stay up to 1 week later. So the week before I can be there, when I see anything I do not like I need to mobilize some people from here (Singapore site A - author). And the good thing within Asia is that in 1 day you can reach most places. No major itinerary." - CPW, DiskCo-A-3

Throughout the project, he maintains a regular and frequent pace of meetings. For early implementations in the Far East, meetings were scheduled on a daily basis. This boasts the conversion team's information processing capacity when all of them are still learning. It sustains the VP's awareness of project progress. He can map that against the master plan, and intervene in his role as a meta-site coordinator if need be:

> "We have a daily meeting with the conversion team, the IT team. At the end of the day we go through what we have done and what issues we are facing. So as we move forward, we will know the situation. Based on the master schedule we see where there is going to be a bottleneck, and we assess if we adjust it, what will happen to the rest. And sometime from the MS Project schedule you can see there is some time lacking, or there is slack time, and then we adjust it. For the very first plant we have every day at the end of the day a meeting. But subsequently we have weekly meetings. But anytime the project leaders have any issue, they will meet and talk about it." - CPW, DiskCo-A-3

Remotely, the VP arranges multi-party and one-on-one and conference calls. When multiple sites were in the conversion process, multi-party teleconferences were organized to share updates. He also talks individually with IT directors to gain an intimate understanding of local progress. All together, these communications provide the VP with an accurate picture of regional progress. This translates into fast response times when issues arise. On a meta-site level, this is important for two reasons: first, local implementations share central resources from Singapore and Malaysia site A. Delays at one site have a spill-over effect to other ones. Second, projects are scheduled very tightly because of the Y2K problem, leaving little margins for prolonged cycle times.

> "When we have a weekly meeting it is a meeting conference call. That means all the sites that are involved in the project, we have a weekly meeting, conference call and each of the sites will report their status. What are the preparations they, are in and individually I will also talk to the director of my IT organization over there, to track where they are. What we have is, for example this is [Singapore site A], then this is say [Malaysia plant A]. We know that from [Singapore site A] to [Malaysia plant A] we have 2 months. And we also know exactly which week we are doing the trial data load, CRP, the business test, user training etc. We track this very closely to make sure that all this is on time. If any of these things slip it is potentially affecting other sites. So then we say immediately: "Which one can we adjust and how we can squeeze it in"." - CPW, DiskCo-A-3

When people worked on the master plan, they realized that some programs would stop by mid 1999 instead of by the end of that year. This is because FY2000 starts at that time. Consequently, some implementations were scheduled in parallel or overlapping:

> "The initial plan came from the US. But as we move forward we adjust our plan. Because initially they say: "Oh this will take only half a year". But it ends up taking longer. Then we adjust it. Initially our plan is to convert all these plants by a certain date. But then we realize that the effort we are talking about lasts until the end of 1999. But we realize that the existing package will not work anymore by mid 1999 because of the fiscal year FY00. By the end of June we will start a new fiscal year. Then we are going to FY2000 and the existing program will fail. So we have to squeeze, and we adjust our plan and we end up having some plants convert at the same time." - CPW, DiskCo-A-3

In practice, implementations presented a major challenge to the Far East IT organization. Especially for the first conversion, they needed more time for learning the application and the conversion process. This implied - according to the original plan - that the team from Singapore site A would have to start on the next site when theirs was still unfinished:

> "We adjusted the previous schedule twice. After [Singapore site A], (...) is supposed to convert another big plant, but ever since [Singapore site A] converted, we are having a lot of system issues because that is only the time when you see the real volume coming. During the test you cannot really do a so-called stress test to the real environment. And we have a lot of other things, also because we are in the learning stage of the learning curve. A lot of things we don't understand well, we have to take much longer. So after the conversion of Singapore site A we suffer a lot - about 3 months before we stabilize." - CPW, DiskCo-A-3

The remaining uncertainty from the Singapore site A conversion would spill over to the next site. Experiences from the first conversion serve as a template for subsequent projects. To a great extent, other sites are merely a replication from first implementation. Starting those projects would lead to a lot of uncertainty. Remote IT would tax resources from Singapore site A, when those were still needed locally. Eventually, IT executives approved the schedule adjustment that rippled through the complete plan. This simplified cross-site dependencies, and reduced their intensity (Loch & Terwiesch, 1998). Instead of parallel or overlapping dependence, conversions were temporarily decoupled. That is, they are more sequentially arranged until uncertainty is sufficiently reduced (March & Simon, 1958).

"The initial plan is that next month we convert another plant. So I tell my boss no. That will just be a disaster. Because we believe that Singapore site A must be stabilized. Anything we do at [Singapore site A] we apply the same to rest of the drive plants. If we cannot stabilize here and we continue to apply, then every plant will fail. And I cannot afford to fail one plant and focus all my resources just to solve all the problems. I cannot afford to stretch my resources to solve problems of a few plants happening in the same time span. So we adjust that and we had a lot of good reasons to convince the boss to adjust. (...) And that is one of my roles, to look at the situation and adjust the plan and convince the management that we need to adjust the plan. And the people below are the ones who keep enough detail and feedback and say: "Hey we cannot make it". I have to make that call and decide either to pull in more resources or adjust the plan." - CPW, DiskCo-A-3

When issues were resolved at Singapore site A, people had aggregated a substantial body of experience. Now they could help other sites in a focused manner. Their know-how reduced the time needed for subsequent implementations. They could help counterparts either directly by talking to them. Or more indirectly through templates that reflected their experience. Says a key user from Singapore site A:

"During the [Singapore site A] conversion we have gone through so many bad experiences, and good experiences as well, so we know a lot of things, we already know the process very well. So when we come to other sites that they want to convert, we can help them. If you gonna do it this way, you will face this problem, and what is the correct way that they should take. So it shortens a lot of time. Even the conversion table that we set up, they follow us closely. Because if you don't do it, then you face a lot of problems. And also, we have established a lot of reports so when they convert they can just pick up whichever they want. So the time required for them to convert is relatively shorter compared to [Singapore site A] ." - JLL, DiskCo-G-1

The VP claims that the postponement he requested paid off. After his site stabilized, the team could channel efforts at local sites and reduce cycle times there:

"We made 3 major adjustments. That means after the [Singapore site A] conversion, we were supposed to convert another Malaysian site one month later. But after [Singapore site A] conversion the system was not stable, we had a lot of problems. And the resources that we have are just good enough to solve our [Singapore site A] problems. Since the rest of the Drive plants were all depending on whatever modification we have for [Singapore site A], and wait for this system to stabilize, we think that we should push up the rest for 2 months. And that is a good decision because after 2 months we cleared all the issues here. Then when we (team from Singapore site A - author) go over there, the conversion only takes 2 days. Because all the issues were resolved." - CPW, DiskCo-A-5

"Through all these experiences we learn. Every plant that we convert, we encounter some issues. So as we move forwards, a lot of these things we encountered before, we know exactly what the issue is and how to resolve it. And that is why initially our schedule to us is aggressive. But as we bring up our knowledge, we know that we can make it. Because then your life cycle, through your training, your learning curve, the time taken is much shorter." - CPW, DiskCo-A-3

We can analyze the changes in strategy by drawing on March and Simon (1958). Figure 47 shows a matrix work of uncertainty (predictability) and the intensity of interdependencies (rows). The master plan started off with tight dependence (parallel and overlapping conversions), motivated by the Y2K problem. However, the project was also very unpredictable since IT units lacked experience with advanced applications like Oracle ERP. The schedule adjustment granted the Singapore site A some time to resolve issues. With their experience, the pacing of conversion projects could be increased again (see also Table 8).

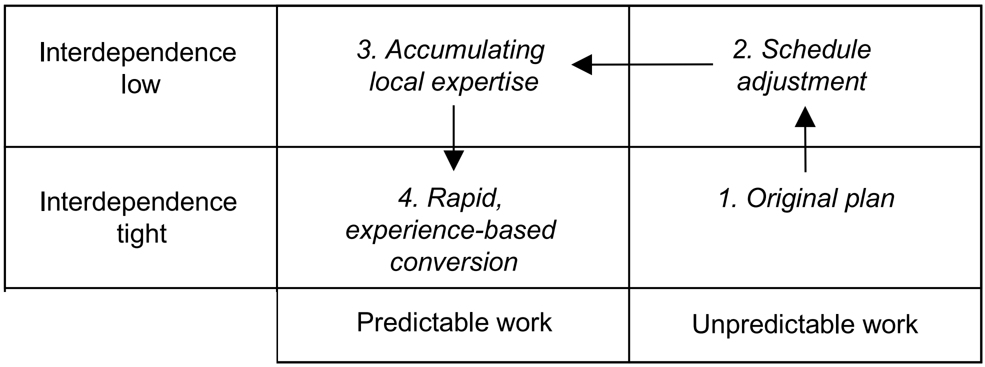

Figure 47 - Changes in conversion strategies DiskCo Far East

§ 9.2.2.5 Nonhierchical Control Modes

So far, we focused on hierarchical control modes. In this section, we look at other ways to "(…) ensure that another person or group works toward and attains a set of organizational goals" (Kirsch, 1996). First, people control their own performance. On a site level, the IT director is responsible for his conversion project. While people can call in support from Singapore site A, they are essentially on their own. A Finance key user from Singapore site A stresses the responsibility of her counterparts at other sites.

> "I can't monitor them, only provide them with training, and they will feedback to me if something doesn't work. So I don't really monitor what they are doing. They are on their own really, unless they have problems then they will come to us. Otherwise they will not come and call us." - ST, DiskCo-H-1

Self control is intertwined with forms of control that are based on trust. People are trusted to take care of their own local work. They are responsible for identifying issues and initiating communications. The Director Applications Development (Singapore site A) expresses this point of view when talking about project members at other sites:

> "I think we kind of trust individually that they know what they need to do, they are mature that if they don't have the thing they will ask the right people to get the thing done." - HHT, DiskCo-B-3

People relate trust to past collaborative experiences. When they worked before with someone, they know their counterpart's usual performance. This is extrapolated to current opportunities for collaboration. McAllister (1995) referred to this as cognition based trust, i.e., individual beliefs bout peer reliability and dependability. One IT member from

Singapore HQ knows whom she can or cannot trust. She explains her different remote communication preferences based on experience with users:

> "It depends on people. Some people I will want them to write email to me, because some people really cannot be trusted. Because sometimes they talk to you over the phone, but then later regarding those things that you told them over the phone, they will say: "Oh you never mentioned that to me before." So for some people I expect email from them, for some people just a call will do. It depends on individuals. (...) If you work long with all these people you know what sort of character, what sort of people they are." - SCC, DiskCo-J-1

Following this point of view, we should tie trust to prior collaborative experience. This means that when people have not worked together in the past, they may be hesitant to rely on trust-based control modes. People need time to develop the working relationships that substantiate trust (Gabarro, 1990; McAllister, 1995):

> "You can hardly have trust with new people. For people you have been working with for a long period of time, normally there will be some trust between us. But for new people you still have to develop that kind of trust." - SCC, DiskCo-J-1

Most people worked for years in the DiskCo organization. They have had ample opportunity to work with people on other projects, and develop a base for trust.

The emphasis in the Far East organization on hierarchy and centralization had an interesting consequence for nonhierarchical modes of control. CPW utilized both his relationships with peer executives, and his hierarchical role to ensure management commitment to the project. This strong involvement paved the way for lateral collaboration. For instance, his kick off meetings at local sites presented the project as an important common goal for IT and users alike. This directed people in same direction, and ensured their willingness to help. When key users from Singapore or Malaysia site A visited remote sites for assistance, people know already about their role and display a helpful attitude.

A key user from Material and System (Singapore site A) mentions the importance of communications at a management level before she is actually involved in a local project:

> "Before I go to a site, (...) in the first place there will be management communications. They will communicate, either the higher management or the site management will communicate with the other site management. So they understand that there is a project going on already. And we have to make sure that this thing works out. Then I will go there and talk, work with the key user on the project. So that's how we work." - JLL, DiskCo-G-1

This view is echoed by a key user in Finance from Malaysia site A. Before she started working with local (key) users on data conversion issues, her VP had urged his directors already to participate in a positive manner in the conversion process. These local directors made sure that their staff was informed and willing to cooperate:

> "As for Finance, our VP knows that this is the timeline that we have to meet, and the VP has already sent directives to the sites who have done the conversion that they have to give support to the other sites whatever they needed. So in that way, let's say

> the Finance key users they already have the pressing from the VP or even the director that any communications or needs that we ask for, that we will have support from them." - SKL, DiskCo-L-1

In a similar way, when the local IT director needs assistance from user management and key users, they are already 'prepared' to do that:

> "Once the IT director starts to work with the key user, all the (user - author) management already knows that we have to do this conversion. And they are already told to give support. So they will assign some users. And normally we will know who are the people." - CPW, DiskCo-A-5

The same principle applied to relationships between Far East and US sites. A key user from Malaysia site A's data conversion team recognized the importance of US management support. When she visits her counterpart in the US, she maintains rapport with that person's boss to assess his commitment to her case. Ultimately, she depends on management level support to get her job done:

> "For my case personally, I know the superior from my US counterpart. When I go to visit their site, I not only visit them, I will talk to their superior too. I think it is important. (...) Because if you get to know the boss, you know what is the support that you can get from the boss. If let's say the boss is very supportive towards this assignment, then you know that you will get it done easily. If let's say the boss has different priorities, well, you got to try harder (interviewee laughs - author). You have to get some other management support to bring across the message that this project is important."- JLL, DiskCo-G-1

In short, control in lateral collaborative relationships depends on management level communications and support. This top level preparatory work precedes and paves the way for collaboration at director and staff level. Especially for a multi-site project, management support seems important. This could be because each context has its own ways of working and direction. When people are expected to collaborate in a site-crossing project, this could lead to conflicts without a priori management exchanges.

§ 9.2.2.6 Control by Representation and Technology

A final category relies on representation and technology. DiskCo's Software Process Engineering Group (SPEG) in US HQ developed the Software Development Life Cycle (SDLC). This method standardizes software development throughout the DiskCo organization. For software development, enhancement and maintenance projects, it prescribes process steps and provides templates. As a standard, the method ensures consistency and quality. We found on DiskCo's intranet a presentation from the Director of Software Engineering IT that explains in more detail the motivation for having a controlled and disciplined development process (downloaded in May 1999). First, the opposite case - not using a method - leads to an unpredictable processes. When people lack a template, they cannot ensure the quality and timeliness of process steps and outputs.
Second, the method reflects past experiences. It distills successful actions and translates those into an explicit recipe. This makes it easier to ensure the quality of IT - user interactions. It also simplifies newcomer's entry in a project since they can use the method to trace a project's track record. Third, prescription simplifies ex post assessment and

modification of a system. It helps people trace process steps and descriptions of a system. Fourth, the method makes the output of software projects more understandable and therefore testable. The coding becomes more transparent since people must document it in detail according to the SDLC method.

In interviews, people mentioned that the method helped them to work more systematically. They could download and use document templates form the intranet. This structured their activities, in particular in areas like documentation. The control effect of the SDLC method was further reinforced by the use of Lotus Notes. In that groupware system, people can enter requests for customizations to the Oracle system. Once these are accepted, people are formally assigned to handle the project. Requests are also prioritized. The Director Applications Development from Singapore site A describes the procedure for customization requests when showing us the Lotus Notes environment on a local PC. She outlines responsibilities of people involved in the process, and how the groupware facilitates involvement of people whose approval or assistance is needed. In a sense, the groupware offers an environment that looks like a single workspace even though people may contribute from different locations.

> "You have to first create a request that needs approval. The request will be created by the end user. Once it is approved then people from IT take over to be the responsible for the project. They will then create a project. (...) On top of this normally when the user raises a request, there will be a mail sent to tell you (IT director like HHT - author) that there is a request waiting for you to approve. But if you don't want that (email - author) you can also come here (in the Lotus Notes environment) and look at it. The general guideline is that the users raise it, the first level approval will be their immediate manager. And then after that they will come to IT. So normally they check who is the responsible manager in IT for type of project.
> For my case, there are some projects that may affect the other user sites. So after I receive a project and before I approve it I will include more approval into the list to make the US also look at it and make sure they have no issues on the changes. We need to add the requirement specs (specifications - author), the review, design specs, review, code test, review code, third party test, user test, and installation. So to each task can be assigned to more than one person. When they are about to start the task, they will update the date, and when they finish they have to update the hours worked, and they will do a sign off to indicate that they are finished. So once they sign off the first task, the mail will send out immediately to the next person to say OK I have finished this one, now it's your turn to do for example do a review." - HHT, DiskCo-B-2

Lotus Notes makes it easy to attach documents to emails or steps in a workflow. People use SDLC templates that ensure their compliance with DiskCo's software development method. HHT describes the resources included in the process of fulfilling enhancement requests. At that time, she was showing us an example of a project in Lotus Notes:

> "The SDLC documentation is included. In fact in the design document, we have to put in the test plan to see what are the areas of testing. (...) All the attachments are attached here. Because let's say when [SX - name of IT staff member - author] finishes the requirements specs, before she signs off, she has to go in here and say: "Add supporting documents". So by doing that, all the attachments will be included. For projects you normally will have at least one (attachment - author) for requirements, and one for design. So inside here we attach the requirements specs, a Word document, simple, just some description. The design specs will be just the same. When we do testing, Lotus is not a must-have kind of thing, but normally I encourage them to put even results from the third party test in the database.

> Especially when there are issues so we put in the description of what happened, what issues we faced. They may need to rework the thing." - HHT, DiskCo-B-2

The groupware system promotes documentation of process steps. Task assignment and accomplishment become very explicit, formal and transparent. This facilitates ex post tracking and modification of a project. The transparency of an enhancement request project is not limited to the particular IT director and staff member assigned for that case. At a management and executive level, people have access to all projects on a worldwide basis. This is because Lotus Notes databases are automatically replicated across all DiskCo sites. Says an IT member of the Singapore site A core team:

> "We create the project in Lotus Notes. So all the sites will be able to see the projects. Because the Lotus Notes database replicates." - OBT, DiskCo-C-1

When we were in Singapore, we could look at projects in Europe and the US with the help of the Director Applications Development. This included all kinds of details, like priority, planning, and people in charge. People can view - not always modify - the projects from different angles, like priority, location, category and so on.

> "Any project by e.g. users in [US Central] you can exactly see how it is processed. But you cannot edit - that's only for people who are involved." - HHT, DiskCo-B-2

The groupware makes it easy to engage people regardless of their physical work site. Their involvement may be needed for approval, specific expertise, or because they have more resources available. Lotus Notes thus facilitates task differentiation on an international scale.

For local projects, people often do not use the system extensively. They prefer a manual process where they just talk about requests, and work in a more informal manner. On the other hand, international change requests are almost exclusively represented in the system. The Director Applications Development explains the difference:

> "A lot of time we do the manual furtherance. If you just take it to me and say: "OK I finished this one, please review". Then we don't really use Lotus. (...) If it is really in the same office then we will normally just talk about it. But we still want them to sign off so that we keep track. But let's say I have a project in which both the [Singapore site A] and US team are involved. Let's say they do the specs, we have to review because the request came from our users. So then of course this mailing is important." - HHT, DiskCo-B-2

Given the time pressure of the Oracle ERP implementation, management closely watches progress of enhancement request projects, especially those with high priority. The system allows them to track issues on a regular basis, and increase hierarchical pressure if need be. The Director Applications Development outlines how management uses Lotus Notes to ensure timely closure of enhancement requests:

> "We can see whether it's a system issue or the user doesn't know enough, or a PC issue. When an issue remains open, we will track it. We review the issues regularly and then close up the issue with the local IT or the US. But we track them in the Oracle issues database. We categorize them into open low (priority - author), open high and things like that. Then we review it weekly.

> Basically we can put them by category, by person and by group because we have different locations. So you can see all the [Singapore site A] issues. And the other way you can look at them is by status. Each issue will pass a status of open, open high (priority - author), open low. This is especially for the CIO, because normally he will want to go through the open high to make sure they are closed up as soon as possible." - HHT, DiskCo-B-2

From a user perspective, the distributed groupware system accelerates problem solving. It makes their requests transparent and thus ensures timely performance. A key user from Malaysia site A comments describes her view on the system:

> "We have a very useful project database where we put in our individual enhancement requests. And this is accessible by all plants. From there the local IT approves them and they work on it. So for the programmers, the IT bosses or whoever has access can just view through that and see whether they are working on the right thing. I'm sure they print that status out and review that every week with their own department. But that has to be commented by the IT department. But that database really does help." - ET, DiskCo-K-1

On a staff level, people do not always appreciate this transparent electronic environment (Ciborra & Patriotta, 1996). It displays their work openly for hierarchical observation in a broader sense than the traditional manager-supervisor looking over someone's shoulder (Kirsch & Cummings, 1996). For this reason, people are hesitant to formalize a request. Before entering it in Lotus Notes, they try to solve it through contacts with peers. A member of the IT core team at Singapore site A explains:

> "We try not to raise too many issues in the database, because [the IT management/ executive level] is always looking at this kind of issues. Since by experience we know people from the same project team doing the same kind of system, we normally write an email to them, to see whether they faced this kind of problem in that kind of environment. If they do, we ask how to solve it. Normally, we try to solve things on that (staff - author) level first, even within a small group, before you put it as an issue. Because once you have an issue, everybody is looking at the issue. And it's not good to have an issue open for so long." - JPL, DiskCo-I-1

Finally, a specific example of control concerns the process of modifying the Oracle source code. So far, sites had their own version of MANMAN. They were free to adhere to local user requests and modify the system independently. The new ERP system changed all that. DiskCo strived to implement a single source code across all sites. They maintained the basic master code in the US and tried hard to avoid any changes to this code that was replicated to DiskCo's globally dispersed sites.

Technically speaking, software is not like a physical resource that is used by multiple parties. A printer can only print one page at a time. Software does not know this limitation. As a digital product, it is easily replicated across sites, or remotely accessed. Since people can independently use the software, there is not need for coordination and control (Blau & Scott, 1962). The problem comes when people want to change something to the program, probably because their local operations have unique requirements. This customization would have to be incorporated in the default code. When other sites receive their updated copy of that code, they are confronted with a modified piece of software that may not match their operational requirements.[44] The form of dependence described here concerns modification of a resource that is replicated across multiple sites. Earlier we referred to this as modification interdependence. In the DiskCo case, we observed to control issues caused by this type of dependence.

First, from a management point of view, an organization must decide on approval procedures for change requests (See the recent section on Lotus Notes workflow control). The VP describes how this feature of Oracle changed the nature of software projects at DiskCo:

> "Previously, a lot of these projects in which we were engaged and worked with the US, were on a much smaller scale and very specific projects. Either I work with this particular site, or I work with another site. It's not a project like this that all sites get involved, and do the same thing. Previously, we might be talking about this particular thing with the US, only applied to this plant. The plants that are not involved we don't care. And each of the plants they have their own local project that they go deal with themselves. Now, because of the Oracle, everything is centralized, everything is one single source code. Any request that comes from the individual organization has to go through a committee to review the request, and see whether it can be approved or not." - CPW, DiskCo-A-3

The second problem is more pragmatic, on a software level. The VP Information Technologies explained that usage of a single source code necessitates centralized control. This ensures distribution of the same code to different sites. Control is particularly needed since changes must be made. To this end, the company needs procedures and configuration management tools to coordinate people from different sites who want to make adaptations to the Oracle code:

> "Because last time (before Oracle - author) in the media sites we did a lot of things ourselves. Now it is global. That's why your study really comes to the right place. Because it's global, we need to have a central control mechanism. Of course our target is single source code worldwide. Even with single source you have some setting that need to be done. And that is a procedure that has to ensure that you pass updated versions of the code down to all the sites." - CPW, DiskCo-A-4

Supposing that people have access to the default Oracle server in the US, there is a risk that they try to modify the system simultaneously, in a conflicting manner. Or they customize the Oracle copy at their local site, like they did with MANMAN:

> "Last time in MANMAN we have different sources for different sites. At [Singapore site A] we have our own source, in China they have their own source. So we can do whatever things we want, relying on the source itself. But now we cannot. When we go to Oracle we emphasize on one common source worldwide. So any changes that we make we have to consider other sites also. We have to make a generic change. There have cases happened that there are some programmers who only hard coded something and then make the change just for the site. And then when they implement

[44] Another problem is that Oracle Corp. seems less supportive of customized versions of their software.

this in production it affects all other sites. We would get a lot of complaints."- OBT, DiskCo-C-1

Avoiding this problem requires configuration management, where only one person can modify the source code during a certain period of time. Basically it means sequencing multiple developers instead of allowing them parallel access to the source code. Like earlier described, DiskCo uses an application life cycle management tool for this process called CCC/Harvest from Platinum, Inc. Developers must check in to lock the code for anyone else. After they are done, the code is promoted to a test and eventually production environment. When they check out, the code is unlocked so that other developers can incorporate their change requests.

On top of this automated control tool, developers contact each other through dedicated Lotus Notes group mailing lists. They discuss and coordinate the requests they are working on, and brief peers afterwards. An IT staff member from Singapore site A explains how the developer community uses the configuration management tool and other control mechanisms to implement change requests:

> "We are using this application (CCC/Harvest - author) to control the source code. This means that if somebody is working on this program, another person can't change the same program at the same time. If they are using the Harvest feature it's not possible. But of course you can also change locally. You can always pull out the program, and do it locally without checking in to Harvest. But this (using the configuration management tool - author) is to avoid that different persons are working on the same program at the same time.
> Suppose for example that this person is working, and you know that you have a request to change this program as well. This means that you have to communicate with the person working on the project currently whether the person can incorporate your request in the program at the same time. Or we have to liaise with each other in terms of timing. Like: "When can you finish so that after you have finished I can continue working on that".
> Usually we will wait until the other party finishes the program completely. Meaning that his program is a working program and already in production. Then I will continue from there. So when we start on our project (i.e., continue working on the same program - author), we will have to study the logic and then to fit in our codes." - OBT, DiskCo-C-1

§ 9.2.3 Organizing for Distributed Collaboration

In this section, we explore relationships between DiskCo project locations. Throughout our interviews, it became apparent that knowledge was an important driver of cross-site connections. Many times, people referred to the need for knowledge transfer, and (remote) support. From a coordination theory perspective, the necessity to connect stems from work dependence, and ultimately task division (Smith, 1793; Thompson, 1967). One could suggest that in the DiskCo case, the task of implementing Oracle ERP was split and assigned to different sites. But that does not yet explain the existence of dependencies that we observed. After all, each site could have proceeded on its own. Equipped with resources and following standards, they could implement the same system across multiple sites. There is no eventual culmination into a single product or service, like with aircraft manufacturing (Galbraith, 1973). Still, sites were very dependent in terms of expertise and assistance. In the next sections, we explore the role of these dependencies, and how DiskCo shaped remote contact patterns.

§ 9.2.3.1 Cross-site Dependence: The Need to Connect Remotely

Sites involved in the DiskCo implementation were very dependent in terms of resource exchange, assistance, and knowledge transfer. As coordination theory proclaims, such dependence triggered information processing and coordination needs (Galbraith, 1981; Tushman & Nadler, 1978). Applied to DiskCo, this means remote dependencies and information processing needs. We assess here the origins of cross-site interdependencies, and main dependence patterns. Our research suggested four drivers: novelty, commonality, asynchronicity, and intra-organizational advantage. We elaborate on these factors here.

First, there was a tremendous amount of novelty and uncertainty. So far, sites were using MANMAN software that was locally customized, running on Digital VAX machines. For all sites, this uncertainty translated in a tremendous need to absorb knowledge on the new IT infrastructure (Oracle ERP application, SUN servers, centralized data centers in Singapore site A and Thailand).

Second, all sites were implementing the same system. DiskCo heavily emphasized commonality of IT infrastructure and business processes. Gone were the days that local sites could customize MANMAN and run their own data centers. The new approach leads to a form of interdependence that we refer to as standardization interdependence. We found pointers to this form of dependence in literature on fast food chains (Bradach, 1997, 1998; Leidner, 1993). And in some scholars' work on a symphony orchestra, where musicians are glued to the pacing of the leader's baton during a performance (Kirsh, 1999; Mintzberg, 1998a). Basically it means that multiple sites are expected to structure their local operations in the same way. They dependent on a single standard, one way of doing things. Their operations will be assessed based on that standard, just like fast food chains have mechanisms to observe compliance of local restaurants with a standard mode of operating. In DiskCo's case, US HQ 'owned' the standard. They acted as exclusive gatekeepers for the default Oracle source code, and had to approve any possible changes. This facilitated consistency. When local change requests emerged, it also triggered connections from local sites to eventually the US for obtaining approval. Obviously, the emphasis on commonality and exclusive ownership constrains local autonomy, as the VP Information Technologies admits:

> "(...) (W)e have the objective to establish common processes, common procedures, commonality, standardization. So to us IT sometimes plays a part to maintain common, standardized processes. We tell them (users - author) this is the whole world using this system and this procedure (...). So that is how we deal with the rest of the sites. Not so diplomatic in the sense that everybody can discover what they want. No. Because the moment you do it you would just delay the conversion. Just like now. Now the users come in and tell me: "Oh we want this". The answer is: "No". Because there is no more time anyway. Because this coming month end is the conversion. There is no way I can design some special program for them" - CPW, DiskCo-A-5

Third, implementations were asynchronous. US sites kicked of the global Oracle roll out. Then in a partially overlapping and parallel mode, sites in Europe, Thailand and the rest of the Far East followed. In these regions, usually a local HQ kicked off, like Singapore site A. When people in the US had already accumulated substantial experience, other sites were still in an early preparatory stage. This triggered knowledge flows, first from the US to regional HQ, and then from there to local sites. Says an IT member from Singapore site A:

> "What happens is this system didn't start with [Singapore site A], it started with the US. Eventually they passed the knowledge on to us, we passed the knowledge to China, we passed the knowledge to Malaysia and so on." - JPL, DiskCo-I-1

In a similar fashion, Singapore site A took the lead for the in the Far East region. Their kick off implementation functioned as a reference model that could be replicated to other sites.

Fourth, there was one more reason for leveraging US know-how. Standard Oracle training in countries like Singapore, Malaysia and Japan did not cater for DiskCo-specific needs. These local resources were not geared to the specifics of DiskCo's operations. Instead, people experienced training from their US counterparts as more effective, since it focused on their industry. Similarly, the Conference Room Pilot (CRP) provided a useful way to assess the implications of Oracle ERP for users' day-to-day operations. Training by people from the same organization and industry implies that concepts are already adapted and geared to the trainees' context. A key user in Finance from Singapore site A comments on this intra-organizational advantage:

> "The time we attended the Oracle open house training at Oracle company, we didn't find that very useful. But the CRP when we go through our actual business, we find that more useful because it's what we are doing day-to-day. So we find that training from the US site to our users here is better than the one from the outside company. (...) When you go to the outside company, they use Human Resource data, and it's not relevant to [DiskCo]. So you cannot imagine what happens to your environment if things change." - ST, DiskCo-H-1

The four drivers discussed here resulted in two main patterns of remote dependence. One between Far East and US sites. This was mainly handled by the regional HQ in Singapore, and to some extent Malaysia site A for data conversion. The second one concerns the Far East region itself. Site A in Singapore and Malaysia kicked off the implementation roll out there. This experience base was channeled to other Far East sites. We elaborate here on the two dependence patterns.

Dependence US and Far East sites

When US sites started the Oracle implementation, they were the first group in DiskCo to learn about such a major software implementation and organizational transformation project. Areas of novel expertise included, first, insight in the application's functioning, and the challenge to match that functionality to actual business operations. On some occasions, this required customizations to Oracle. Second, IT staff had to learn about different hardware and networking infrastructure, based on client/ server computing. Third, they must develop procedures for converting data from old systems like MANMAN to Oracle ERP. Fourth, sometimes interfaces were needed between the Oracle and other application that could not be replaced. And fifth, people must learn how to handle a multi-site system implementation and organizational change project. This intensified contacts within IT and user communities, and across these.

Apart from some operational differences, US experience applied to the Far East situation. Those responsible for the roll out there - Singapore and Malaysia site A - were eager to learn from their US counterparts. At the start of the Far East roll out, US staff came over to Singapore for training IT staff and key users. During the implementation project, key users and IT staff from Singapore frequently contacted US counterparts for specific requests. A key user from Singapore site A comments on her experience:

> "The US sites converted earlier than [Singapore site A]. So they have a lot of people who are more experienced in Oracle. So I work with US in the sense that if I have any question or issue, or anything that I'm not sure of, I will normally ask them. Because when we have the training session, they do come over and train us, give us some sort of training. So if we have any questions, we are free to ask them." - JLL, DiskCo-G-1

During the Far East conversion projects, novel issues that were not covered in training triggered remote exchanges with US colleagues. Task uncertainty thus initiates an assistance dependence relationships given knowledge asymmetry between Far East and US sites.

> "Sometimes we may also encounter some ad hoc issue which we have not encountered before. And then they (Far East sites - author) may also come back to us to ask us whether we know about all this problem. And sometimes if we can't really solve the problem, we write to the US counterpart, because they started Oracle earlier than us. So they have probably more experience than us. So we write to them, we seek their advice to resolve the problem." - OBT, DiskCo-C-1

The Director Applications Development admits that the Oracle implementation presented her organization with a formidable challenge. Their motto became 'learning by doing', and part of that was learning from US sites. This was indispensable for materializing the roll out within project constraints:

> "At that time (start of Far East roll out - author) we also were really not sure of a lot of things - it's really like we just tried to work things out. And then of course when there is any issue when we need more resources for help, one way we normally get the help is from the US in some areas, especially when you come to project development which is quite a main part of the time span. So US have given us a lot of help on that part. If we have to do everything on our own I think that is not possible." - HHT, DiskCo-B-3

Experience with kick off implementations in the US was captured in documentation, templates, and Lotus Notes databases. It was also transferred in person, through US on-site training and support in the Far East. Conversions in the Far East were not exactly sequentially aligned to those in the US. When their implementations started, some of the US projects were still in progress.

> "They (US sites - author) started first, they started 2 years ahead of us. But the first year they have spent a lot of time doing a lot of foundation. Although it's for the US, but it helped to build a foundation for the Far East sites. When they were almost done with the first site, we have started doing it. So by the time when Far East started to

> look at the requirements they (US sites - author) are still doing the other sites. Because I think they have about 7 sites to do. So it's still kind of in parallel." - HHT, DiskCo-B-3

At that time, US sites took on the role of both local implementator and remote supporter. Later, Singapore site A tried to avoid such a dual responsibility. That was when they were supposed to implement locally and prepare conversions at other Far East sites. As discussed in a previous section, the VP Information Technologies decided to postpone conversions that were supposed to follow closely the one at his own site. This was to avoid engaging his core team in local and remote concerns at the same time.

Dependence in the Far East region

In the Far East region, Singapore site A became the center of expertise. Having learnt from US sites, their mission was to implement the system at a couple of locations in Singapore, and to assist other Far East sites. People looked at Singapore site A as the center of excellence. They were responsible for their own implementation but lacked resources to do so. This made them dependent on Singapore site A. They started to connect to that site for leveraging expertise available there. Moreover, Singapore site A was the gateway for escalating local issues to the US. All this intensified contacts in the Far East region. The Director Applications Development comments on the renewed level of networking in her region:

> "I think, first of all it is the coordination and communication between the different IT groups. We didn't have to do that although we did communicate quite a bit last time with the older system (MANMAN - author). But it was not key, because we worked as groups quite independently. But because of the Oracle implementation, we try to emphasize knowledge sharing, communication, and commonality. So that is one of the aspects that we did very different from last time (before the Oracle project - author)." - HHT, DiskCo-B-1

The team in Singapore site A started first, just like the US started before them. They worked with Oracle consultants and went through a full implementation cycle for their own site. The intention was that this would resolve most of the issues possibly emerging at other sites. The head start of this team equipped them to assist remote sites:

> "They are more like a consultant to them on technical aspects that they are not sure of, on the application. Because we started the [Singapore site A] team first, so they have slightly more experience than the other groups. Because we have gone through the full, more complete cycle doing the AIM method and then they have the chance to learn Oracle, learn from Oracle consultants quite a bit through the discussions and meetings. So basically it's transfer of knowledge, interacting." - HHT, DiskCo-B-1

Knowledge transfer to remote sites - in particular China - was setup according to specialization and function. IT members were experienced in specific Oracle modules, and connected with their counterpart from another site. The same applied to key users. An IT member from the core team in Singapore site A explains this setup for China. At the time of the ERP roll out, China did not have local Oracle training facilities available. They were mainly supplied from Singapore. Remote knowledge dependencies were mainly homogeneous, i.e., between people with similar roles. Contacts across areas were setup

locally. This applies to communications between users and IT. And also between IT staff members specialized in different modules that need interfacing.
Not all sites needed the same level of remote support from Singapore site A. It depended on the availability of local resource, both within and outside the DiskCo organization. At the time of the Oracle project, China maintained a limited internal resource base. They also did not have access to local Oracle training facilities. Their demand for support from Singapore was therefore considerable as the VP Information Technologies explains:

> "Our plants are standard, but slightly different. The China plant is setup by us, we maintain a small group of IT people there to take care of daily operation. But the skill set in terms of knowledge everything is still mainly from Singapore. So as we move forward, like for example you talk about what kind of requirements for people, and I would say that if we start off in China, if China is the plant who start off doing the conversion, I don't think we can make it. We start off in Singapore because of the knowledge, the people here, their experience is much better than the other sites. These people help to transfer the knowledge down. And it is exactly the same [for other functions], not just our IT. Manufacturing it is the same thing. We go down to China and transfer and train the people out there. So there is always a gap between the level there and here. But Malaysia is very close to us. Their standard is very high, in fact their team is a very good team." - CPW, DiskCo-A-3

The team in Malaysia site A was technically strong, and worked more independent from Singapore site A because of their local expertise. They were assigned to handle data conversion and supported the team in Singapore instead of just demanding resources. Having looked at remote dependencies, we expand in the next sections on modes for connecting people across sites.

§ 9.2.3.2 Establishing Remote Contact in the Far East

> "We have very very little direct contact between remote key users and our IT (Singapore site A - author). So if in some cases we think that we need to get all the folks together and discuss something, then we will just have a meeting, a conference call where both the key user group and IT group are together in the room and talk." - HHT, DiskCo-B-1

Implementing an Information System is a cross-functional endeavor between users and IT (Grohowski, McGoff, Vogel, Martz, & Nunamaker, 1990). Eventually, the system should help users in their day-to-day work. They need IT for technology implementation and subsequent support and maintenance (users pulling resources from IT). Conversely, IT's success depends on cooperative users whose input and help is needed to implement and customize the system (IT pulling resources from users).
In DiskCo's case, we transpose this mutual dependence relationship to a distributed work environment. Users operate at different sites for the business. And IT is also organized in a distributed mode to provide local support, headquartered by Singapore site A. For such an environment, a question is how users and IT connect. Do users pull from local IT resources, or refer back to Singapore site A? What if they need help from the US, how is that channeled? And the other way around: How does IT connect to local users? Directly or through local IT? Why? We look here at the initial phase of establishing remote contact, and give an example of the Japan implementation project.

A guiding principle that seemed to emerge from the case is: remote contact is organized as homogeneously as possible. That means: people with similar roles are supposed to connect across sites. Diverse, inter-functional contacts are preferably handled locally. The Director Applications Development expressed the principle as follows:

> "I think people communicate normally within the same area, where they share knowledge and seek advice on problems within the same application area." - HHT, DiskCo-B-3

The VP Information Technologies discussed with us is approach for connecting IT and user groups across sites. Starting point for local implementations is replication of the organizational structure at Singapore site A. That is, he asks local IT and user management to assign members for the local cross-functional core team. Once that structure is in place, the VP establishes contacts between corresponding individuals, or counterparts. These persons have the same role at different sites, both in IT and user areas. Here, the VP comments on remote connections for IT project members:

> "For every site we should have a minimum of one person taking care of this module, the other person taking care of that module. So we also have - like in China - a person looking after the manufacturing side, one person looking after the finance side. We always tie all of them back to who in this team at [Singapore site A] is expert in that area. So they all know. That is from an IT standpoint." - CPW, DiskCo-A-5

Similarly, users from remote sites were connected to their counterparts in Singapore site A. For China, key users from Singapore site A were sent down to work with their local counterparts. Once people know their counterpart from such on-site visits, they find it easy to contact that person remotely:

> "From the user standpoint, we send the key users down (from Singapore site A - author) to work with the key users in corresponding areas, like receiving shipping. Then these people always tie up. So when the users in receiving have any issues, they will make a call to their counterpart who has been helping them last time during the conversion." - CPW, DiskCo-A-5

In Malaysia, a similar procedure was followed. A key user there mentioned that the core team (key users and IT members) from Singapore site A came over for a project kick off. During that visit, the teams established rapport that helped them connect remotely during later stages of the implementation:

> "Before the conversion, the team (form Singapore site A - author) came down once and we talked and we had a presentation and things like that. That's when we get to know each other and when they went back we also called them." - ET, DiskCo-K-1

These quotes point at the role of visits to tie up counterparts between sites. Another way to achieve this is by providing contact lists. This provides people with a minimal awareness as to who does what at other sites:

> "When we started on the project we were given a list of people whom we can contact and what are the areas of responsibilities they are handling. So that gives us the information so we know whom to contact." - SCC, DiskCo-J-1

Contact lists were used in three ways. First, to establish remote homogeneous connections, i.e., users - users, or IT - IT. This way, people get to know who their counterpart is (at least by name), and how they can reach that person. For IT, this network connected local IT units with their counterparts at Singapore site A, and from there to experts in the US. A basic condition for establishing a globally distributed, homogeneous community was thus established. People could utilize that infrastructure to escalate local issues.
The VP describes how users contact their local IT person on an issue. If that person cannot resolve the problem, he will liaise with specialists in Singapore or eventual the US:

> "Then this hierarchy here (i.e., resources in Singapore site A - author) is more for our additional support to them. If a local IT person has problems with purchasing users and cannot resolve them, they will know that hey there is another person. And this goes all the way back to the US. US also has some developers specialized in manufacturing or purchasing or AP or GL. So we know that anything to do with AP, if my AP person here cannot handle it any more, she will escalate up to the AP person in the US. That is how we manage it." - CPW, DiskCo-A-5

In other words, when an issue emerges that requires attention from IT, users contact local IT (i.e., local heterogeneous connection). If need be, this is escalated through remote homogeneous contacts, namely, within IT.

An IT member from Singapore site A describes how contact lists are used for setting up remote, intra-IT exchanges. Often, IT staff from the Far East had to contact US counterparts. After all, US sites were ahead in terms of know-how, and they had to approve changes to the application:

> "So they (IT management - author) give us a list in spreadsheet form stating who are the people we should contact for this kind of system. So we have the support list and know whom to contact. Once we have a problem, normally we contact this list of people in the US, and cc to all the people who are local." - JPL, DiskCo-I-1

The IT member concludes by pointing out that communications within a geographically distributed community of like-minded IT professionals is very easy. This relies on a combination of common knowledge (Grant, 1996b), and working relationships (Gabarro, 1990). People know each other since they have collaborated throughout the Oracle implementation, and possibly before. And they are obviously specialized in the same area (DeSanctis & Fulk (Eds), 1999).

> "But as I said earlier, we have seen each other, we implemented the system together, we know each other. We know whom to put on copy. Very very easy." - JPL, DiskCo-I-1

Second, the lists provided local users with information on IT support at their site (and vice versa). Users know who is responsible for what areas in their IT department. This facilitates directs contact between people in the same area but from different functions as the VP explains:

> "If you talk about support we have a list given to the users in case they have any issues. I say regularly to them: "Anything to do with purchasing, contact this person;

anything to do with shipping, ask this person." So this list was given to the users as well as IT. Within the local IT and local users. The local users knows in the local IT who manages manufacturing, who manages purchasing. They will approach the people accordingly." - CPW, DiskCo-A-5

Third, two IT units have a regional role: Singapore site A and Malaysia site A (for data conversion). While these units usually work through local IT, sometimes they want to connect directly to local users to obtain information. To this end, they receive a contact list that is shared through a Lotus Notes database. Says a member from the data conversion team in Malaysia:

"We get a user list for the local sites, we put it up in our Lotus Notes database so that everybody knows whom to contact." - MC, DiskCo-E-1

Direct cross-functional contact across sites is seen as an exception. It occurs for instance when local IT cannot convince their users to supply information. The Project Manager of the data conversion team in Malaysia comments:

"Most of the time we contact the IT person. So if the IT person tells us that the particular group of users cannot supply the information, we try to find out more what is the reason. Or sometimes if we need to, we will also call the users directly. And we'll try to explain to them why we need the information, and need to get their understanding and cooperation to give the information." - JNL, DiskCo-F-1

Contact lists represent a location's human resources. They are often a primary navigation tool for remote colleagues to connect to the right person. Changes in a local unit trigger a need for modifying the list. According to an IT team member from site A, sites should take this responsibility of updating and pushing renewed information to remote counterparts:

"We had recently a reorganization. In the US they are also confused who are the people in charge of which module. So recently we have sent an email to them with the persons in charge of every module, so then they will know whom to contact. Otherwise they would still go back to the old people that were doing the modules." - SCC, DiskCo-J-1

Example Singapore site A - Japan

Establishing remote contact thus relies on a combination of cross-site visits and providing contact information for electronic communications. The combination is well illustrated in an example provided by the VP Information Technologies on the implementation in Japan. He describes how he and his team started to work for the first time with users and IT there. To start with, they invited Japanese IT staff to Singapore. These visitors could get acquainted with their peers, attend basic Oracle training, and follow pending implementation projects:

"The Japanese site is a good example of something new. Because we do not know anyone there. All the while Japan has been supported by the US. Because of the Oracle conversion they have employed somebody new. So we don't know them, we don't know the users, we don't know a single user, we don't know a single IT person.
So what we did is to start off we sent the IT persons here first, way before the conversion. Come here, go for training, let them attend a local Oracle training. Get them involved in the team when they do the conversion of the other sites to know all the processes. So at the same time they were here for a while to know each other. I

> mean the people they come here, we show them good hospitality, like HHT (Director Applications Development - author) taking them out for dinner." - CPW, DiskCo-A-5

This immersion in the Singaporean context was followed by a counter visit to Japan. IT staff strengthened bonds earlier built in Singapore. Contacts were extended to key users who were tied back to their counterpart in Singapore site A. For both sides, people received lists of individuals with similar roles in the other location:

> "And when they went back we go. This time when we go there we ask them to organize a meeting with the key users. Then we sit down, we make a list of team, who is responsible for what, individually we get to know each other. "OK you are taking part of shipping, this is your IT counterpart in Singapore, and this is the Japan person". And they get to know each other. We provide the individual there with information on the person with a corresponding role here, like telephone number, everything. So they know each other. So we have all the supporting lists, they know." - CPW, DiskCo-A-5

Once he had established homogeneous contacts across sites, the VP moved to the initial project phase, consisting mainly of training. Since people in Singapore site A were seasoned in Oracle, Japanese staff started to leverage these contacts:

> "And then we start to pull in there (in Japan - author) and conduct training for them by groups. And these people suddenly start to ring each other (i.e., DiskCo staff in Japan and Singapore - author). They will establish some kind of relationship there. And because they know that we are there to help them to do the conversion, to make them successful, the attitude is different." - CPW, DiskCo-A-5

§ 9.2.3.3 Redundancy and Directness of Remote Contacts in the Far East

> "If I can't contact the person that I really want to talk to, I will try to catch somebody else whom I think may have the information. And that person may not work at that site. Let's say if I'm talking about Japan, I will contact somebody in Singapore. Just try out maybe somebody else who knows that information." - JNL, Project Manager Data Conversion Team, Malaysia site A, DiskCo-F-1

To people in the DiskCo's Far East environment, remote collaboration came natural. Prior collaboration had established extensive contacts across sites. This fostered a climate of direct, informal communications, especially in the IT organization. We zoom here in on the fact that people knew - either personally or through contact lists - multiple colleagues at counterpart sites. They combined this contact redundancy with an emphasis on direct communications.

Interviewees liked to establish multiple points of contacts at remote sites. This provided them with back-up channels in case their direct counterpart was not available (Burt, 1993; Meadows, 1996b). Through contact lists and visits, they got to know a local community, including management. A key user from Malaysia site A gives her perspective:

> "We need to know the name list of the supporting group from the other site: What are their names and what are their main projects and main areas that they are covering. And in their absence who would be the backup person. And also who are their bosses. I think the name list is very important." - ET, DiskCo-K-1

Having redundant contacts at Singapore site A makes people in Malaysia less dependent on a single person. With time-pressed tasks, they can reach someone else when their primary point of contact is not available:

> "We have sometimes difficulty in getting them. Sometimes they have their own thing to do. And even through a call you might not be able get them. So we have to send them a note. At least in this company we are kind of advanced, we are equipped with all the Lotus Notes, and the phone lines so that we can get hold of them. If we can't get hold of their manager, we try to get hold of who is in charge in their office. So basically we don't really have much problem in that sense. In fact we do have good support from Singapore." - ET, DiskCo-K-1

Similarly, a key user in Finance from Singapore site A points out that she 'roughly' knows the organization. She can fall back on redundant contacts if need be:

> "If there is any issue we will contact the manager, that's the final person. If we cannot get anybody we will look for the manager. We know the local manager. (...) We know roughly the organization. Because I visited them before, so I know them, I know their manager, and who is doing what in their sections. So it's a sort of knowing whom to communicate to when I have any issues." - ST, DiskCo-H-1

Redundancy does not only mean that one person knows multiple persons at another site. It also means that people share experience locally so that when a remote call or email comes, they know how to help that person. A key user in the Material & System area from Singapore site A describes how local sharing enables people from her department to help remote counterparts in her absence. This is further reinforced by her practice of taking local colleagues along for visits to other sites. They establish rapport with remote counterparts that at a later moment when people must contact electronically.

> "Because my group is a very small group, we share everything. So that's why when sites are asking a question or they are asking for something, my people know what I want to give to them. Because I will normally discuss the problem with them even before they ask the question - they know what to do. So I have good people that work for me. (...) When I go for a site visit, I will sometimes bring them along, so they get to know all these people." - JLL, DiskCo-G-1

Similarly, an IT team member from Singapore site A emphasizes two aspects of redundancy in the DiskCo organization. On the one hand, she knows multiple persons at another site. When people are on leave or for some reason not accessible, she can switch to that person's manager or a local colleague. She knows these people from earlier visits.

> "Normally what I do is that if I write to this person (on leave - author), I will cc to his/her manager. Because his/her manager will know whether his staff is on leave or not. If it's an urgent matter normally they will ask another staff member to attend to it. I think it's important instead of just writing to a single person. If he or she is on a long vacation then your problem will not get solved. (...) Normally we know quite a few persons (at other sites - author), not just the person doing that module. They will introduce other people in their department to me also." - SCC, DiskCo-J-1

On the other hand, different peers in her group know about her module. This local redundancy of knowledge helps people contacting the unit from outside. They have the flexibility to talk to anyone for assistance, rather than being dependent on a single point of contact:

> "Right now we have more than one person in our department who knows the module so they can contact anybody else. Not like last time when we just started Oracle, I'm the only person who knows this module. So they got no one else to ask and had to wait for you the person to come back." - SCC, DiskCo-J-1

For distributed work environments, this second point extends traditional notions of holographic organizing (Morgan, 1997). Redundancy of knowledge serves not only the local robustness of a system (Hutchins, 1990). It underpins choice and backup options for connections between a unit and its environment.

Direct contact

Interviewees emphasized the fact that communication lines between Singapore site A and local sites were usually short and direct. On an executive level, the VP from Singapore site A commented in previous sections that he worked directly with his IT directors in the Far East region. Similarly, on a staff level, people worked directly with their counterparts. One IT member from Singapore site A sketched her approach. She emphasizes that she does not contact her counterpart's boss first. This would add a communications layer, and lengthen cycle times:

> "We don't go through layers. It's important, otherwise it would take a lot of time. If let's say the manager never attends to his emails, managers normally have a lot of emails. So you would be rather delaying things. (...) We talk to the person who is in charge of the module directly. We never go up to their boss." - SCC, DiskCo-J-1

Not only do people contact their counterpart - on staff level - directly (Figure 48, arrow A). If need be, they will connect directly to management of another site, without going through their local boss (Figure 48, arrow B).

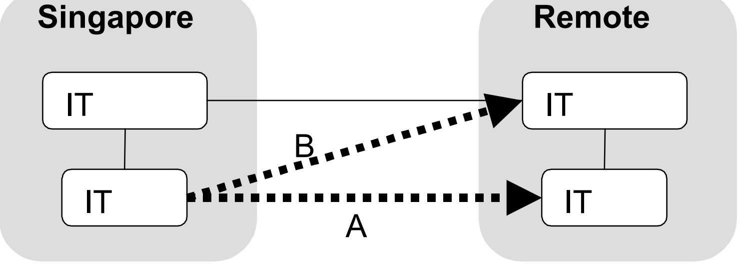

Figure 48 - Connecting across hierarchies

We can further illustrate Figure 48, arrow A, i.e., lateral contact across hierarchies without managerial involvement. The Director Applications Development stresses that local IT staff and key users can contact her team in Singapore site A without management intervention. Similarly, she helps local directors without involvement of their common boss - the VP Information Technologies:

> "As for the local IT, they have the director who is overseeing it, and also a manager who's responsible for the implementation group. So when there is a need on the project management and coordination portion, then of course the manager will talk to me. And if there is a need for help in the respective units, they (local IT staff - author) are free to talk to each of them (Singapore site A core team - author) in any aspect when they need help. They are on modules like JPL for the GL module so anything concerning GL they (local IT - author) will just call him or send him a mail to ask questions. Sometimes even the key users they can consult them for anything." - HHT, DiskCo-B-1

An IT member of the core team in Singapore site A expands on Figure 48, arrow B. She comments:

> "We will contact whoever is in charge of that area. Then that is the manager, or SA or PA. So we don't really say that: "OK, if you are not at manager level, you don't contact the manager. We don't have that. So even at director level, if we need to contact the director we will contact the director. We don't really have to go by level. Like this level you need to contact within this level and then if you need to go to a higher level you must go through your manager and so on. We don't really practice that. I think that will be less efficient. Of course, when you contact a director you must put your director a copy in your mail so that your director or even higher manager know what's happening." - OBT, DiskCo-C-1

While direct connecting across hierarchies seems more efficient, people run the risk of being left out. Unless the person quoted here sends a copy to her local boss in Singapore, the IT director remains unaware of what is going on. This is particularly a risk when multiple actors are involved and people communicate directly across sites. A concern related to that situation was aired by an IT project member from Singapore site A. He was responsible for coordinating IT support between Singapore site A and China. In that role, he worked with IT and users in Singapore and China. Sometimes he was left out of communication loops:

> "What happens is that normally I will try to get the expert from here [Singapore site A] and the expert from there [China] to talk. And I myself will receive a copy, and all the bosses are on copy. And there is a team role I would say. There is always a coordinator. I make sure they coordinate on all those issues. As I said earlier, sometimes I'm totally left out of the picture, because somehow there are too many people involved. It could just be a user department. They sent out a mail but forgot I'm supposed to be on copy for a certain kind of issue. And eventually this problem can go on for weeks without me knowing it, it's possible. Maybe it's initially, we are still learning, we make mistakes. So we try to make sure that it doesn't happen." - JPL, DiskCo-I-1

Knowing when to put people on copy requires judgment and skill. Too little cc-ing results in information asymmetries. Too much overburdens people who are only minimally involved in an issue. The same IT member reflects on this balancing act:[45]

> "Try to put people on copy so that they are aware of what is going on. Yet I think it's not always possible. Sometimes for example when you write an email to VP, you can't copy all these people [directors] because it may not be very effective. So that's why I'm saying the communication skills of people at each level is important. Because a [director] may not write an email to a [VP] and send a cc to people at each level. Because it is not necessary for them [directors] to know sometimes at that moment. It's only when they start to know what they want. I think that's to say that the communication level of each leader is very very important." - JPL, DiskCo-I-1

During the Oracle project, communications setup and cc-ing changed. Initially the interviewee with coordinator role expected direct emails from the persons he supported in China. Others locally involved, including bosses received a copy from that email. After turn live, local IT took on a primary support role. Consequently, the main contacts were between local users and IT. Our interviewee received in that stage only copies to remain aware of what is going on.

> "In an initial stage, during the system studies I said: "It's OK to go to me directly, but make sure that everybody is on copy". Because it's quite difficult. (...) With email it's normally this way: to me comma whatever their own people there pop pop pop pop [interviewee points at chart], and cc to whoever is there at the last level, that's the way. But after we hand the system over to them, it's a different kind of support. They have to write to their own people, and put me on copy - it's the other way around." - JPL, DiskCo-I-1

Direct communications may leave some people unaware of communications. But is has many advantages over indirect linkages. We expanded on this topic in the theory section with the telephone game metaphor when discussing Meadows' (1996) work. The game's intentional use of indirect exchanges illustrates settings where people communicate through liaisons or persons with hierarchical roles. By doing so, they become dependent on the 'middle man'. His capacities and interpretations affect overall communication loops. An IT member from Singapore site A reflects on the hypothetical situation that they would have to communicate with someone via her boss (see also Figure 48). She expresses concern for speed, message integrity and communication volume:

> "If you have to follow the hierarchy kind of communication, first thing you must tell your manager what's happening, and then wait for your manager to communicate with another party, and then come back again. I find that is less effective and there may be some missing communications. So maybe like when I tell you 10 point, and depends on how you interpret the 10 points. So when you talk to the other person, you talk based on your interpretation, so there may be a lot of communications." - OBT, DiskCo-C-1

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[45] The interviewee used an example from the military to illustrate his point on multi-actor hierarchical communications in a distributed setting. This was applied to a civil organizational setting in the interview. We use here only role descriptions related to the latter context.

Middle men may color communications and add to task uncertainty. This, in turn, triggers more exchanges for clarification (Daft & Lewin, 1984; Van de Ven et al., 1976), and taxes the multi-node communications channeling (if it is retained).

§ 9.2.3.4 The Role of Key Users

Bridging the context from users and IT is traditionally considered a challenge (Newman & Robey, 1992). As an example of functional diversity, these groups are believed to work in distinct 'thought worlds' (Dougherty, 1992). This complicates cross-functional connections that are so important for implementing an Information System. To counteract possible concerns, DiskCo assigned the role of 'key user' for different functions. Persons with this role are usually senior users. They represent their user community, and act as an exclusive liaison to IT. In the Oracle project, they receive extensive training in the new system, and work closely with IT project staff in the so-called core team.

Key users have one foot in the user community, and one in the IT community. This dual inclusion supports their role as boundary crossers (Engeström et al., 1995; Tyre & von Hippel, 1997). Their added value is threefold: remote, locally, and a mixture of these two.
First, remotely, a key user participates in a distributed network of individuals with a similar role at another site. Leading in that community are key users from Singapore site A. Like the example on Japan in the previous section shows, they train and support local key users throughout the implementation process. The Director Applications Development (HHT) describes how key users from her site are seen as role models for other Far East sites:

> "There is another role that key users have - especially those from [Singapore site A]. I think the various sites - especially the drive sites - they really look quite a bit upon the [Singapore site A] key user group. They (key users from Singapore site A - author) are also like the lead key user: they help the local key user to do the thing they need to do, like understanding the system. Because they are the people who know the business better. So they will also advise them, why you need to do it this way, why we have to change the way of doing. (...) So they will also advise the various key user groups in the local sites - [Malaysia site A], China - on user procedures. So they also communicate between key users themselves, to learn from one another more on the business aspect of the application usage." - HHT, DiskCo-B-1

Key users find exchanges within their distributed community easier than working with IT. When they talk to counterparts, they experience little novelty because of the similar work environments. They lack this common base with IT. Working across functional boundaries implies facing novel terms and putting effort into effective communications. People attempt to avoid that for regular communications:

> "[Interactions between Finance people] are on the same wave length. As finance people we talk to finance easier. If we talk with IT, we may not really understand some of the technical things that they mention. So it will be better that the patterns of communication go by IT to IT people, and finance to finance." - SKL, DiskCo-L-1

Globally distributed key user communities do not exist for all functions. Mainly for Finance and Distribution, which are the most internationally oriented and standardized functions. Manufacturing in the Far East differs from the US. The former is mass-production oriented, while the latter concentrates on design and test production runs. This operational diversity makes it less useful to foster exchanges internationally and impose guidelines (Goodman & Darr, 1998):

> "For manufacturing not as much (contact), but for financial yes. They have a corporate finance group. And they also have a financial systems group (...) They are the ones who communicate to all the different finance key users on standards and guidelines people should follow. This concerns financial guideline that are related to using Oracle ERP. It's only on the financial side. Because manufacturing their business is quite different. Theirs (in the US - author) is more on design center, very minimum on manufacturing, so there is a marginal guideline that they have imposed. Except maybe for the distribution site, the order entry, the shipment part. That one they also have a US system group that will standardize the procedure of how drives should be shipped, what are the procedures to follow, on things like credit check, receivables. There is some central body who governs some regulation. So it (international networking - author) is really for finance and distribution." - HHT, DiskCo-B-1

Second, key users have a local role, as liaisons between users and IT. We expand in this section on that role. To start with, we look at the selection of key users, and their early involvement in implementation projects. The Director Applications Development from Singapore site A comments:

> "They (key users - author) started almost together with IT, about 2 months after we started the project. Because we need to get the management to identify who are the people who can be involved in the project. Although they are not full time. But they need to dedicate quite a bit of their time to involve because they have to go for training and they have to attend all the meetings when we do the studies (like Conference Room Pilot - author). So about 2 months after we started, we formed the key user group. Their role is to be the coordinator between the IT group and their own user department. They learn the package, and they know their business well." - HHT, DiskCo-B-1

As linking pins, key users have multiple roles. Some oriented towards IT, some towards the users they represent. In the initial phase of the implementation, they helped IT understand the business background of the implementation process. For users they conducted training:

> "They (key users - author) help us to understand the business process better. So basically that is the role of the key user group. And they need to subsequently do the user training for their own user department before the turn on." - HHT, DiskCo-B-1

Initially, IT and not the key users trained end users. One problem was that IT staff lacked insight in the users' business environment. When they conducted classes for e.g. users in Finance, they obviously knew about the technology but not the specifics of using the system in that operational context. This made the training more difficult for users and IT alike. Key users on the other hand became very experienced in Oracle while carrying their departmental background with them. They could easily relate to Finance end users and pre-contextualize technology concepts for this group. Says a key user in Finance from Singapore site A:

> “Initially it's not like that. Initially we are just the key user. Each department will identify their key users and they will attend the business test and so on. And they find it much easier for the key user to train their users. They know what are the accounting entries. Because for the IT guys they will not understand the accounting background and so on.” - ST, DiskCo-H-1

From an IT perspective, training by key users was not only easier since they did not have to connect in detail to the users’ operational context. It also allowed them to channel their support towards a limited number of key users, instead of working with larger user groups. Key users function as representatives for their user department and offer a single, economical point of contact for IT. An IT member of the Singapore site A core team comments:

> “We don't really train the local key user. Because the key users also attended Oracle courses. So we only identify a few key users. Because we have a lot of users. So the key users also attended the Oracle courses conducted by Oracle. And some of them are working full time on the Oracle project. So they themselves also have a lot of hands on experience. So for the first site converted they are the training team, they really conduct the user training for the end user. And IT only support them. We went there, we support them in the sense that in case they found anything like system problem, or any technical questions then we will try to give them some opinion or advice.” - OBT, DiskCo-C-1

Key users are also charged with conducting the Conference Room Pilot as part of the implementation trajectory. They coordinate, filter and channel user comments towards IT. Says the director:

> “When we do the Conference Room Pilot they are the people who are there to do the things. Then when we finalize the gap, when we go into the detailed study and design of the individual gaps, then the respective key users involved will have to give input and coordinate and get input for us from the various users to finalize the design.” - HHT, DiskCo-B-1

Later in the implementation trajectory, key users take care of testing, and voice user concerns or requests:

> “They are also involved in testing the project when it's done and the later part when we do the business test, [i.e.] the integration test. So they are also the people who do the test itself. Even now when some of the project sites have already have turned on, they still act as the coordinator between the IT group and the user group. So if they face any problems, or see that there is a need to enhance or improve, they will be the channel that the user will go through, and they are the people who normally talk with IT.
> Some of them are able to dedicate full time doing the project. In fact there is one we call them Material Systems group (...). They know the material process quite well. They are dedicated to look at all the system-related aspects of the business process. They act as the coordinator between IT and the end user. So they work very closely with the team here on testing system features, test out the enhancement that was made and give feedback on what users want.” - HHT, DiskCo-B-1

Third and finally, key users at sites other than Singapore site A have a role in the user community that mixes local and remote elements. On the one hand, they know local operations very well, and work closely with colleagues in their department. On the other hand, within the distributed community of key users, they have built relationships with people from Singapore site A. Early in the project, they received training from that site. And during an implementation trajectory local key users could escalate concerns from their users to issues through Singapore site A.

A key user in Material & System (Singapore site A) talked with us about the way she connects with counterparts, and how roles are divided. Being part of the core team there, she is the spider in the web of key users with similar roles throughout the Far East region. She points out that her counterparts are closely connected to both their local context and herself. Participating daily in their own context, they know the local team and operations very well:

> "I find that my counterparts are well versed and they are in charge of this. The receiving supervisor, store supervisor and also the shipping supervisor are reporting to them. So I can talk to them (local key users - author), and they know the operation very well. And when these supervisors have a problem, they also feed back to my counterpart. So when I talk to them (local key users - author), it's the same thing as that I would be dealing with the end-user." - JLL, DiskCo-G-1

At the same time, these people are embedded in a distributed network of key user with similar positions. These people know each other from visits and working together on the Oracle implementation:

> "Most of my counterparts understand me and I can understand them very well. Because they are also the core people that I communicate with. They have to communicate with the end user again. (...) When I talk to them they have to explain to the end user on how to do it in detail." - JLL, DiskCo-G-1

Local key users play an important role for the person from Singapore. They are the first point of contact for local users and filter their issues before they reach Singapore site A. This economizes remote contacts between key users.

> "When users from other sites report any problem to my counterpart, he will check whether there is a general problem or he can offer a solution. If not, if he doesn't know what to do and needs help, then he will come back to my site. (...) Not for every problem people must come to me. Because if let's say it's an operations problem, then they need to change their process. I mean my counterpart can make the decision on that." - JLL, DiskCo-G-1

When locally an issue arises, users contact first their key user. If more resources are needed, local key users escalate to their counterpart in Singapore site A. As a community coordinator, the key user in Singapore can leverage the network of key users to assess whether the issue has been faced before, and how people could solve it:

> "They (local key users - author) contact me first. Because maybe we have encountered already at [Singapore site A] the issue that they encounter. Or another site has encountered the issue and knows how to go about it. So the first thing they normally do is to contact me. Because sometimes it is not an IT issue at all. That's the way you do it. I am also a user, so normally they will contact me first" - JLL, DiskCo-G-1

We expand on these contact patterns and procedures in the next sections.

§ 9.2.3.5 Contact Patterns Between Local Users and Central IT

In this section, we zoom in on contact patterns between IT and users, both during and after conversion trajectories. We focus in particular on connections between on the one hand IT teams in Singapore site A and Malaysia site A (data conversion). And on the other hand local IT and user communities. These IT sites were important as regional, central HQ's for the Oracle ERP project. They supervised local implementations, and functioned as linking pin between local sites and the US. We analyze this linking role towards the end of this section, and conclude with risks associated with Singapore site A's central role.

To start with, we zoom in on situations where central IT (from the sites mentioned) initiates contact with local users. It seemed that one of the following two options was adopted. First, central IT worked through the local IT organization. They maintained close contact as a distributed IT community, and used that for collaboration with local users. For instance, the VP Information Technologies mentioned that he asked local IT to prepare users for the implementation project at their site:

> "For the key user level, I use the IT person at the site to communicate with them, prepare them, and go through the schedule: when we should bring a PC, upgrade the PC's, when the users should go for training, and how to plan according to that." - CPW, DiskCo-A-5

Similarly, a member from the data conversion team in Malaysia site A outlines that she relies on local IT to work with users. Her team needs information from the local users to prepare the data conversion process:

> "In terms of data conversion I would say (...) the local site helps us to coordinate with the local users. So for us we do not meet with the local users. The local IT personnel are the contact point for us. (...) The IT staff will email or call us. They are the in-between person. We do not contact directly with the local users. It's always through the local IT. We don't train them (local IT - author), because at this stage we only need them to help us, to provide us the information we need. We need them to be a contact point with the users." - MC, DiskCo-E-1

A second mode starts with the same central IT organization but works through key users at their site. These persons, in turn, contact their remote counterparts (also key users). The Director Applications Development explains that this contacting mode is used when her IT group must assess the feasibility of implementing a standard practice across Far East sites. She stresses the fact that key users know their counterparts' setting. This makes it easier for them to receive and coordinate input from the local user groups:

> "Sometimes on certain things we want commonality, so I will tell the [Singapore site A] key users: "OK please sign up with the other key user sites whether they agree on the way we want to do things." So I let the key user here do the necessary communication. If it is let's say [Singapore site A] initiated then normally we will get the [Singapore site A] key users to try to talk to the [local] key users. Because they know the business, they have a common language of the things they do. So we will

trust that the [Singapore site A] user will get the right feedback. And then we will just want to have one communication channel to know what things need to be done." - HHT, DiskCo-B-1

Applying the first mode here would mean that local IT works with local key users, and relay that information back to Singapore site A. There, the director's IT team would have to consolidate feedback. The problem here is coordination of the distributed user community. Using their networking capital seems more appropriate here than relying on IT's network, the first option. The director points to this notion when commenting on choosing between either mode:

"I think it all depends on which is the best way they think is to get things done, and fast. It depends on the problem I would say." - HHT, DiskCo-B-1

To conclude, central IT initiates contact with local users in two ways: through the local IT organization when the issue concerns IT related tasks. This leverages the capability of their distributed community. Alternatively, central IT works locally with key users on more business oriented topics. This benefits from the user relationships across sites. Either way relies on homogeneous remote contact. Direct contact between central IT and local users (heterogeneous) hardly occurs.

Vice versa contact

We now look at the reverse situation where users contact IT in Singapore site A or Malaysia site A for support or change requests. Sometimes, these questions are escalated to the US for approval or expertise from there.

The Director Applications Development distinguishes two trajectories local users follow to resolve issues. First, they liaise with their key user counterparts in Singapore site A. These people may decide to contact IT members of the core team there. Second, local users may go to their own IT unit. From there, an issue may be escalated to IT members at Singapore site A. Generally speaking, the first option applies to business type of problems that are discussed almost constantly in distributed user communities. It also includes general questions on how to use Oracle ERP. The second mode is adopted when issues concern the technical infrastructure.

The director describes the two routes users may follow:

"Local users can either talk to the key users here (Singapore site A - author) and then through them they communicate back to us (IT team, Singapore site A - author). Sometimes when the local key user have problems on certain things that they face that they want to clarify, they will either chat with [Singapore site A] key users, if not they will go to their local IT group. And from there then the local IT group if they can't advise them, then they will come back to the core team for advice. So [people use] both channels." - HHT, DiskCo-B-1

For issues related to the IT infrastructure, people usually talk to their local IT first. Direct contact between local users and central IT happens only on rare occasions:

"If let's say the problems are initiated from the remote sites, then most likely I would say they will want to talk to their local IT. In fact they are advised to talk to their local

IT first, to see whether local IT can advise them on what to do. If they are not too sure, then they will come to the core IT group for advise." - HHT, DiskCo-B-1

For the first option, an IT member of the director's core team stresses the role of ex ante communications in user communities. Since people maintain a regular pace of exchanges with their remote colleagues, it is easy for them to discuss issues they are facing. He gives an example of users in shipping departments in China and Singapore. When they face an operational anomaly, they talk to each other remotely before escalating to IT. If need be, users can formalize their issue in the Lotus Notes issues database. Then more resources are pulled in, which may even culminate in requesting patches from Oracle if there is a bug:

"What happens is that normally complaints come from the users. So in the first place they will communicate in the users community, because they are talking to each other every day. [Example] Because they have shipments: "I have a shipment to you, did you receive it or not?" "No my shipment record never came in." "Let's wait for another day". Then they will say: "It's still not there? OK, let me call IT". IT may not know about the issue at that stage. They start to call IT, so the group gets bigger. Their bosses will be on copy too with this kind of problem. They will say: "OK let's put this as an issue if they (IT - author) still can't solve it".
And someone must have ownership of this issue - a person responsible for it. Could be anyone. And then the participants in this issue will be the people in this group. (...) China will contact the people here (in Singapore - author) because the data center is here, all the systems are stored remotely. And sometimes if there is a systems problem, even before we put it as an issue we try to talk to the DBA (database administrator - author). And they say "OK, maybe just check Oracle". Maybe there is a bug, maybe we need (...) patches". (...) So once the patch comes we close the case and that's it." - JPL, DiskCo-I-1

A key user in Inventory Control confirms that they liaise first within their own distributed community before contacting IT. Her group maintains close contact with key users in Singapore site A, who will escalate an issue to the US if need be:

"We knew all the inventory control staff there (Singapore site A - author) and also the project staff, and some of the IT people. We do not have weekly meetings with our supporting group (at Singapore HQ - author), but in this project the key users are expected to really work with their counterparts on their own before we - the key users - post a problem and highlight it to IT. So what we do is we call a meeting internally (...). The key users are supposed to call their counterparts and find out the details. (...) I would say the conference calls with our counterparts in Singapore are more regular compared to the weekly meetings here (cross functional meetings with other core team members - author). Because the weekly meeting is supposed to be the main means to provide peer updates, and the conference calls and Lotus Notes with our counterparts are supposed to come up with some solutions. (...) We normally do not talk to key users in the United States. We liaise with Singapore." - ET, DiskCo-K-1

Another Finance key user from the same site points at the importance of homogeneous remote contacts. She liaises almost exclusively with her Finance counterparts in Singapore. The same applies to IT core team members from Singapore and Malaysia. Issues that cannot be resolved in the user community are locally escalated to IT. Either key users in Malaysia contact their local IT, or their user counterparts in Singapore site A liaise with IT members of the core team:

"Our key users in finance they will liaise with the [Singapore site A] key users to get things understood and to test on the Oracle data. That is on the finance side how we liaise with IT. And as for IT (...) they will liaise with IT on the technical side. We only contact the core team on the finance side. We don't contact to the IT. Because this is an arrangement that was made: IT will contact with IT, then key users will contact with key users. (...) we don't really communicate with the [Singapore site A] IT people. It's our core team IT people who communicate with them. As a key user, like I'm from the finance side, you are used to communicate with finance only. So if there is anything that they cannot resolve they will bring it to the core team and our IT director will then communicate with IT there" - SKL, DiskCo-L-1

If users must contact IT, they do that locally. Direct contact between say a user in China site A and the IT team in Singapore site A rarely occurs. Local IT has the advantage of physical proximity to the user community. They know local staff and operational specifics more extensively than central IT. To give an example, the VP information Technologies describes the task division between local IT and his team in Singapore site A:

"(...) It is their (local IT staff - author) responsibility to do the setup because some of the information in there is site specific. They are the ones who are near to the user, they are the ones who are going to get all the information. But the people here (core team at Singapore HQ - author) will train them and when they finish it, they always come back to us and say "OK we have done this one". It is part of our checklist before we do the turn live, that somebody here will do the check on all the setup that they make. So that is very consistently applied to the rest" - CPW, DiskCo-A-3

Later in the project, local IT filters user requests before they reach Singapore site A. This minimizes remote problem solving, and reduces the central IT team's working load:

"If users have any problem, our procedure is that they should report to the local IT first. So the local IT is supposed to do some investigation, at least front line investigation, and see whether they can resolve the problem or not. Of course if they still have no clue and don't know what to do (...) then they will come to us. Then we will try to help out from there." - OBT, DiskCo-C-1

Reducing the workload for Singapore site A became important in the middle of the Oracle roll out trajectory. Involvement in new implementation projects absorbed most of their resources. For that reason, local IT became responsible for user issues that emerged after the turn live date. The same team member explains this policy and gives an example for a request emerging in Malaysia:

"Let's say users in Malaysia have a request. They will contact their local IT. The local IT will have to see whether this request is a genuine request or not. Some requests may not be necessary. For genuine request, the user will have to query the request in the IT project manager database. And then they will post it for approval.
Initially our team (Singapore site A - author) is to take care of the Oracle conversions. We provided support, and did also development. But later on, because of limited resources in our department, we don't provide support. We focus on development. After every turn on, we have a handover to the local IT. So the local IT will have to provide subsequent support. But of course if they think they need our help we will also be involved in helping them. But our focus now is really the development. Except for those sites that have not yet turned on Oracle. When they have any doubts or any questions, they will come to us." - OBT, DiskCo-C-1

Another member of the IT core team in Singapore site A confirms this view. Up to the turn live date, his group provided direct support to local users to expedite problem solving. Afterwards, a layered contact model was adopted where local IT has a front line role:

> "It is kind of a convention to contact the local IT before they (users - author) directly contacted the project group. This is what we expected in case of media (Singapore site A - author). After we implemented media that is the first site to go live, we requested the users to contact first the local IT and get the problem solved before they contact us. But during the project implementation and customization we used to directly talk to the users on the phone." - GP, DiskCo-D-1

Far East and US sites

Involvement of US sites may be needed for various reasons. Sometimes, local sites have requests that require approval from the IT organization in the US. Or specific technical expertise is only available there. These issues are usually aggregated in Singapore site A, through user or IT communities. From there, IT staff members or key users connect to their counterparts in the States. Vice versa, people in the US may need information on Far East sites. They connect in a similar way: through Singapore site A. One key user from that site comments on this communication channeling:

> "If they (counterparts at Far East sites - author) encounter any questions, normally they will write to me. I'll get my people or some US guy, IT or anyone to find a solution for it. (...) I have a counterpart in the US too. Because I used to work in inventory control department, and on US side they do have their own inventory control department. So sometimes when I need information from them for certain things, I will contact them. Same thing if they need any information from Far East they will contact me." - JLL, DiskCo-G-1

Direct contact between local Far East sites - e.g. in China - and the US seldomly occurs. Local users for instance prefer to liaise within their own counterpart in Singapore site A. Or they talk to their local IT. As far as US sites are concerned, they experience too many barriers as a key user from Singapore site A explains:

> "I mean the first thing is the time difference, second thing may be the language, and so on. Maybe some team manager they will call for some other issues. But for system issues and so on they will usually call me. Sometimes they (local users - author) will contact their IT, depends on what type of problems they encounter: is there a system problem, or is it to understand the program, so it depends. There is not really a procedure on this. Even for us, sometime we will contact local IT, sometimes local IT will ask us to contact the US IT and so. So there is no very clear procedure - we don't really have a procedure." - ST, DiskCo-H-1

In a similar way, users in Singapore site A prefer to liaise with their IT instead of going directly to the IT organization in the US. People communicate locally across functional communities. Bridging functional boundaries is easier when the counterpart is familiar with the local site (Lawrence & Lorsch, 1967b). Remote cross-functional contact would imply combining cross-functionality, and distance, i.e., unfamiliarity of another person with local operations. On the other hand, people seem to maintain close remote contacts within their own community at little effort. Commonality of their background makes it apparently easy to connect remotely (Grant, 1996b). A key user from Singapore site A comments on her experience with these topics:

"If we got a problem we will contact our local IT first. If our local IT cannot resolve it, then we will go straight to the US. We seldomly go straight to the US IT. Unless they want us to feedback and I mean some more supporting, then we will go straight to them and they will liaise with the US Finance. (...) When you talk to the local IT here, they understand the problem, it's much easier then. So that's why when we have system issues we communicate to the local IT. Then they will communicate to the US site. For IT we'll go through IT. But for users issues we will go straight to our counterpart related to Finance in [DiskCo US HQ]." - ST, DiskCo-H-1

Risks associated with the central role of Singapore site A

The IT organization at Singapore site A adopted a central role in the Far East conversion project. The team there was responsible for implementing the system at various site in Singapore, and one site in Japan. Moreover, they assisted other sites in the region, and liaised with the US. The site was both a reference role for expertise and an almost exclusive gateway between the region and US sites. Figure 49 shows their position as a central node between Far East and US sites. The white and black dots represent sites. The connecting lines are communications and reporting linkages.

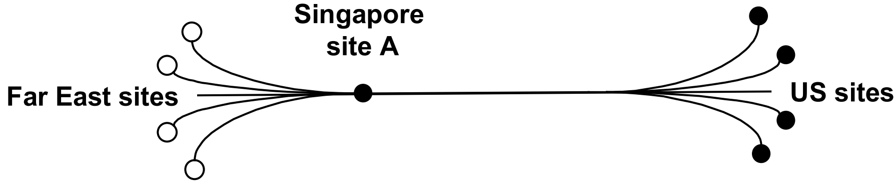

Figure 49 - Central role of Singapore site A

Because of its role, communications in the Far East IT organization were mostly between local sites and Singapore site A, and not between local sites. On a staff level, people connected to Singapore site A for IT resources like applications development and the data center. On a management level, local IT directors reported to the VP Information Technologies in Singapore. Together, this implies that most connections are between local sites and Singapore site A in a 'hub and spokes' manner. Local sites operate independently as the Director Applications Development points out:

"At different sites there will be different sets of issues. So to me, the sites are all independent. That means if we are talking about issues only in China then I would of course only communicate with the China group. It's quite independent in a sense." - HHT, DiskCo-B-3

Later on she extended this purely 'hub and spokes' view. Some sites do contact directly if they manufacture similar products. Their common business requirements and IT infrastructures make it useful to interact and learn (Goodman & Darr, 1998):

"The 2 China IT groups they communicate very frequently because they are under the same IT manager. So I think they also do share resources. Then I think the rest is mainly communication to [Singapore site A] itself. I would say they don't communicate with one another. Because if my boss calls a meeting he will normally involve all the IT organizations. If there are problem - [China site A] they talk directly to [Malaysia site A]. Because they are doing both the same desktop hard drive. So I think there are a lot of similarities, also in certain business requirements. So I think they do talk quite a bit. (...) This is the normal type of communication because we are under the same boss and they have similar business requirements. So it is really not only pertaining to the Oracle conversion. Even for other application groups where they have problems they also talk." - HHT, DiskCo-B-3

The central positioning of Singapore site A in terms of resources and networking brings its risks too. Far East sites depend on the node's availability and capacity to meet their needs. Similarly, US sites rely on the site for information on other sites in the Far East region. From Burt's (1993) perspective, structural holes exist between sites that increase the importance of DiskCo site A. At the same time, they increase the vulnerability of the overall collaborative network. The core team in Singapore acquired expertise on Oracle conversions from US sites, external consultants, and trial and error. Subsequently, local IT units and key user groups depended critically on the core team to make their own implementation successful. Their demands for assistance taxed at times the capacity of the core team:

"They (local IT - author) have to rely on 1 of the 6 of my core team members to do tasks like gap analysis, reviewing, testing, and whatever they did. So the bottleneck can be the core team. We started with 4. I was not given the reason on how many I want at that time. I decided that I wanted to have 4 at that time. I thought that is a manageable number. We tried to manage with the resources that were given to me, and then try to plan out the project based on priorities." - HHT, DiskCo-B-1

Not only could the existing core team be over demanded. There was the risk of core team members leaving the project, not unlikely in the volatile IT labor market of the late 1990s. The Director Applications Development explains that she did not have back up for any of the core team members. This decision was made after considering pros and cons of a redundant team of experts. Speaking for redundancy was the central role of the core team for the Far East region. On the other hand, a larger team would be more difficult to manage. It would also increase communications volume and complexity.

"Sometimes I do see a problem, like if one person is going to leave and we have an issue on an area (...) and nobody can back it up. Of course if I can double the size of the team, then for each module I have 2 persons doing it. That could be ideal but then the bad point is that the team is getting too big, so it may be also hard to manage them. (...) So there are pros and cons. And then it is always the case if too many people are involved, I think the communication is always the problem. If there are too many parties involved, it's even more important that they have to communicate to one another to be able to get things done." - HHT, DiskCo-B-1

§ 9.2.4 Task Contingencies

Coordination and control theory distinguishes several contingencies that drive the need for, and use of integrating mechanisms (Kraut & Streeter, 1995; Malone & Crowston, 1994; Van de Ven et al., 1976). This section assesses the impact of some contingencies in the

DiskCo case: uncertainty and novelty, work unit size, and operational differences (see also Figure 37). It also features a contingency that has - to our knowledge - not yet received attention in literature or empirical research: the criticality and urgency of tasks. In this case it played an important role. The Oracle implementation was a time-pressed project with vital importance for DiskCo's operational performance and competitive positioning.

§ 9.2.4.1 Uncertainty and Novelty

Information processing needs are related to task uncertainty and novelty (Scott, 1990). When people encounter tasks that exceeds their current set of competencies, they start contacting more experienced experts. Here, we assess the impact of task uncertainty and novelty on communication patterns in a distributed project. At the beginning of the conversion projects in the Far East, Singapore site A faced the challenge of implementing an application that was completely novel to them. This triggered their dependence on US teams that had started much earlier.

During the initial phase of the Far East project, regular triple site teleconferences were held. At that time, the Singapore site A had a lot of questions and issues on which it needed input from the US and Europe. For instance, the setup of Far East operations required customizations to the Oracle application. These small projects had to done by the US since Singapore did not yet have sufficient know-how. Obviously, these dependencies had to be coordinated.

> "During the first year when we first started launching the Far East project, we had almost weekly teleconferences (with US and European counterparts - author). We discussed issue that are affecting all the different parties. And sometimes we have issue and then we need some advice and guidance from the US. And we brought up and discuss so that each party can give their opinions on that. And then we also have conferenced to do prioritization on the projects (small ones for customizations to Oracle - author) that need to be implemented. Especially those that are required by the Far East but need to be done by US counterparts." - HHT, DiskCo-B-1

The kick-off phase of a project seems to lead to direct communication patterns (Galbraith, 1973). People need real time contact to bring up and discuss issues. In a distributed project, this translates into phone calls and teleconferences. The manager of the Malaysian data conversion team mentioned: "What we normally do is we have a teleconference when we start (a local project - author)" (DiskCo-F-1).

Underlying these communication needs is an increased level of dependence. Task uncertainty and novelty imply that people are responsible for a job that exceeds the know-how they have accumulated so far. A sort of vacuum or knowledge under pressure emerges that urges people to pull in resources from outside. JLL, key user from Singapore site A, explained that she connected to her counterpart in the US to resolve issues related to her Oracle module:

> "I contacted the US for issues that were special to me. I don't know how to resolve the problem, that's why I need to contact them for advice." - JLL, DiskCo-G-1

An IT colleague form the same site pointed out that initially they depended on the US for designing customizations that were too complicated for their current level of experience. As time went by, they became more familiar with the Oracle application and modification process. Accumulation of expertise reduced the under pressure and thus dependence on the US:

> "Because we are very new in Oracle for those very complex customizations, we have the help from the US to do them for us. At [Singapore site A] we only pick up the simple customizations, but as experience goes on, now we are doing development for some of the complex processes also." - SCC, DiskCo-J-1

Novelty stretches the time people need for accomplishing a task. They cannot yet focus on just accomplishing a job, but must learn how to do it. This delayed early implementations in the Far East. Once people became more experienced, they develop routines (Pentland & Rueter, 1994; Stinchcombe, 1990). These compress work cycles:

> "Through all these experiences we learn. Every plant that we convert, we encounter some issues. So as we move forwards, a lot of these things we encountered before, we know exactly what the issue is and how to resolve it. And that is why initially our schedule to us is aggressive. But as we bring up our knowledge, we know that we can make it. Because then your life cycle, through your training, your learning curve, the time taken is much shorter." - CPW, DiskCo-A-3

§ 9.2.4.2 Work Unit Size

The size of a work unit refers to the number of people or organizational units involved in a single activity, like a project. In DiskCo's Oracle project, geographical distribution of implementation site led to a larger number of participating units (not necessarily people). If DiskCo had operated a huge plant in Singapore, the project would have demanded huge local departments, but only one of each. With distributed operations, each site needed its own IT and non-IT departments. This increased the number of project contributors.
HHT described that local IT is responsible for their own implementation. They represent in a sense a layer between the core team in Singapore site A and local users. According to HHT, the larger number of parties involved in the project enhances coordinating activities:

> "The local IT is the main coordinator for their projects, because it is their country. So the core team (HHT's team in Singapore site A - author) acts more or less as a resource, as a consultant to them a lot of time. Of course we try to tell them what are things to watch out for, things like that. But it all depends on how they want things to be done, and what are the requirements that they need. So I would say that there is more coordination to be done. Because there is one more channel, one more party to deal with." - HHT, DiskCo-B-1

The scale of the Oracle project increased the importance of formal coordination modes. The myriad of parties called for extensive planning information so that they knew what was expected from them. More formal communication patterns would ensure coherence in such a large scale undertaking. Looking back, HHT admitted that she had preferred more comprehensive planning and more formal communications. Maybe because of the project's novelty, people sustained a somewhat informal mode of operating that did not fit its scale:

> "Maybe we can build up a more formal type of communication channel. Because so far what I have seen it's really quite an informal way. In certain cases if we can do it in a more formal way then sometimes we can get things done better. People can also expect what needs to be done in a more formal way. I would say the problem I have is when I was first putting on the project I didn't really know what to expect. And then a lot of things is like: we do one step and then just take ahead one step of what needs to be done. So if I had an opportunity to do it again, of course with my experience I have, definitely we want to have a more formal type of planning in the sense that we can have a better, complete plan on all the activities that need to be done. So that each site that is responsible for doing certain tasks is better informed beforehand. So I think that is something that I want to do." - HHT, DiskCo-B-3

A key user from Malaysia site A confirms HHT's point of view. She explained that elaborate planning before the actual conversion reduces complexity and coordination efforts during subsequent phases:

> "The key lessons that I learnt from this project is that whenever you want to do a project of this big scale, we have to plan it very well. Because a good planning can avoid a lot of problems, and can eliminate some of the issues from occurring. That is the first thing that I learnt, that we must work on a detailed plan." - SKL, DiskCo-L-1

Finally, size impacts the role of management. Supposing that managers' span of control is fixed, larger projects demand more management involvement. In the case of DiskCo, CPW observed that the scale of the Oracle project had changed his role. Before this project, he was used to smaller ones that did not demand close involvement:

> "Last time with the smaller project, I don't really have to be involved. (…)It was on a small scale, which means you only need a manager and a team to work with them (users - author) directly. We don't even need to know anything at all. (…) And my involvement used to be (…) neglectable." - CPW, DiskCo-A-3

With the Oracle conversions, the project scope became much larger. It involved multiple parties and sites, all working within a single global planning. While local directors were responsible for their implementations, an additional management layer was needed to oversee everything on a meta level, i.e., on a regional and global scale (Penrose, 1959):

> "When you come to a global project like this, you have to have a person to oversee the whole thing. Because everybody oversees only their part. I'm another layer on top who sees the important things. Not all the details, but I can see everything. And I think that helps a lot." - CPW, DiskCo-A-3

§ 9.2.4.3 Operational Differences and Commonality

For years, DiskCo sites around the world had run their local business and IT operation in their own way. IT departments adapted their version of MANMAN to user needs. Financial information systems were setup according to government regulations in countries like Malaysia, China and Thailand. The Oracle project changed all that. DiskCo top management had a vision of globally integrated operations and information systems. This would accelerate product life cycles and supply chains, and make the company more competitive. Says HHT: "(…) The non-IT management try to emphasize a lot of commonality" (DiskCo-B-1).

At some point, the push for commonality would have to meet the reality of a multi-site company with diverse operations. This section explores the nature and impact of operational diversity in the context of the Oracle project. We discuss first diversity between the US and Far East, and continue with differences within the Far East region. Towards the end of the section, we pay brief attention to diversity and remote support.

Far East - US sites

Diversity between the US and Far East is caused by the fact that the former focuses on R&D, while the latter deals with large scale manufacturing. The difference surfaced when US sites assisted the Far East with customizations. IT staff from Singapore site A and Malaysia site A tried to explain - often remotely - their local situation. This was hard to grasp for their US counterparts. JNL from Malaysia site A:

> "I guess maybe one of the differences is because in terms of our DiskCo business in the US, they are more on the Research & Development side, whereas in the Far East here we are more in the manufacturing kind of business. So they may not fully understand our way of business, and we may not understand their environment there. So sometimes when we ask some questions, they may not be able to visualize what is the scenario that we are working on. So that could explain why sometimes we need to make sure we ask the right questions." - JNL, DiskCo-F-1

A key user from Singapore site A (ST) commented that her American colleagues just could not imagine the problems she encountered. With their background in R&D, they lacked a framework for understanding the unicity (i.e., specific nature) of her site's operations and system requirements. Bridging these different thought worlds required additional effort on both sides (Dougherty, 1992). US colleagues questioned issues that were brought up by ST. This led to additional interaction loops to clarify reciprocal points of view.

> "Because Singapore site A is a main manufacturing firm, we have huge volumes. To them (US - author) it is mainly for R&D. So usually when we have some issues, they will not see the problem. Usually IT (from US - author) will say: "How come Singapore site A you have that issue?" The volume is different, we have a higher volume. There is a difference here, but they will not really see our problem. Because sometimes there are some system problems, their sites do not have the problem, but our site has the problem." - ST, DiskCo-H-1

HHT described similar issues. During the gap analysis in Singapore, the team there identified many differences and customization projects. These were initially questioned by colleagues in the US who were not aware of manufacturing processes in Singapore. They assumed that requirements would be more or less the same, and need little attention from their side. HHT then engaged in numerous conversations with US counterparts to bring them up-to-date on her local context, and the background of customization requests.

> "(…) A lot of a time especially when we were defining the gap, we had a hard time convincing them why we need to do this way. They always say: "But we are not doing things this way, why do you need so special a type of treatment? Sometimes I have a hard time trying to explain to them why we cannot do things the way they do, because of the difference in culture, and really the way we do things, the practice here. (…) So I would say, initially we had a problem there. They would still question things in the sense that we just had to be very sure that we know what we want, and we are not

> asking change for the sake of changing. So they always double check and counter: "Are you sure you want to do it this way?" - HHT, DiskCo-B-1

Far East region

Within the Far East region, DiskCo operated different types of operations. Like Drive manufacturing plants in Singapore, China, and Malaysia; media and tape manufacturing in Singapore; a distribution center in Singapore; a head factory in Malaysia (e.g., for hard disk drives); and a plant for Printed Circuit Boards in Singapore. Operationally, the drive plants were setup in a similar way. This simplified the implementation process: once the process was understood in Singapore, they could implement the same approach at the other drive plants. HHT commented on the drive plants:

> "The way they run the factory (in China, Malaysia - author) is similar to the [Singapore site A] factory. So the processes will be more or less the same. So we needn't have to go through the detail of the current process study." - HHT, DiskCo-B-1

At the same time, local teams in China and Malaysia identified differences that could be traced to unique government regulations in these countries. These surfaced early in the project, and were taken care of by local teams and the core team from Singapore site A:

> "I think the remote sites are quite OK, because the [Singapore site A] operation is quite a representative of how the other drive plants are being operated. So that didn't give us too much criticism on that part. Of course there are here some quite unique requirements that [Malaysia site A] needed because of some government regulations. So those are already been highlighted quite upfront when they are aware that they need to highlight new and unique features; and then similarly that was done for China. So I would say that there are quite a number of them that is unique because of country requirements" - HHT, DiskCo-B-1

An example of Malaysia's unique requirements concerned a local system that was written by their IT group. They did that because before Oracle, each site operated more or less on its own. With the new Oracle system coming in, they had to write interfaces between the systems they were keeping and Oracle. At times they faced problems with these custom-written interfaces. Yet when they needed help, the unicity of their system and requirements became apparent. The core team from Singapore site A did not understand their situation. This led to back and forth discussions that delayed progress. SKL from Malaysia site A explains:

> "Before this global IT project, each of these sites was having their own IT. Some of the project functions were written by the local IT. (...) When we do the conversion, the interface job is written by the local IT here, but then sometimes when it doesn't really work well that's when we need other sites to help us like [Singapore site A]. But they are not that familiar with the way our site is doing things, so sometimes the IT progress is a little bit stuck. (...) Certain issues are very (interviewee emphasizes - author) unique." - SKL, DiskCo-L-1

The same key user pointed at situations where Singapore site A proposed a certain way of handling document flows that seemed correct from their understanding. Yet it did not take into account the fact that Malaysia site operated differently in some respects:

> “We face the problem here that we may make a mistake on the ways that we handle our [...] (technical term - author). Just for example: we asked them (Singapore site A - author) how to do a certain set-up of an instance in Oracle by email and even through the phone. And they would tell us to do it that way. But later on we found out that there is a better way for our environment. Because the way we handle the document flow is a little bit different from [Singapore site A].” - SKL, DiskCo-L-1

Resolving these diverse approaches required effort from both sides to identify differences. To some extent, this could be achieved on a distance through phone and email. For more complicated issues, visits by the Malaysian team to Singapore site A appeared necessary. This way, they could observe, discuss and learn how the latter site operated (von Hippel, 1994).

> “So that is an instant that we have to have a better understanding. Maybe that we go to their site to understand exactly how the whole flow is through the documentation. Because that will affect the setup. (...) If I have a problem in facing the setup (...) I think the different views (Singapore site A versus Malaysia site A - author) can be resolved through email and phone. But however, when it comes to handling the data, especially like the document flow, I think email is very difficult. Because different sites have different ways, so the best way is we go there to see exactly how they do it. Let's say I create an invoice. If I want to void it, what is the best control how to void it. So these things we have to learn from other sites.” - SKL, DiskCo-L-1

On-site visits seem appropriate when people must learn about another way of doing things. After some point, documentation or remote communications cannot accomplish this. People need rather temporary immersion in that other context to gain understanding. This was also the case with the data conversion team from Malaysia site A. That team commonly supported drive operations. For the first implementation in the Far East, they were expected to assist with the media plant in Singapore. They would take care of the data conversion side of that conversion, but were not familiar with operations of the media plant. In order to understand requirements from that type of business, they flew down to talk with key users and IT.

> “They (data conversion team from Malaysia site A - author) came down once because we had some training here (...) And initially also because we needed to setup some so-called conversion rules as to how you want to bring data over from the old system to the new one. So there is a need for them to understand, especially because they are from [Malaysia site A] and that group is supporting drive operations. So I would say they are quite familiar with the drive operation and the requirements. But because the first time we converted is the media group, they came down twice to talk to the local IT and the user group on some of the requirements.” - HHT, DiskCo-B-1

Diversity and remote support
Diversity of operations returned in a discussion with the data conversion project manager, JNL. The Oracle project led to a environment with common business processes and IT infrastructure. This would facilitate remote support, where for instance a regional expert center could offer IT services to various sites. When we talked with JNL about this setup, she pointed at requirements to make this happen. First, that central team should be very knowledgeable about the application. Second, from JNL’s point of view, some differences between the sites would persist even after the Oracle implementation. Assisting a site

requires understanding of that context. This could be a challenge, depending on the level of local unicity.

> "The first thing is obviously they have to know about the application that they are supporting. That would be something that is common to everybody in the team. And on top of that, they would probably have to understand to a certain extent the different environments of the other sites. Because sometimes the way they do business is different, which will affect the way you troubleshoot problems, or you advice to them as to how to resolve a particular problem according to their environment." - JNL, DiskCo-F-1

§ 9.2.4.4 Urgency and Criticality

The criticality and urgency of a task is defined by its importance in workflows, combined with time pressure. Criticality implies that a task is considered vital for the accomplishment of certain output. Urgency is a related concept and depends on time pressure. In our research, both constructs appeared to influence the choice of coordination and control mechanisms. Yet far as we know, criticality and urgency have not been addressed in literature on coordination and control, or in research on distributed work environments. We consider them therefore an add-on to the current list of contingencies as discussed in the theory section.

Urgency refers here to the situation that activities from two or more persons are interrelated, combined with time pressure. It leads to an instantaneous need for interaction. When people work at different sites, a potential problem emerges. They must connect to another context without awareness of what is going on there (Hinds & Bailey, 2000). An IT professional from Malaysia site A expressed this tension when she tried to contact people in Singapore site A:

> "So far our other site IT (Singapore site A - author) has been giving us very good support, so I don't feel there is any difference. Except that sometimes when we on one end have an urgent issue that we address, it's frustrating when we cannot get them on phone because they may be away from desk." - MC, DiskCo-E-1

Urgency demands real-time contact to avoid unnecessary time lapses. On a distance, people's media preference shifted from asynchronous media like email towards phone calls and teleconferences. Because of time zone differences, instantaneous calls are often unfeasible between sites in the Far East and US. As Table 24 and Table 30 show, between Singapore/ Malaysia and US sites there is only a window early in the morning Far East time, and late in the afternoon/ evening in the US. JNL from Malaysia site A indicated that for urgent cases, she would sent a note to the US to arrange for an early morning teleconference:

> "Email is a very common way of communication for us. So if there is not a very urgent case, we normally write emails even those who are local here, maybe a site in Malaysia. For local sites, sometimes we call them up because they are on the same time zone. For US for urgent cases, normally what I will do is I will send them a mail to make an appointment with them to have a teleconference so that the next day when we come in early in the morning we are able to catch them in the US." - JNL, DiskCo-F-1

For these situations, MC from JNL's team mentioned that she would contact people at home. The combination of urgency and time zone differences thus demands adaptive communication behaviors, here on the side of US staff who are called at home.

> "We have not a procedure for dealing with delays. But instead, if there is a really urgent issue, then we will contact them (US counterparts - author) at home." - MC, DiskCo-E-1

US colleagues adapted also in another sense - their local priorities. When Singapore site A was working on the first gaps analysis, they received priority attention from the US for this critical stage. Later on, they continued to synchronize their priorities in accordance with Far East needs. SCC from the core team in Singapore site A comments:

> "During the period that they (US counterparts - author) are concentrating on the Far East gaps (analysis), they act on immediately (...) They also help in the implementation of other sites, also writing programs for them. (...) We prioritize projects by urgency - whether it is high priority, medium or low. So they will go according to this for the development." - SCC, DiskCo-J-1

Adaptation could also occur on the Far East side. GP working from Singapore indicated that he would stay late to catch US colleagues early in the morning. He would create an artificial window. By staying later or arriving earlier at work, he could connect real-time to the US (Table 24, Table 30, and especially Table 31).

> "It depends on how critical the issue is. If we say that it is a critical issue and the US person has to support us, then we really stay back till late and we try to call and solve the problem over the phone. When the problem is critical you can solve it very fast." - GP, DiskCo-D-1

Within the Far East region, time zones do not play an important role as most DiskCo sites are located in the UTC +8 zone (China, Singapore, Malaysia). In this region, task urgency shifts electronic media use from email to phone calls. This real-time communication mode expedites problem solving:

> "(With China - author) Every time there is a great need and they should communicate immediately and get the things done, then I will make a direct call. I would say that talking directly to them, communication by phone is not very much, maybe 20-30% of the total communication." - GP, DiskCo-D-1

MC mentioned that she would initially use DiskCo's email application to identify the urgency of a task. Beyond a certain level, she would also switch to phone calls:

> "But if there is an urgent issue you will surely indicate in the email heading that it's urgent. If it's really urgent, something that needs immediate attention, then we will call them." - MC, DiskCo-E-1

For critical phases of a project, people emphasized the role of collocation. This lowers the threshold for communications with colleagues when they are needed most. Co-presence ensures richness and interactivity of exchanges. It boasts information processing capability so that people can handle complex or novel issues straightaway. ET from Malaysia site A related this aspect to assistance from the Singapore site A core team to her site around the conversion phase:

> “(…) the project team (from Singapore site A - author) should be here for presentations before, during and even more often when we are approaching the conversion, and also after the conversion.” - ET, DiskCo-K-1

Hierarchy and urgent, critical tasks

Urgency and criticality alter the role of hierarchy. They pull managers’ attention strongly to the work floor to monitor and facilitate progress there. CPW compared the Oracle implementation to earlier smaller IT projects. He indicated that Oracle was a high profile project where failure was not an option. Should the program fail, no backup would be available. The project was also time pressed with only a few days for the actual conversion. He mentioned that this increased pressure on his role, and necessitated close involvement. CPW stressed the importance of on-site presence to interact with his subordinates and monitor progress:

> “You can’t just sit in your office, waiting for something to happen. Because the impact is so great, when you turn on and it fails, there is no way to go back. And in our conversion, there is no such thing as a parallel run (i.e., running simultaneously the old MANMAN system and new Oracle ERP - author). It's cut. So when they cut, you move on from one week, there is no way to move back anymore. Since the consequences are a lot more serious, I cannot just sit there and wait for people to tell me all the good news. I have to be in there to see it. And also an important thing is our conversion schedule is so tight. It's all 24 hours or sometimes 2 days, 2 nights continuously. So you have to be there to give them the support, and they know that they are having it, they know that when they have a problem, the big boss (CPW - author) is there to help them to make the call. They don't have to worry. They just do what they are supposed to do.” - CPW, DiskCo-A-3

From a subordinates’ point of view, criticality and urgency bring hierarchical relationships to the fore. For instance, the author sent an email to HHT after on-site empirical research. Since she was not I, an automated message was returned with the following text:

> “Subject: [HHT] is out of the office
> Date: Wed, 9 Jun 1999 18:43:32 +0800
> From: [HHT]
> To: [Author]
>
> I will be out of the office from 06/05/99 until 06/22/99. I will respond to your message when I return. Any urgent matters, please refer to my boss, CP W.
>
> Regards.” - HHT, DiskCo-B-4 (Automated Lotus Notes message - author)

In her absence, urgent communications are re-routed to her boss, CPW. Similarly, a key user from Malaysia site A indicated that critical and urgent tasks leave little room for waiting. She would hierarchically escalate an issues beyond a certain due date, in the assumption that a person’s boss would know his current situation:

> “If we don't see any response within the time that we required them before the due date, we have to escalate up to a higher level. And then we understand the situation and whether they are working on it.” - ET, DiskCo-K-1

In a polycontextual environment, awareness of someone else's situation comes less naturally (Chute & Wiener, 1995, 1996). This increases pressure in case of critical tasks that involve dispersed actors. Thus, people have to pay more deliberate attention to updating others on their absence and work progress. Alternatively, people will move up the hierarchy when they have not been provided with updates, like alternative contact information:

> "On critical projects you better update others when you are not in because if let's say you don't solve the problem and we don't get a reply and it's very urgent we will go up one level higher. So normally we have the habit of informing each other on the project that we are on." - JLL, DiskCo-G-1

§ 9.2.5 Learning, Documentation and Technology

A key challenge in the Oracle project was to ensure that IT staff with implementation responsibility would know how to implement and use the system. Next, users from different departments and sites would the capabilities to deploy the new system in their day-to-day jobs. As interviewees stated repeatedly, they did not know anything about the Oracle system before the project. Both IT staff and users had to become acquainted with a system that was totally new to them. They were confronted with a new generation of technology in a project environment that was very international. Says the project champion CPW: "In fact none of us knew anything of Oracle. None of us knew anything of SQL, or Oracle database. No knowledge at all. We are only VAX" (DiskCo-A-3). This section explores how people bridged that gap. It shows that DiskCo adopted various ways to enhance knowledge and problem solving across the multiple locations that implemented Oracle. Among these are classroom and on-site immersive training, development methodology, documentation, remote communications and use of Lotus Notes groupware.

§ 9.2.5.1 Training

When US sites started implementing Oracle at the first sites in 1996, CWP decided to get his staff involved. This would position them for learning the new system and implementation process. He emphasized a structure of remote counterparts, meaning that people would connect to a colleague in the US with the same job. From Singapore IT core team members and key users were sent over to the US. Representatives of the Malaysian data conversion team went as well. Onsite presence of these people was considered important in this early stage of the learning process. While being there, they could just participate in the processes. In this phase, it appeared not wise to have US counterparts report on their experience through electronic media. They did that rather after a certain 'discovery' stage through Lotus Notes databases. Lack of experience at this early stage of Oracle implementations would make it hard for US staff to define what they learnt and represent that in a coherent manner.

> "When the US started their conversion we sent people from here to there to kind of go through their conversion process. We also sent people from the data conversion team to work with the data conversion team and the programmer there for them to explain to us everything about the program and we do everything hands-on there. We go

> through their live conversion for one of the plants to observe how they do the conversion and what kind of problems they encounter. So that is what we refer to when we talk about the transfer of knowledge. Before we do anything we send people there to learn from them. There are Operations people sent there for 2 weeks to sit with their Operations people, and of course the US sites also established some standards, like how the configuration should look like, this is the hardware that we want, this is how we gonna organize the files, the databases and things like that. These are some standards that we will follow. The program changes that we need to follow are also sent. This is one part of the transfer of knowledge: go there, work with them, know, learn from them." - CPW, DiskCo-A-3

Conversely, US representatives joined their Singaporean colleagues for the first implementations there. Through their onsite presence, US experts could watch how things were going in Singapore. They could interact instantaneously and solve problems if need be. This made more sense than supporting an inexperienced crew from the US. In that case, Singaporeans would have to spot mistakes or inefficiencies, and initiate remote contact to the US.

> "When we converted the first plant (in Singapore - author) we also get people from there (US - author) to come here to help us and do the conversion. In fact they came for the first 3 plants. Not all of them, but 1 or 2 of them came over to sit through together with us. So only after the 3rd plant we really stand alone all the way." - CPW, DiskCo-A-3

After the third Singapore implementation, the core team members and key users from Singapore and Malaysia could take on the role of experts for their Asian colleagues. Their experience enabled them to distill a core body of knowledge for novices. They could structure and economize the knowledge transfer process for the unique Asian contexts (Kumar & van Dissel, 1996). This was not yet possible in the 'discovery' phase as CPW explains:

> "We believe that once we have acquired enough knowledge we know what knowledge to pass on. Last time we started off one whole year of training. The problem is that when you don't know anything, you go learn everything. But you really need to be trained only on this part. So we kind of filtered that down and prepared all the material for training. By then we know who needs to be trained, what needs to be passed down, so the crash course is on the job training." - CPW, DiskCo-A-3

It appeared necessary to tailor Oracle know-how to site requirement. Those not involved in the US learning phase had to go to local Oracle training courses. These offered a generic view on the system, regardless of attendees industrial background. A key user from Singapore site A sat through sessions on for instance HR modules while these were not relevant to her case. She preferred interaction with colleagues who had become experts in Oracle. These people 'speak the same language' from an organizational point of view (DiskCo-H-1). Leveraging on that organizational advantage reduced novelty for her and thus facilitated absorption of Oracle knowledge (Grant, 1996b; Williamson, 1975):

> "When we attended the Oracle in house training at Oracle company (in Singapore - author), we didn't find that very useful. But the CRP when we go through actual business processes, we find that more useful because it's what we are doing day-to-day. So we find that training from the US site to our users here is better than the one from the outside company. So maybe on the training, they should train key users, then

> you come down and train us that would be much easier. Because we speak the same language. When you go to the outside company, they use the Human Resource data, and it's not relevant to [DiskCo]." - ST, DiskCo-H-1

For Malaysia, CPW decided on a multi-stage strategy to get users up to speed. Initially, key users attended local Oracle training, like the one in Singapore. With this general basis, they flew to Singapore to interact with core team members there. Then the key user group returned to Malaysia to setup their own test facility. They use that for getting more acquainted with the system and use local data. Subsequently, the key users pass on their knowledge to users, to ready everyone for the implementation. SKL, a Finance key user from Malaysia site A comments:

> "In order to get to know more about the system, the key users attend a training course conducted by the Oracle people. And that is on the training side. But that is where we learn to understand the Oracle module. Subsequently the key users will go to [Singapore site A] to learn there live how they do it. So that is the phases that the key users have gone through.
> And finally when they come back, the key users will go through an Oracle test database. That means they will create a platform for us to do the testing. So the key users are going through the system, and play with the system. And after that the key users will compile some materials to teach other Finance users how to run the module. So this way, the key users start basically as learners, after that they experience the system as a user and then they become an instructor. So in that way we ensure that progress is done smoothly." - SKL, DiskCo-L-1

Setting up training in a geographically distributed setting has its challenges. Because traveling is resource intensive, onsite training is often attended by site representatives. That person must fill in his colleagues upon returning. An executive working for DiskCo in Singapore describes this situation:

> "If 3 guys are involved in the same project, ideally you would like to send them all away (from Singapore to US sites - author). [This is of course unfeasible] so you send one guy and the other 2 are not there, they have to pick up what happens from this guy when he comes back." - Executive, DiskCo Information Technologies, Singapore[46]

According to CPW, indirect training has its disadvantages. When people who stay in the office receive information from colleagues attending a training seminar, they depend on these persons' memory and interpretations. This reduces the effectiveness of their training compared to people joining in the original session, comparable to the telephone game. For that reason, CPW prefers direct training, with as many people as possible attending a class. For the Oracle project, he reserved a considerable budget to this end. Core team members and other IT staff and users attend basic courses outside the company. This is complemented with DiskCo- specific knowledge:

> "Now the one thing that I always believe with regards to training: you send someone out for training, they come back and train another person. In between there is always something missing. When you go for a course you maybe absorb 70%. You come back

[46] Transcribed from interview by Professor K. Lee, Nanyang Technological University, Singapore in 1994. Used by kind permission.

and conduct the same course for somebody else. And somebody else may absorb only 70% from you. So the net gain is much less learning because it is all discounted. So we have a very big budget for training. Even before we go down to a site and transfer knowledge, we send the people already to basic training conducted by Oracle or by SUN. (...) What we transfer over to them is our actual experience and the issues that we encountered and resolved throughout all these implementations. We pass down to them customizations, the program changes that we make, what are the things that changed and how our Oracle operates slightly different from the generic Oracle. That is the knowledge we are talking about." - CPW, DiskCo-A-3

Directness not only means that people attend courses themselves instead of receiving second hand information from colleagues. It also implies that they experience the new system hands-on. Users from different sites and countries were sent over to Singapore site A to get immersed in the new setup that was already in place there. Their presence on-site was considered important to trigger the learning process:

"Every CRP we send our people, the project team plus the key users to help them. Every conversion, the live conversion we send our people there for one week. That means on the day of the data conversion, turn on on Monday, one more week, on site helping them. For most of the sites 2 weeks before the conversion we send people here for a week on the job training. That means I'm the shipping guy, I need to log on to use Oracle to do shipping. So they are here work here in the shipping department as though they are the shipping person who does his job. So by the time they are back there they really know exactly how to do it. Because I always believe that when you do a training, you just have to go through all these trainings, practice on a test database, that is a neat way for you to start off. But for you to really understand, you have experience it hands-on and use it, and encounter problems, know how to resolve the problem. And that is the completeness of the training. So we call it OJT, On-the-Job Training." - CPW, DiskCo-A-3

From CPW's point of view, effectiveness of people's learning process depends on their own participation in a session so that they do not depend on peers. And on-site immersion in a new setup for a complete experience. This approach suggests a minimal role for distance learning. Especially the on-the-job training experience cannot be replicated to a distributed setting: "I think you can't do on the job training remotely. They have to be physically here" (CPW, DiskCo-A-5).
Still, remote training has a role. DiskCo used NetMeeting and Proxy to conduct remote training sessions between Singapore and China. CPW noticed that these sessions work mainly for small groups. The rooms with meeting facilities cannot accommodate large groups. Besides that, technology does not really cater for interactive sessions with questions and answers, or alternation of instruction and hands-on practicing (Abel, 1990). This reduces the role of distance learning to one-way instruction on basic topics for small groups.

"You can do remote training for a small group. Like for example there is a training on order entry. We use NetMeeting. NetMeeting is very widely used here or we use Proxy. Proxy is software that works like: this guy gets a computer screen that I can see or the guy can also move the mouse. So then we use a conference plus NetMeeting to conduct some training when we think that is possible and effective. (...) It's kind of limited in the sense that NetMeeting is one-to-one or can be one-to-many. But we cannot get in the same room if we are too many people. NetMeeting is not so interactive. It's like I keep talking - talking - talking, and users don't really have a chance to practice because it's instructive on how to do it. So only when you stop, then the user can start to practice. But it's not so real-time, not so interactive. So for certain simple applications, simple entries we can do." - CPW, DiskCo-A-5

Table 28 summarizes DiskCo's strategies for knowledge transfer in the Oracle project. The rows capture the local versus remote dimension; the columns direct versus indirect (liaised) training approaches.

- Cell A depicts a traditional setup. Experts and participants conduct sessions in a collocated setup. This was the preferred approach for DiskCo. For instance, core team members from Singapore worked with US counterparts on initial implementation projects. They trained locally users and IT staff, and organized on-the-job training. Before that, Far East staff attended external training sessions on Oracle and SUN.
- Cell B refers to situations where people are trained locally, and transmit that knowledge to peers, hence indirect. Inevitably this occurs in a distributed project where representatives instead of large groups attend training. For DiskCo, knowledge transfer followed a multi-node route between US experts and Far East staff members who did not participate in on-site sessions. It also happened between core team members and local users. Key users were expected to function as linking pins between these groups to reduce pressure on the core team.
- Cell C strategies - direct remote training - played a limited role in the Oracle project. Technology supported only small groups and little interactivity in the instruction process. This made the approach only suitable for one-way training on basic topics.
- Cell D with the least information processing capability was not used.

Table 28 - Learning strategies in the Oracle project

	Direct training: Expert to novice	Indirect training
Face-to-face, collocated training	Cell A ▪ US experts train Far East DiskCo core team members in US/ Singapore ▪ Local Oracle company trains IT staff, users ▪ Far East DiskCo core team members train local IT staff, users ▪ On-the-job training in Singapore site A or China site A	Cell B ▪ Training US experts vis-à-vis local Far East IT staff, users ▪ Training Far East core team members vis-à-vis local users ▪ Avoided, risk of telephone game
Remote, electronically mediated training	Cell C ▪ Limited role: NetMeeting, Proxy sessions for small groups on simple tasks	Cell D ▪ N.A.

§ 9.2.5.2 Development Methodology

DiskCo adopted a development methodology for implementing Oracle ERP. Initially, they used Oracle's in-house methodology called Application Implementation Method (AIM). Later they switched to Software Development Life Cycle (SDLC), a more generic model that they customized for internal use. The methodologies offered DiskCo IT staff a documented blueprint of how they should implement and adapt a system like Oracle ERP. It is a generic prescription, like a recipe:

> "This methodology helps a lot in the sense that because we had never done such an ERP implementation before, not for my self. (...) I think it is quite a structured way, a method, and it really fits very well. I think the method is really derived in such a way that it is a good fit for any organization who wanted to do the Oracle ERP implementation." - HHT, DiskCo-B-1

The methodologies document any implementation process, outlining steps people have to go through. They also assist in documenting actual steps in an implementation trajectory. To this end, the methodologies come with a myriad of (electronic) document templates. Implementors have just to select the appropriate template for their task, and fill it in. Structuring a process - like methodologies intent to do - helps the novice. It enables him to leverage on others' distilled experience from prior occasions that is rendered in an explicit format (Adler & Borys, 1996). Documentation separates know how from the people who developed the methodology. With DiskCo's intranet and groupware technology, it becomes electronically available to the company's IT staff members, anyplace, anytime.

> "The AIM methodology puts on emphasis on documenting the processes. And it also helps us in identifying the difference between our existing system and the Oracle system. They also have a lot of documents templates that we can use for our documentation purposes." - OBT, DiskCo-C-1

Along with the AIM methodology came training from Oracle consultants. They guided DiskCo IT staff through the initial phases of the project:

> "The applications consultants they are quite well versed on the method itself. So with their help it is a good guidance for people like us who have no formal training on how to manage such a project. So they help us to know what to do next, what needs to be done, and there are a lot of documentation templates that help us to generate all the necessary documentation through all the stages." - HHT, DiskCo-B-1

Like AIM, SDLC offers numerous document templates, ready to be filled out. OBT from Singapore site A explains that US HQ decided at one point to switch from AIM to SDLC, making it a new corporate wide policy.

> "Initially we were using the AIM, then subsequently we - it's a kind of world wide policy - have to follow the SDLC method. So I think now we start using SDLC and we stop using AIM. So for SDLC we also have a lot of document templates. So it depends on what type of documents you have to prepare, then you just follow the templates and they have certain format. Last time I know was that someone came from the US and conducted a class for some of the IT staff here. But I was not involved at all. But subsequently we were asked to use this all the new documentations, using the SDLC format." - OBT, DiskCo-C-1

DiskCo enforced the use of a single methodology across its international operations: "Everybody should follow the same way according to SDLC" (DiskCo-J-1). This homogeneity helps when there is a need for site-crossing assistance or reference. People can refer to the same set of procedures and documents (Grant, 1996b). This makes distributed operations more transparent.

At the same time, commonality excludes other ways of doing things (Adler & Borys, 1996). It may contrast with people's past experience (Ciborra et al., 1996), and offer an approach that does not fit a particular situation. Seasoned staff may dread the sequentiallity and formality of a methodology. SCC from Singapore site A reports:

> "For a developer to pick up the tools in MANMAN or Oracle I think it's easier to pick up the tools using MANMAN. You write a very simple report in just probably half a day. If you want to compare this report to Oracle it may take sometimes a week. The tool is not easy. Because now we have to follow SDLC. Everything must go step by step. We cannot skip the design specs before you do the coding. It takes longer time also." - SCC, DiskCo-J-1

§ 9.2.5.3 Knowledge Database

When US sites completed the first conversion projects, they realized that many of the issues they encountered were relevant to other sites as well. For that reason, they started a so-called knowledge database in Lotus Notes. The database is intended for DiskCo's worldwide groups of IT professionals involved in the Oracle project. Experts from the US and later Singapore select insights and experiences with potential relevance to counterpart sites (Goodman & Darr, 1998). They document their knowledge in a problem - resolution format. Like a heading stating: "Printer issues in Oracle Finance Module", then a description of the problem, and steps to solve it. This explicit knowledge is represented independent of the person who encountered the problem. It is then automatically replicated to other sites. Peers from around the world can access the database from different angles, like problem area, modules, people, or location.

> "At a later stage when we had more sites turned on, we setup another database setup, called knowledge database. That one is more for support for those sites that are already turned on. When you turn on live there will be a different set of problems that we face. And then of course there are different resolutions that go with it. So that's why later on we set up another knowledge database. It's basically for knowledge transfer and experience sharing. It applies to all the areas. It can be an application problem, it can be PC problem, and even printer problems. We are advised to try to document all the problem phases and the resolution that was taken to resolve the problem, and put it in the knowledge database. That applies to those problems that we solve that we think is worth sharing with the other sites. These are supposed to be documented in the knowledge database." - HHT, DiskCo-B-1

A knowledge database in Lotus Notes stretches the role of documented know-how (Van de Ven et al., 1976). Traditionally, documentation referred to paper-based notes and procedures that were copied, mailed and perhaps faxed. Digital documents combined with database and communication technology offer a stand-alone, integrated environment. People can participate in the same electronic environment anytime, and from anywhere. This gives a distributed work environment holographic properties. Morgan (1997) discussed holography in the context of the brain metaphor in his book Images of Organizations. He states: "Holography demonstrates that it is possible to create processes where the whole can be encoded in all the parts, so that each and every part represents the whole" (Morgan, 1997: 75). Multi-site groupware enhances holographic capabilities. It

absorbs and combines insights from different locations, and makes these available to anyone with access to the database environment.
It should be noted, though, that the database contains brief descriptions of a problem and resolution process. It pre-supposes that ‘entrants’ share a certain professional background and range of experiences to navigate, digest and apply the information. Finally, while the groupware reduces interpersonal communication needs across sites, it shifts the burden to people expected to enter information into the database.

§ 9.2.5.4 Documentation

Documentation embodies know-how. In the Far East region, the core team in Singapore site A collected built substantial knowledge and experience on the Oracle conversion. They had worked with US counterparts, and experienced a number of local conversion trajectories in Singapore. Transmission of that expertise to other Far East sites relied strongly on documentation. Elaborate checklists, templates and procedures were developed. In addition, local projects were planned in the timeline dictated by US HQ. CPW explained that his site developed in fact documentation that enabled local core teams to plan and document their project. The teams received a sort of do-it-yourself kit and became then responsible for setting up their own conversion process (Adler & Borys, 1996):

> “We (Singapore site A - author) are the resource for them (other sites - author). So we know the plan, we deal with the plan, with the things that we know they will need, we organize all this for them. But the rest they have to organize. Like they have to come up with a check list, they have to come up with a schedule. But for all these things there is a template given to them. They just fill in their own timing, they fill in who are the persons and some additional local stuff. They are responsible but they always have us to support them.” - CPW, DiskCo-A-5

Documentation accelerated local implementations. At the beginning of the Oracle project, DiskCo staff in the Far East region knew virtually nothing about the new system, and how to handle its implementation. Since the Singapore site A core team was the first to acquire know-how, they covered the first phases of the learning curve. The team reflected on the path they had followed, and documented relevant facets. This collection of explicit know-how reduced novelty for other sites. It informed processes, structured and accelerated them. A key user from Singapore site A explains:

> “During the [Singapore site A] conversion we have gone through so many bad experiences, and good experiences as well, so we know a lot of things, we already know the process very well. So when we come to other sites that they want to convert, we can help them. If you gonna do it this way, you will face this problem, and what is the correct way that they should take. So it shortens a lot of time. Even the conversion table that we set up, they follow us closely. Because if you don't do it, then you face a lot of problems. And also, we have established a lot of reports so when they convert they can just pick up whichever they want. So the time required for them to convert is relatively shorter compared to [Singapore site A].” - JLL, DiskCo-G-1

Once a local team picked up documented standards, it could assess whether and how their situation differed from the generic approach. This simplified and focused local conversion projects. MC explained this for documented data conversion standards:

"We have documentation on each module, what are the conversion rules that we are currently using. And also the changes that we have made for other sites. The local IT staff has to review all this documentation together with the users to see what is apart to them and what is not." - MC, DiskCo-E-1

Similarly, documented experience from Singapore site A economized the generic implementation process, and therefore local implementations. People could use documentation to compare their operations with the 'default' setup in Singapore site A. This revealed possible differences that would require additional attention. As long as things mapped one-to-one with the documented process, people could follow an accelerated trajectory. This facilitated multi-site implementation of the same application:

"Of course for the other sites we did not go through so many steps. Mainly for the 3 main business units: the media, [Singapore site A] and the customer repair center we have gone through the full cycle. And for the other sites Malaysia sites and China, we didn't really do the business process baseline, but we did ask them to review what we have documented. Let's say for the drive plant, they have to look at the [Singapore site A] business process to see whether there are any differences. So they don't had to redo the whole documentation. So from there they roughly know whether there are any differences between their drive and our drive operation. So then they did the Conference Room Pilot, and from there they also make sure that there are no additional differences that is not been catered for by the [Singapore site A] drive." - HHT, DiskCo-B-1

Documentation also played an important role for the data conversion group in Malaysia site A. Their responsibility was to assist other Far East sites with the data conversion aspect of Oracle implementation projects. They received documentation from a team in the US team with a similar role. This covered most technical aspects of the data conversion process as the Malaysian project manager points out:

"I was involved somewhere in the middle of last year. And my responsibility was to do the data conversion for the Far East sites. They have a similar group in the US and so what we did is we get all the necessary programs and files from the US and do the modifications for the Far East plants. (...) The US team came up with conversion document. I don't think they used any special methodology, but they did document down. It is a very technical kind of document. So they specify the programming that was used for the extraction of the data from the legacy system. And they also document down for the loading portion, what are the programs that were used and what are all the scripts that have to be run. It's basically a technical kind of document." - JNL, DiskCo-F-1

The Malaysian group developed checklists applicable to the Far East sites. These were passed on to local key users, and drove local testing and validation efforts:

"What we did was to supply them with some checklists, we have a spreadsheet that documents down some testing that they can do. And what they did is they would pass this to the users, and the users will perform the test or the validation. And they will then put in the comment whether they found something wrong or whether the check is fine and everything is OK. So they will update the checklist back for us, and we will just take a look them." - JNL, DiskCo-F-1

Checklists remained dynamic documents. Experiences from subsequent sites in the Far East were used to improve the list. The checklists thus represented an aggregated body of knowledge that facilitated each new conversion project:

> "I would say the checklist was quite comprehensive to a certain extent. And as we have converted a few plants before right up till now, we are able to fine-tune the documents with helpful feedback from the first few sites that were converted. So it was updated periodically and I guess we have a good checklist at this moment now for the other sites to put on." - JNL, DiskCo-F-1

JNL, project manager for the data conversion team, stresses the advantage of documentation for local teams. In the early stage of a new conversion trajectory, the data conversion process represents a novel challenge to the local core team. At that time, documentation gives an overview of phases, areas and activities. It makes expectations and priorities clear from the outset:

> "I think we need a set of rules to a certain extent so that at least the local people will know what to expect. For example when we start to take on a new site for conversion, what we will is we will provide them with some documents that explain to them what will be the requirements to do the conversion. And for each conversion module what are the criteria that have been set for. And they are expected to review the criteria and the rules. And they will have to come back to us to say if they agree with the rules or they need a change. So I think we need a set of rules and procedures for every start off with a new conversion." - JNL, DiskCo-F-1

Guidelines provided by the Malaysia data conversion team improve local understanding of the different phases. It helps people to setup their own project, and control their work. This reduces their dependence on the Malaysian team. Documentation thus substitutes in part for remote communications (Mintzberg, 1979; Van de Ven et al., 1976).

> "Distinguishing project phases and documenting these makes more sense if you are working remotely. Then you would help the people from the remote sites to know the different phases or to monitor their work. They will know what is the expectation from them, that they have to complete a certain task within a certain timeline. So that would give them a rough schedule of the whole project, and they know the different phases that they are going to expect. That's helpful because you don't communicate to them on a regular basis maybe." - JNL, DiskCo-F-1

Documentation not only reduces interactions between local sites and the data conversion team from Malaysia site A. It makes them more structured, and helps the Malaysian team to handle its involvement in multiple projects:

> "We also have a checklist for our conversion process. So we document down all the activities that have to be done. And that could also include activities that are not related to data conversion. But we have to (interviewee emphasizes - author) document them down in a checklist together so that we know the timing, and at what point we can start which loading data, etcetera." - JNL, DiskCo-F-1

One of the members of JNL's team - MC - commented on the role of documentation in her job. She explained that each local implementation presents her with similar tasks. This makes documentation important. By documenting the first few projects, she can re-use her experience in subsequent ones:

> "What I learnt from this project is that it is very important for us now to document down what we have communicated with the first site, because very often this communication will have to be repeated with other sites. So it makes our job much easier if we have documentation. (...) So I learnt to document things down that I did not have to previously, because of the repetition of the job function. And also to come up with a checklist of what to do." - MC, DiskCo-E-1

§ 9.2.5.5 Issues Database: Digital Documentation and Process Representation

The multiple Oracle implementation teams used Lotus Notes not only for email exchange, documentation and knowledge databases. They also built a more dynamic environment to bring up issues and manage the problem resolution process. Users could enter issues they struggled with in the conversion process. These were grouped and prioritized in a standardized manner. These so-called issues databases were initiated in the US. People there encountered a myriad of issues while learning the Oracle system and adapting it for DiskCo operations. When Singapore site A started on the first Far East projects, they started their own issues database. One reason for keeping two separate databases was that issues in the Far East and US were supposed to be different. Sharing them would not be very useful under these circumstances (Goodman & Darr, 1998). Later, it appeared that some overlap existed, meaning that US experts could contribute to resolving issues from the Far East sites. This led to the merger of the two databases so that all issues from all sites were available to any IT professional or key user involved in the Oracle project. HHT describes the early phase of the issues databases:

> "In fact they (US implementation teams - author) have started using it (i.e., issues database - author) when they started the project. So when we started the Far East project, initially we had a separate one, just to keep track of the Far East issues. But then the US was requested to also look at the issues we have and help us along. At that time the US is also still doing quite a lot of new sites. And their set of problems may be quite different from ours. So initially we have different issue databases. Along the line we later on decided to merge them. So we now have one common database." - HHT, DiskCo-B-3

The issues database became a central platform for raising questions and knowledge contributions. Like a market place, it electronically connected problem owners and experts from any DiskCo site. Once issues were resolved, the database functioned as a digital library. It showed factual descriptions of problems and steps that were proposed for resolving these. The environment evolved into a permanently available representation of project-related know-how. According to HHT, the database was a principal means for transferring technical knowledge across sites.

> "We organized knowledge transfer across sites not so much for personal management skills. But I think we did try for technical knowledge, like the issue database. I think that's the way how we transfer knowledge to the other sites." - HHT, DiskCo-B-3

The database enhanced accessibility of documentation. JNL from the data conversion team explains that her unit pasted checklists in the environment and updated them according to the latest insights. Management and staff at project sites could easily pull this information from the database. Automated replication of the Lotus Notes databases implied that the most recent version of documents became available to anyone with access:

> "I think that checklist helps very much because it is distributed evenly to the users, to the local IT, and to the management as well. So when we start the conversion process we make sure that we cover every step that has been listed on there. So everybody will have the latest update on what's going, what has been completed and so on. And we also publish that checklist so that everybody can have a look at it and can get updated. It's a Word document and we have put it into a comment Lotus Notes entry, so everybody can access it." - JNL, DiskCo-F-1

The issues database grants access to key users, unlike the knowledge database which is only for DiskCo IT units. In fact, the issues database functions as a digital interface. It substantiates cross-functional contact between users and IT. Key users can enter problems into the system, like a serving hatch: "For the issue database the key users are also allowed to access so they can put in their problems" (HHT, DiskCo-B-2). This kicks off discussions amongst dispersed IT professionals. If need be, they initiate separate projects to resolve the issues. JPL from the core team in Singapore site A comments:

> "Normally, if Malaysia thinks it's a big problem they will put it is as an issue into the database. China can contribute by putting their solutions to it. And then if Malaysia thinks China's solution is not acceptable, they will assign someone and raise a project request to have something changed to the system. Because normally the person who raises the issue is the one who suffers the most." - JPL, DiskCo-I-1

Since people from different sites have access to Lotus Notes, it becomes a virtual level playing field. They can look at textual notes that represent problems-to-be-solved. The system represents work in progress. It mirrors operations within the IT function to other communities like key users.

From JPL's angle, the environment lowers the threshold of information access and participation. Information asymmetries between people or sites become less likely. The moment someone represents a problem or document in Lotus Notes - and that is an important condition - it is replicated and open for multi-actor involvement. This triggers more involvement and contributions like a snow-ball effect, until an acceptable solution has been found and entered into the system. JPL describes:

> "The good thing about Lotus Notes is participation - because once you go in, you look at the problem, you can participate. You can just click the button or discuss issues, or you put your comments in. Everybody can do that. It's open to all. So this the place where commonly people will share the information. As I said about documentation just now - I don't think it's likely that someone would have it and someone would not have it. Unless the person never pasted it into the database." - JPL, DiskCo-I-1

As indicated, the effectiveness of the database environment depends on participation. People must look at the system, paste their documents in it, and help others. The environment thus embodies explicit representations of knowledge and collaborative processes. Figure 50 illustrates this setup. An expert (bottom left) encounters an issues and resolves it. He makes that insight explicit in textual/ graphical format. This document is then pasted into Lotus Notes, and categorized. From there, replication takes it to anyone having access to the system. Problem owners (there are 2 depicted here) can pull the documentation and apply it to their setting.

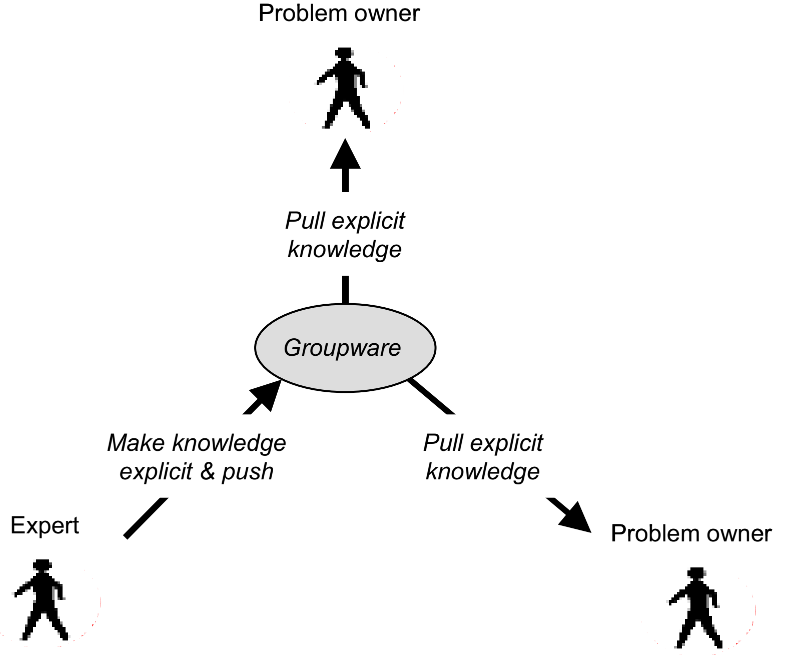

Figure 50 - Knowledge exchange in groupware environments

All this relies on experts pushing explicit know-how into the environment. This is enforced top-down. JPL indicated that his boss - CPW - expects everyone to contribute documented know-how to the system:

> "In the [DiskCo] environment, everybody must paste their documentation in a standard database so that everybody can see. So that you share whatever you have. (...) Our VP wants us to log whatever we do - should we have a white paper, or design documentation to go along with a project. (...) We have a Lotus Notes database that just replicates to all sites after a few hours. So that's how we communicate." - JPL, DiskCo-I-1

Proactive pushing of information into the database environment has an important role in dispersed knowledge sharing. If a person in site A has a problem, and someone in site B knows the answer, the question is how these people connect. HHT explains that this occurred when US sites were ahead of her site, Singapore site A. History repeated itself when Singapore site A became the expert for other Far East sites:

> "A lot of times we tend to forget how to inform people. Initially, when we first started we always had this hard feeling: US have already experienced certain things, they had this problem before, why did you not tell us. Until we decided to avoid that and we'd say: "Oh this is a problem." And it happened to us again when other sites want to start

on the project, and then they also face some problems and then they say things back to us again: "Oh you in Singapore have encountered the same problem before. And then it was not told to everybody"." - HHT, DiskCo-B-1

The initiative to connecting person B's resources with person A's needs could come from both sides. One way is for person A to raise an issue. This approach may require substantial effort for someone with little experience and a myriad of issues at hand. An alternative is that experts - the persons B - are supposed to translate their experience into documentation that is pasted in the groupware system. This taxes their schedule. But an advantage is that gradually a comprehensive stand-alone resource emerges that is accessible to any problem owner, independent of the experts. To HHT, this seemed the preferred and main mode of knowledge transfer in the Oracle project:

"I think the issue database is the only and the best way I'd see. So without that, of course we tend to forget. Even myself, I have to keep reminding the staff and my boss (CPW - author) keeps reminding me: "Any thought on this, please fill into the issue database". that is the only way that people have a chance to know it and learn from you." - HHT, DiskCo-B-1

HHT continued to stress the initiative from experts to push information into the virtual environment. Like her boss, she pressed her expert-subordinates (core team members). To the expert, this process requires some effort. But in the end that is supposed to be well worth the benefits for others in need of know-how:

"I also reminded the team that we have to take the initiative to really inform people and help them with what we have done. Not wait until people ask when they have problems. We are all humans, we tend to forget. It's just sometimes maybe it's just a small little problem and then if we just solve it very easily then we tend take it for granted: "Oh yeah, it's just a simple thing". But sometimes it's really beneficial if you just document it down, put it in the issue database. Although it may take us just less than a day to resolve it, but once you document it down it benefits a lot of people to go forward." - HHT, DiskCo-B-1

The issues database evolves as knowledge accumulates. MC from the data conversion team in Malaysia site A remarked that with each new implementation, her team learns more. They represent that in the system, and make it thus accessible to other sites facing possibly similar problems. Once the experts like her team have pasted information in the database, it becomes the problem owners' responsibility to retrieve it.

"Every time when a new site is coming in, we make sure that we paste every issue in the Lotus Notes database. We have an IT enterprise issue database where we posted all kinds of issues so that every site will have the knowledge of what's going on, even if it doesn't happen to their organization. So eventually it is up to the individuals to read that." - MC, DiskCo-E-1

Patterns of use: Problem owner perspective

Scholars have started to document some of the ways in which people use groupware (Ciborra et al., 1996; Majchrzak et al., 2000a, 2000b). These systems formalize work processes and make them more explicit. They offer remote communications capabilities with extensive documentation functionality, often in an integrated manner:

> "We communicate through Lotus Notes all the time. Every site would have Lotus Notes. So what happens is that we write an email to someone maybe in China, and they see there is a link to this database here (in Singapore - author). So when they receive the link they double click on this link and they go straightaway to the document." - JPL, DiskCo-I-1

In this section, we explore how people use the system in combination with remote interpersonal exchanges. The extensive collection of resources in the issues database encourages people to look first of all in the system for answers to their questions. Others may have encountered a similar situation and already initiated a resolution process. If that happens, it is represented in the system. This avoids reinventing the wheel and avoids redundant communications, as JPL points out:

> "Normally we keep track of the project by issues of the project in Lotus Notes by modules. Like for AP (example of Oracle module - author) these are the issues. So when you have a problem, the first thing is you go to the issues database to check whether that problem has already been logged in by somebody. Whether that problem has already been discussed with our vendor Oracle. And they could say: "Yeah it's a problem", and they are creating a patch for it. So the Lotus Notes database is the first point of contact normally, before we post any issues." - JPL, DiskCo-I-1

GP from the same Singaporean team confirms that when he faces an issue, he starts looking at the documentation available in Lotus Notes. Only when that resource does not suffice, does he contacts peers:

> "What I do is when I face a problem like this is I go through the Lotus Notes database where they just put in all the issues they faced and how they solved them. So I try to look into that. And if I get anything meaningful there, then I use that. Otherwise I just call directly to the people." - GP, DiskCo-D-1

According to HHT, people commonly look first at the Lotus Notes database for entries on similar problems. They may also call more experienced counterparts for assistance. This could be in-person, where the expert tells the problem owner on the phone or by email how to resolve an issue. Or the expert refers to a part of the Lotus Notes database that the problem owner could not find on his own. Like Majchrzak, Rice et al. (2000) asserted in their research, people use groupware not as an exclusive platform for collaboration (see Figure 32). It constitutes rather a sophisticated, person-independent documentation environment (Figure 33). In that role, it helps people to find information that would otherwise require elaborate interpersonal exchanges. Groupware thus substitutes in part for (remote) communications. It substitutes in part for remote interpersonal contact and economizes it:

> "The various sites are able to communicate in the sense that the US may have encountered the problem before, and then they document it and then they may already have found a solution. So when we have a problem, either we go in and look for similar problems or (...) we just ask them on this. And they may say: "Oh yeah, OK this happened before and it was documented". So they just need to point us to the documentation, that is in the issues database. So that is how we share and learn experiences from them. So the issues database is (...) a very good tool for us. Even now we still do it. Although we implemented already, but they may still have new problems, new issues that come along, so we just document it and then we just ask

> around whether anybody has seen this before, then we can share experience." - HHT, DiskCo-B-1

While talking with JPL, he focused our attention also on another side of groupware. Explicitness and transparency seem to get another connotation in a hierarchical organization structure. Since the system clearly shows priorities and pending issues, management may start using it as a control tool. By checking the system regularly, they see progress of tasks. In a sense, they are looking electronically over the shoulders of subordinates (Ciborra et al., 1996). As JPL pointed out, this makes them hesitant to raise issues. If for any reason there is little progress, management may not be aware of that and only look at the system. This makes subordinates not look good and leads to circumvention of Lotus Notes. People prefer to contact counterparts by phone or email to retain a sort of informal lateral process, rather than entering their problem in the open virtual environment.

> "We try not to raise too many issues in the database because this level (points managerial and executive level on a chart - author) is always looking at these kind of issues. So what you do is normally by experience we know people from the same project team doing the same kind of system. So we write an email to them, to see whether they faced this kind of problem in that kind of environment. If they do, how to solve it. Normally, we solve things on that level first (i.e., team member level - author) before you put it up as an issue. Because once you have an issue everybody is looking at the issue. And it's not good to have an issue open for so long. (...) If they cannot solve it, they think they need to proceed further, then they will put it up as an issue. Or maybe it's a problem and they are not sure what it is, could be a bug in the system. Then after a few times they say: "Oh it's serious. We should better put it up as an issue". Then we put it up as an issue." - JPL, DiskCo-I-1

§ 9.2.5.6 Limits to Coordinating by Documentation

Documentation is a means of impersonal coordination mechanisms that include operating procedures, plans, and standards (Blau & Scott, 1962). Scholars have argued that this category of mechanisms applies to tasks that are structured, i.e. known in advance (Kumar & van Dissel, 1996; Van de Ven et al., 1976). Conversely, the limitation of structured mechanisms lies in the nature of tasks that are coordinated. If work becomes less predictable, structured coordination becomes less relevant (Galbraith, 1973; Victor & Blackburn, 1987).

In the Oracle case, documentation practices faced a related constraint. US sites had implemented first, so most documentation reflected their experience. They had developed elaborate procedures for the implementation process and data conversion. This information applied generally speaking to the Far East setting. However, on some occasions, the unique local situation limited their usefulness. For instance, in Malaysia, several interfaces had to be developed between Oracle and legacy systems (Galbraith, 1973). This changed the data conversion process compared with US sites. As JNL, manager of the data conversion team explains, her team had to develop novel procedures to handle these situations:

> "The US team came up with conversion document. (...) So they specify the programming that was used for the extraction of the data from the legacy system. And they also document down for the loading portion, what are the programs that were used and what are all the scripts that have to be run. It's basically a technical kind of document. (...) Most of the time for most of the cases it is applicable. They gave us the programs that they have used, but what we needed to do was to review each of

> the programs to see what are the criteria that have been incorporated in the program to see if they fit our requirements. Most of the time it does, but for specific sites and countries we have to make all the changes." - JNL, DiskCo-F-1

A key user in Finance from the same site - SKL - echoes her point. Knowledge posted in the Lotus Notes infrastructure has been derived from operational contexts that differ from the Malaysian site. Unique local requirement thus make that infrastructure less relevant (Goodman & Darr, 1998):

> "The Lotus database does not fully cover our needs at [Malaysia site A]. Because all these special needs are very unique to the site. So it's very difficult to post all these things into the Oracle database." - SKL, DiskCo-L-1

Structured coordination mechanisms have another limitation. Even though sites operate in a similar manner, documentation from one location may not suffice for another one. It may not reflect the full measure of tacit and explicit know-how that is required for accomplishing a certain task (Polanyi, 1967). An expert's competence could be reflected to a limited degree in a set of procedures. The novice attempting to achieve a desired output merely from represented activity procedures may therefore fail. Kogut and Zander (1992) point at this constraint of formal mechanisms like recipes or checklists:

> "(…) a blueprint favors much more a description of information than know-how. Knowing how to do something is much like a recipe; there is no substantive content in any of the steps, except for their capacity to produce a desired end. The information is contained in the original listing of ingredients, but the know-how is only imperfectly represented in the description" (Kogut & Zander, 1992: 386-387)

In the Oracle project, documentation did not enable a sort of do-it-yourself conversion process. It rather emphasized formal dimensions and milestones that people would encounter. They could use it to sort of benchmark their local processes. For instance, the data conversion group in Malaysia site A came up with extensive checklist for other sites. These were not intended to let local sites do their own data conversion, but "more for validation of data that was converted" (DiskCo-F-1).

Another example concerns the approach of the go-live date. Until that time, DiskCo staff in locations other than Singapore site A could pull most information from the databases, following templates and the like. But after a certain point, they had to switch to mutual adjustment (Mintzberg, 1979). In a distributed project like the Oracle conversion, this implied face-to-face contact with more experienced staff in the US or Singapore site A. SKL from Malaysia site A comments:

> "For certain things we can refer to the database. Like for testing we can refer to the library (digital Oracle library in Lotus Notes environment - author) and the issues database. But when we are going to convert, that means we are going to migrate to a new system, then we will arrange a trip with the key users to Singapore site A to see how things work out with the live database." - SKL, DiskCo-L-1

§ 9.2.6 Face-to-face versus Remote, Electronically Mediated Collaboration[47]

> "We use virtual teams all the time. But there are other projects where because of the length of the project, and complexity it may make more sense for people to go there for this project." - Executive, DiskCo Information Technologies, Singapore[48]

> "If you do a cross-country type of project, it is more challenging, and of course you have more problems to look after." - HHT, DiskCo-B-3

Work division in the DiskCo project created multiple remote dependencies:

- US sites supported Malaysia site A and Singapore site A. They helped Malaysia with data conversion, and Singapore with the overall Oracle implementation process
- Malaysia site A and Singapore site A supported Far East sites in Singapore, Malaysia, China, and Japan.
- SysCo staff in India worked for Singapore site A.

Technically speaking, people could handle these workflows remotely. They could make phone calls, check emails, and use groupware for remote communications and data transfer. In reality, however, interviewees preferred sometimes co-presence over mediated communications. This triggered our interest in questions like: What is the difference between remote and local collaboration? Why and when do people want to see their counterparts face-to-face? This intrigued us in particular since traveling is associated with additional costs, like time and money. We seek to answer these questions in this section. We grouped our analysis around five main perspectives.
First, we focus on the way people from Singapore and Malaysia site A experienced local versus remote collaboration with US sites. Second, we expand on the perspective of people in Singapore on collaboration with other Far East sites. Third, we focus more specifically on how they experienced working with people in China, either locally or remotely. Fourth, we explore how people at Malaysia site A perceive local versus remote collaboration in the Far East. Fifth and finally, we do the same for collaboration between Singapore site A team members and vendor staff from SysCo, India.

§ 9.2.6.1 Experience with US Sites

> "After you have seen the person (US counterpart - author) it's easier to work with them. They know you! Let's say you write an email to someone you don't know. But after you have talked to them and you worked with them, you know the people well, so it's easier to work and communicate with them. Sometimes they will just ignore you

[47] We assume here that people working at the same site have the opportunity to see each other face-to-face. Exceptions occur, but are not considered here, like local colleagues travelling or teleworking.
[48] Transcribed from interview by Professor K. Lee, Nanyang Technological University, Singapore in 1994. Used by kind persmission.

> because they don't know who you are. You have to introduce yourself and what is your responsibility." - SCC (IT project member Singapore site A), DiskCo-J-1

The relationship between US sites and Malaysia and Singapore site A was crucial for the Far East implementation. The data conversion team in Malaysia contacted peers in the US who had been responsible for similar tasks there. Similarly, the team in Singapore connected to US counterparts to learn from their overall Oracle implementation experience.

People at different levels and areas connected to the US with their questions. Not only did they need general know-how on Oracle and DiskCo customizations. To some extent, the Far East sites had also unique requirements that were channeled for US approval through Singapore site A. These had to be prioritized and possibly translated into requests for Oracle customizations. As a result, duplex knowledge and information dependencies emerged. First, Far East sites learned and pulled knowledge from the US.
Second, their demand for new customizations required explanations to US staff. The challenge there was that US staff did not know Far East operations in detail. They needed first of all insight in the background of Far East user requirements. The diversity of Far East and US sites thus led to novelty and uncertainty on the US side. This in turn triggered knowledge flows from the Far East to the US. Interviewees from Singapore and Malaysia responsible for channeling these user requirements indicated that they preferred a face-to-face meeting with US staff for the initial phase of explanation and knowledge transfer.

One IT member of the Singapore site A team pointed out that users from Far East sites identified many gaps for the module she handles. This means that the Oracle ERP does not map perfectly to current business processes. In order to explain these gaps to her US counterparts, she arranged a visited. While subsequent phases of the review process are handled remotely, this initial part required co-presence:

> "Different modules were handled in different ways. For myself I flew to the US to discuss the user requirements with them. So they can have a better understanding. And then they would write up the detailed design specifications and ask for a review before they proceed. (...) They want to have a better understanding because there are quite a few gaps for the module that I am handling. So I flew down. Because for the past I was in charge of this pay bill module in MANMAN. So I know the requirements very well. I went down there and briefed them on the existing requirements, and see how can we fit these requirements into Oracle, (...) and write the customization in Oracle. Or probably they can propose some alternative way of doing things. (...) I flew down there, so it's quite easy. I mean face-to-face we talk to each other, it's easier to explain. (...) Normally we will try to write out specifications and we give the specifications to the US to review through email." - SCC, DiskCo-J-1

This team member faced the challenge of getting people from another context (here: US) understand and act on local (Far East) user requirements. The difficulty is that this concerns unique, location-specific know-how. It is 'sticked' to the site (von Hippel, 1994), and embedded in local routines. These properties imply that asynchronous, textual transmission or phone calls do not suffice. Instead, a rich and interactive face-to-face discussion is preferred to present local requirements and frame them for US staff. Back and forth discussions help to express and align people's different points of view. This is supported by a range of supportive resources, like documents. Remotely, it would be difficult to achieve a similar compressed effectiveness as the Project Manager of the Data Conversion Team (Malaysia) told us:

> "(Face-to-face meetings) are very helpful. When I setup a planned meeting with the person in the US, I have some preparation to do on my side. That means, I have to compile the things that I want to discuss with her. And I have all the documents that I need to show her, which is something that you can't do through email. So I can really get the right message across to her with all the examples at the same time." - JNL, DiskCo-F-1

The efficiency of co-presence meetings is echoed by an IT team member from Singapore site A. She liaises with US sites and compares face-to-face meetings with remote email contact. According to her, co-presence facilitates direct and fast collaboration cycles. She values the instantaneous question/ clarification cycles that may include all kinds of supportive resources. Remote contact, on the other hand, is more time consuming. People must represent their thoughts and resources in a textual/ graphical mode. This communication approach is not only lean and therefore more likely to trigger counter questions for clarification. It is also asynchronous. While the minimal cues require more exchanges, the asynchronicity then stretches these into a chain of back and forth messages.

> "With email you need to draft out what you have to write. Because sometimes they read your message but may not understand what you are trying to say. Then they will write back again to ask some specific questions. But if you sit down face-to-face, anything that we are not sure of, we can maybe draw all the charts for them so that they can see. If you write an email you have to draw all those graphic things, it takes time." - SCC, DiskCo-J-1

Co-presence not only facilitates a particular meeting itself. It establishes some form of working relationship that affects posterior collaboration instances in a positive manner (Gabarro, 1990). The Director Applications Development describes this process for her relationship with US counterparts:

> "Because through the meeting you also get to know them, by discussion, by the meeting we have. (...) . Through the communication - I don't know how to describe it - but you feel the difference. After seeing them and just talking to them it is much easier. And then through this Oracle project, quite a number of some of the key US people also have been charged to travel over here either to do some training for us, or to come here to revise things. Because like doing the gap development we have the various groups of people helping us to do the development. So some of them do come fly over here to work with the users here and to talk to the core team. So from there we get to know each other better, so it helps in the project." - HHT, DiskCo-B-1

Because of these effects, DiskCo organizes bi-monthly a world wide meeting in the US for global IT management. People with local managerial roles in the IT function meet face-to-face. Co-presence of this group promotes interactions and mutual understanding that would be difficult to accomplish remotely.

> "Of course [remote communication] is not as effective as local meetings. So we also have at least once every 2 months a so called worldwide meeting in the US, where all the various sites directors will have to fly in to the US to have a meeting there. Not all directors actually, but representatives. Like for [Singapore site A] normally CPW will

have to be there for all this meeting. And then sometimes I was also invited to be there to also see how things are done, to experience it." - HHT, DiskCo-B-1

Even with visits and electronic communications, people found it difficult to build relationships with US counterparts like they did within the Far East region. The project manager data conversion from Malaysia site A points out that contacts in the latter region are more frequent and thus conducive to establishing rapport:

> "I travel to Singapore quite often. So when I am there, I interact with them very closely. I join them for lunch, sometimes they take me out for a dinner. So I guess that builds up our relationship. Sometimes you don't talk just about work, it's also about our personal live, our families. (...) I guess it is very good to know a bit of their background. (...) With the US it's not like that I would say. Unless you really communicate very often. Otherwise I think it is quite difficult to achieve that." - JNL, DiskCo-F-1

§ 9.2.6.2 Singapore and Far East Sites

> "If you understand the background of people, it's much easier to work them. If I know what term they should be using and what type of environment they are in, it's much easier for me to communicate to them. (...) You can understand roughly what type of problem he or she will be facing. It's much easier that way." - ST, DiskCo-H-1

Mr. GP has been IT member of core team in Singapore site A. He was stationed in a responsible position at Singapore site E to handle the local implementation project. In that role, he encountered complex, unique requirements for which he often contacted colleagues in Singapore site A and the US. This broadened his experience in local and remote team collaboration. Here, he compares these modes in a teleconferencing interview between Singapore site A and E.

> "The difference is communicating with them, and (...) pass on to them information (...). And the problem solving, sometimes it gets delayed. Sometimes what I find is that when you talk face-to-face you see a lot of facial expressions that show how important it is to the other person. But you don't get this chance when you talk over the phone, or send an email. So that makes a difference when you work with remote projects: you need to be more systematic and you have to know precisely what you are going to do and how you are going to communicate to them and how you are going to use them.
> But if you are having a project that is local, and if the persons - project team members and the project people - are around in the same place, in the same location, then there is a natural tendency (interviewee laughs - author) to keep things a little bit cool, and we always have a saying that 'OK anything that happens can immediately be solved'. Whereas in a distributed, remote project you have to be very careful when you handle a project and you have to plan everything properly." - GP, DiskCo-D-1

GP claims that when people meet face-to-face, they can utilize a range of cues that are not available with electronic media. These visual cues represent comprehensively someone's communicative behaviors. Collocation also allows for informal work and interaction processes. Issues can be resolved when they emerge in an impromptu fashion.

With remote collaboration, this changes in multiple ways. People lack the richness of face-to-face interactions. Their assessment of counterparts is therefore less precise. They simply know less of other people, contexts, activities, priorities and so on. Contacts are also less frequent, informal, and at random. They have to be setup more deliberately. Overall, collaboration becomes more formal, and pre-coordinated. The coordination moment shifts to an earlier moment. People make expectations explicit as early as possible. They plan collaborative processes, and by doing so, they reduce uncertainty. As a consequence, communications become more focused, complete, fault-free and functionally oriented than in collocated settings. People attempt to leave little room for questions to minimize communication loops. This demands careful preparation and ex ante knowledge acquisition. GP continues:

> "In remote projects you have to be more systematic than working in a local project. That is, proper plannings, proper procedures, and your documentation should be up-to-date. Before you really start telling people and to explain the procedures, we need to make sure that we understand the context very well. Communication between sites should be complete. And there should be very minimum errors and very minimum clarifications coming from the other site. What I'm saying is: your documentation and whatever you explain through phone or email should be more precise compared to the local projects you handle." - GP, DiskCo-D-1

Economizing on remote communication loops is important. In local settings people can easily interact and clarify at little effort. This is often unfeasible in a distributed setting. Exchanges are often asynchronous because of the medium (email), or because people are not available for time zone differences or other reasons. Handling uncertain tasks this way stretches the problem resolution process into a chain of back and forth communications. Compared to face-to-face communications, time lapses between exchanges tend to be longer. GP explains this difference:

> "Sometimes it happens that if the person is around with you in the place you are working, it is easy to explain and get the things done fast. Rather than talking through the phone or to explain through mail and get them to understand. There is always a time gap, and you face little bit of a problem on that. (...) If people work at the same site, it goes like this: I'm asking a question and trying to clarify the question and solve the problem and work with them. (...) When you work remotely I have to send a file and it would be slow, unless they talk over the phone. If the person is sitting in the same place, same location, maybe within Singapore itself, things can be readily solved and we can come to a conclusion very fast." - GP, DiskCo-D-1

Still, the work can be done remotely. But this demands more attention to communicative behaviors as earlier indicated. And it delays problem solving:

> "For some of the problems, yes, it's always better to talk face-to-face and get it solved. Most of the problems that you face can be solved through email also. But as I earlier mentioned, it is just a time delay, that's all." - GP, DiskCo-D-1

The VP from Singapore site A shares GP's view on the difference between local and remote collaboration. Compared to face-to-face discussions, he experiences a gap between him and a remote partner when using electronic media. This is caused by the limited cues transmitted remotely. The lean representation constrains proper assessment of the counterpart's attitude, behavior, and situation. The resulting lack of knowledge and awareness makes remote interaction difficult. One way to resolve this challenge is to rely on earlier common collaboration experiences. This establishes a working relationship that obviates communicating with minimal cues (Gabarro, 1990).

> "At least within the same organization (i.e., collocated - author) you see each other, you know each other fairly well. When you start working together you see each other every day. But when working remotely, we 'see' each other through the phone, we don't really see each other every day. So if we don't have that kind of relationship which is built up beforehand, then it's kind of difficult. If you are working with remote sites, you never see each other, and you only work through email, voicemail or telephone. You always have a gap there. Because even over the phone when I talk to you, I never know whether you are really happy, when you say something whether it's a joke, or you mean it, or something. Its different. And without working with you for a while, I cannot judge how you will behave, and whether you are offended if I say something like this." - CPW, DiskCo-A-3

Typically, interviewees emphasize the role of visits and face-to-face meetings to get to know people and gain an intimate understanding of remote contexts. For an executive like the VP, this awareness is important. He comments on his investments to sustain close interpersonal contacts with people at remote sites:

> "We use a lot of voice mail, a lot of email. We have very close contact, I would say. Not so much on the lower level, but on the higher level, director level. We have very close contact with our counterparts in the US and also with the rest. I think for the Far East, the good thing is that all these people here are helping me personally to run the operation there. And I visited them very regularly to understand the people, to know the people there. All this comes in and plays a very important role. And on top of just knowing the IT people, my personal relationship with their management people there, director level, execution level, is very good. Because like for [China site A], I am personally involved." - CPW, DiskCo-A-3

Connecting to remote sites is also important for project members at Singapore site A. Their job is to support local implementations. In order to fine-tune their involvement, the Singapore team must know context specific issues. They must be aware of diversity between local operations and those in Singapore. Like earlier described for the relationship between Singapore and US, people transfer and build this understanding of a remote setting through visits, i.e., face-to-face meetings. Otherwise, people reach a catch-22 situation, where local people may not know the difference because they don't know Singapore. And staff in Singapore don't know either because their information on the remote site is incomplete. As this interviewee suggests, information obtained remotely differs from local insights. The former type of information represents relevant parameters to some extent. But being locally there achieves an insight that is more precise and complete.

> "Sometimes we can talk about one thing, and end up they are doing something else, differently. So it's good that periodically you can visit them and see what is going over there. (...) Some of the countries the people like China they will follow whatever you say, whatever you have the subsystem they will try to accommodate. But the thing is their operation may be slightly different. But they didn't feedback to you. So if you go there and visit them and you kind of talk to more people, then you get to know more. Then you see that that is not the way they operate. It deviates slightly, and maybe we have to have some workaround for that. If I'm talking about feedback, that is when I go and talk to them during on-site visits. That is the feedback that I gather. So that's why I say it's important to me that I visit them every 3 months or 6 months.

> I have to do work both locally and remotely. I cannot say - I just sit here (in Singapore - author) and know what's going on outside there. The information you get remotely might be different from what you get when you visit them. So the first one is that I sit here, I look at the system, what reports they have. And I look at the system inside, what they have in the data. But I also need to talk to them (on-site - author)." - JLL, DiskCo-G-1

Know-how pertaining to a local context tends to remain there (von Hippel, 1994). This is a potential problem for site-crossing interdependencies if a context differs from what an 'outsider' is used to. If someone in Singapore tries to help counterparts in China, unique dimensions of Chinese operations may not be available in Singapore. This complicates inter-context collaboration. In this spirit., a key user from Singapore site A comments on her involvement with China:

> "Some of the sites have different practices that we are not aware of until we go there for the training. Then they realize that "Oh, we are doing something different from [Singapore site A]". Some customs they cannot apply Singapore standards identically to China. So they must fine-tune and adjust something to fit their government." - ST, DiskCo-H-1

Visiting sites in China helped her identify local problems. While she was there, she could also help people solve problems faster then remotely.

> "[Visits to China are] important because I can contact them there. When they have any problems they can bring the report to you straightaway, and tell you what type of problems they have (...)." - ST, DiskCo-H-1

This experience was shared by another key user from Singapore site A. She stressed that working at the same site as users makes it easier to gain understanding of their issues. This is because communications are more synchronous and interactive then when communicating across sites:

> "The final result - yes it's the same, but sometimes you have to go through 2 or 4 exchanges (with remote users - author). I mean with the mail (email - author) you have to clarify so many times. So that is a bit time consuming. But with the local user you can talk face-to-face, and understand their operation immediately. (...) I can still get the same result, but it does affect. The thing is that it takes longer." - JLL, DiskCo-G-1

Remote support makes it harder to contact people. Distance raises some form of barrier. Instead of walking to someone's cubicle, people must invest more effort in connecting to remote counterparts. People's awareness and contacts are most strongly tied to their local place of work. Their involvement in remote dependence relationships shows that such ties are less across sites, and more difficult to achieve. The combined effect is that people experience some form of - what could be referred to as - curtain between contexts. Remoteness is perceived as a more indirect form of collaboration as indicated by an IT member of the Singapore site A team:

> "If he (remote counterpart - author) is in the same physical location, you can walk to the person directly. But sometimes when we work in different locations, you may have slight difference in terms of like you call them, they are not at their desk, or having a meeting. So you can't get them immediately. And you don't know when to call them

again. Because you can't see them. You don't know when they will be back at their desk." - OBT, DiskCo-C-1

Collocation not only accelerates problem resolution while people work together in a face-to-face fashion. It also helps subsequent remote support. One key user from Singapore site A remarked that she understood quickly the issue at hand, probably faster then when she had supported all the time remotely:

"[Visits facilitate remote contact afterwards:] You can understand roughly what type of problem he or she will be facing. It's much easier that way." - ST, DiskCo-H-1

The relevance of on-site visits is echoed by the Director Applications Development. Looking back on her experience in the distributed Oracle project, she emphasized the importance of getting to know remote contexts better:

"[I would prefer] to have more exposure on how the other plants run their business. Especially for China I haven't time because of the project to go there and look at the factory itself, to understand the people, and to know more people in the China plant." - HHT, DiskCo-B-1

Apparently, visits enable better connections to local people and practices than working remotely. People need that connection that encompasses knowledge of remote counterparts and possibly relationships with them. Especially with intense dependencies across sites, this become important (Gabarro, 1990; Van de Ven et al., 1976).

§ 9.2.6.3 Singapore site A and Chinese Sites

The core team in Singapore site A was not only responsible for local implementations. It was also assigned a supporting role towards other sites. We zoom in on the way they assisted DiskCo locations in China. They did that in part remotely and sometimes on-site. The question we seek to answer here is how to chose between these two options. Before doing that, we explore in more detail the form of dependence between the teams in Singapore and China.

Assistance is a variant of agency dependence. The latter implies a delegation relationship: the principal delegates a task to the agent (Eisenhardt, 1989a). This triggers a workflow from the agent towards the principal, i.e., the main performance. On a different level, the principal and agent participate also in knowledge and information exchanges. The principal must receive information on the agent's behaviors and/ or outputs (Govindarajan & Fisher, 1990; Kirsch & Cummings, 1996). Before that, the agent needs to know the principal's preferences.

Assistance (dependence) is conceived here as a form of agency relationship. The person-to-be-assisted maps to the principal role, the person-assisting is seen as the agent. The difference is that the agent performs a task for the principal, while the person-assisting helps the other actor to do his job. It is like person B helping A in the kitchen, versus B preparing a complete meal for A. The two relationships overlap in the sense that (parts of) a job are accomplished by someone other than the person ultimately responsible and receiving the job's result.

We can map the agency dependencies discussed above to the assistance relationship (Table 29). The table shows in the first two rows knowledge and information dependencies. The third row represents the workflow dependence, while the gray row at the bottom shows the roles for teams in Singapore and China. Arrows depict the direction of the various flows.

Table 29 - Agency and assistance dependence

	Principal/ person to be assisted (A)	Direction of flow	Agent/ person assisting (B)
Knowledge & information flow	A provides information/ knowledge on his expectations/ context to B	→	B needs information/ knowledge on A's expectations and context
	A needs information on B's assistance/ performance	←	B provides information on his assistance/ performance
Flow of activities	A receives assistance/ performance from B	←	B assists/ performs for A
DiskCo:	Sites China, Malaysia		Singapore site A
Outsourcing:	Singapore site A		SysCo India

Applied to DiskCo, assistance dependence implies that the Singapore team provides an assistance workflow to China (and Malaysia). Fueling that process is a knowledge and information flow from China to Singapore (the top row in Table 29). In other words, people in Singapore must understand the intricacies of China operations to customize their support. In that context, local visits played an important role. One IT team member from Singapore site A explains why:

> "I spent a month there (China - author) doing some system study. It's something requested by myself. Because (...) I want to know more about the business and see it. So that's why I requested that I started on a fresh site, that's China. (...) So he (the VP - author) assigned this task for me. I spent about 3 weeks there trying to learn about MANMAN and overall what's going on. So I tried to be a coordinator for this, tried to do the mapping (i.e., of current business processes to Oracle ERP functionality - author). (...) Basically what we do is we just pass our experience to them. We have gaps analysis, we have CRP, we liaise with the users there. We just pass on to them what we know, what we do here (Singapore - author). (...) I think the most important thing is to pay them a visit, look how they look like. So when you talk to them on the phone it's easier to visualize, it's easier for us to work. (...) If I don't know you when you start talking on the phone, I can't visualize how you smile and when you are angry how it looks like. I think it's important to meet them at least once. It's a very important thing to get an impression of the person. So when you liaise with them on the phone it's so easy, it's much easier." - JPL, DiskCo-I-1

The team member stresses the role of on-site visits. When working face-to-face, he absorbed local impressions. For subsequent remote support, these complemented the minimal cues provided by electronic media (Carlson & Zmud, 1999).

The visit itself connected him closely to local people and their ways of working. He could look at documents and other resources that represent the local situation in a straightforward manner. Remotely, people would have to put effort in representing these to him. Being there also allowed for extensive meetings that could not be conducted as easily on a distance:

> “If you gonna do an interview with someone overseas it's harder. But if you (interviewee gives an example and refers to interviewers at this point - author) can see me you can get more information. I can draw this (interviewee points at earlier made drawings - author); clearly you know what I'm trying to tell you. And I use less words to explain because I use more visual (ways) to explain to you.
> So it's the same thing there. When I go there I ask them all: “How do you ship this thing (the drives manufactured in China - author) out?” And they say: “Oh we have to go through Shanghai customs.” But if you show me the paper with this information it's OK (clear), straightaway.
> On-site is important if you want to have longer days of meeting, and it's important to see the thing. Unless maybe we come at a stage where the technology is so advanced that we don't see time lapse between the lips and the words, and things are moving very normally. But to me, I think to be closer to the person is always nicer than seeing them on TV. So this kind of thing, technology cannot replace it, no, no. That's what I'm saying: the meeting and all this is important. You must at least see the person once.” - JPL, DiskCo-I-1

Meeting counterparts from another company context in person implies a closer connection to the people in that place, and resources like documents. On a distance, people must represent their world. This costs in itself more effort and appears less complete - even with advanced IT - than having someone from abroad submerge in another context and experience its nature for himself.

JPL continues reflecting on his decisions to support remotely or fly down to China. Situations that justify investments in co-presence include: long meetings and large groups of people that need to work on cross-functional, novel issues. For instance, the conference room pilot requires intense collaboration between users and IT. His local participation allows for interactive discussions on resolving pressing issues on the spot. From Singapore, it would be difficult for him to be involved in a similar manner in these group problem solving events:

> “Get together I think it would help a lot. Because if we have a group of people together they understand each other better. But subsequently you don't have to travel all the time. And if you think you need to go down again, I mean is that necessary? Like for example I went there for a systems study, I think it's necessary. I can't do a remote study because it takes time. I was there for a classroom pilot, CRP, I was there because I need to be there. Because it's easier - everybody is in the classroom. (...) We have business people from Materials and Finance, with people from Storage and whatever, together in a room to do a whole week of business testing. I think we have to be there, it's quite difficult to support them remotely. Because they may have pressed you on the spot if they need. Sometimes the lease line is quite difficult to get through. So we have to be there. I mean track down most of their problems, try to have a workaround solution and get back to them. So this is important. Because we have the experience here. (...) And I went there when they implemented. So these are the 3 times I need to be there: system study, CRP training and business test, and implementation. But in between there are just basically emails and phone calls. (...) I visit when I think physical presence would be better than just a phone call.” - JPL, DiskCo-I-1

An important phase in the implementation process is training. In terms of Table 29, this is part of the basic workflow from Singapore site A towards China. Visits play an important role for this activity too. Remote training is less suitable for large groups and instances where experiential learning is required:

> "You can do remote training for a small group. Like for example there is a training on order entry. We use NetMeeting. NetMeeting is very widely used here or we use Proxy. Proxy is software that works like: this guy gets a computer screen that I can see or the guy can also move the mouse. So then we use a conference plus the NetMeeting to conduct some training when we think that is possible and effective. So those are the trainings that we also have. But we also send people down there to conduct training. It's kind of limited in the sense that NetMeeting is one-to-one or can be one-to-many. But we cannot get in the same room if we are too many people. NetMeeting is not so interactive. It's like I keep talking - talking - talking, and users don't really have a chance to practice because it's instructive on how to do it. So only when you stop the user can start to practice. But it's not so real-time, not so interactive. So for certain simple applications, simple entries we can do this." - CPW, DiskCo-A-5

More specific on the job training close before the turn live date also relies on co-presence. People fly down to Singapore site A to experience hands-on working with the new system. Giving people that immersive feel is apparently unfeasible on a distance. The process of discovering and learning very novel skills cannot be replicated remotely (CPW, DiskCo-A-5). On-site presence plays also an important role for the last phase of the conversion, around the turn-live date. For this critical stage of the projects, IT staff and key users from Singapore site A come down to local sites to assist. Their presence allows for time-pressed response to any remaining issues:

> "The IT people (from Singapore site A - author) are really helping the local IT. (...) When I know the conversion we will have people from here over there, helping them. The key user also go over there to help them. And we stay 1 week after the turn live, just to make sure that all the initial issues we have enough people there to help them. (...) We believe that within a week any problem they can see will pop up by then. Do not forget they already have a local IT group that is also fairly involved in understanding the Oracle application. So basically this is the same structure that we apply to every plant." - CPW, DiskCo-A-5

§ 9.2.6.4 Malaysia site A and Far East Sites

The IT team in Malaysia site A was responsible for data conversion in the Oracle ERP project. In that role, they assisted sites in Singapore, Malaysia, China and Japan. They also liaised with the US to tap into their experiences. The project manager for data conversion in Malaysia gives her perspective on working with remote sites. She observes that working with people at the same site creates natural opportunities for sharing day-to-day issues. With remote sites, the impromptu character of these exchanges is lost to some extent. This means that people remain unaware of things going on at distant locations, leading to information and knowledge gaps. Without dependencies across sites, people do not experience this phenomenon as problematic. Yet in a distributed project environment like DiskCo's Oracle ERP implementation, dependencies across sites demand much closer connectivity (Galbraith, 1973; Thompson, 1967). This is because local implementations are embedded in regional and global project plannings. And they utilize common resources, like the team in Singapore site A, and the data conversion team in Malaysia site A. The project manager from Malaysia comments on how this connectivity can be archived:

> “I think you have to adapt a little bit if you are working with people on a remote site. Because you don't meet them physically, so I think you have to put more effort in trying to keep them in contact with you. Keep them updated with whatever information that you have. (…) I guess you have to do that so that they feel that they are being updated. (…) Because you are not able to discuss with them any issues at any time of the day. If you are working with a local team, you can chat with them during lunch, during tea. So I guess the difference is there. It (information sharing - author) has to be two-way. Because if they are working remotely, then quickly things are happening over there that you are not aware of, but that may affect your schedule or your work. So I guess it has to be two-way.” - JNL, DiskCo-F-1

The project manager emphasizes local attitudes and efforts that help overcome knowledge and information gaps between sites. Sustaining a network of updated sites relies on local players who keep their counterparts in mind and share information (Weick & Roberts, 1993). As the quote reveals, avoiding knowledge and information gaps is especially important for polycontextual environments that combine cross-site dependence and uncertainty. Dependence spreads the impact of uncertainty across sites. In fact, this is an application of March and Simon’s (1958: 169) insight in the combination of uncertainty and predictability. Even with the remote networking capabilities earlier described, the project manager data conversion sees a role for collocated interactions. Group meetings with people from different functional areas may benefit from co-presence. This facilitates interaction which may not be necessary for other communication instances:

> “I would say it's a situation dependent kind of thing. If you are trying to go through the conversion checklist to try to finalize what are the activities you are going to do for the particular conversion with them, then if it involves different people from different areas, setting up a face-to-face meeting definitely helps very much.
> But if it's just trying to convey an issue over to a local group, even to a person from the other site, I think an email is sufficient if you can convey your message correctly and clearly.” - JNL, DiskCo-F-1

For her involvement with the implementation in Japan, she describes the advantage of meeting IT staff in person. Face-to-face interaction speeds up uncertainty reduction and problem resolution. Clarification loops are instantaneously handled, instead of being converted into asynchronous communication cycles.

> “I think meeting a person is very helpful. Even during the time when I met up with the IT person (from Japan - author), I was able to discuss many things with him. But it was unplanned. If you are communicating with the person by email rather than directly (face-to-face - author), sometimes you post them some questions and you have to wait for them to reply. So meeting them in person really speeds up. I think it is not necessary (to meet face-to-face - author), we can still get what we want without meeting them. But I guess if you do have a chance to meet them in person, that will help.” - JNL, DiskCo-F-1

One of JNL’s team members in Malaysia reflects on participation in the Oracle ERP project. Her role is to work with local staff on the initial stage of data conversion. She points at the tension between a tight project schedule and working in a distributed environment. A contributing factor here is the fact that she works with new people at each implementation site. To these people, data conversion is a novel task. Consequently, a lot of (remote) communications are needed for analyzing requirements and briefing procedures.

> "If you need a tight schedule then for a distributed environment we cannot afford that. It's harder to have a very tight schedule because of the distance. Key factor is for the distributed sites (...), they have to start from the beginning. All this takes time: I have to explain the whole thing, and communicating with them causes delays. If you are working with the same people, let's say when we are working for Singapore, the manufacturing in Singapore, but the IT people if they have assigned the same person, then I find that it's much easier when we are converting the next site. Because we don't have to deal with the same thing again. So when the person understands what the requirements are, everything can speed-up. If even the users we communicate with are people who have been through the conversion before, they will be more effective and they can understand the procedure and give us faster feedback." - MC, DiskCo-E-1

In this environment, she prefers minimal face-to-face exchanges. This applies in particular to complicated data conversions that are time-pressed. Face-to-face meetings are richer and interactive. This speeds up the conversion process since it allows for on the spot problem solving. It also makes subsequent remote support easier:

> "I would think it is possible to work from a distance and convert rapidly, but I think we need to have at least one meeting face-to-face to become familiar with people, get to know them well, and also to learn and understand their requirements. (...) If it is complex, like if you are talking about this Singapore site - because of the short timing I would have preferred to work locally with them. It will be much faster.
> The previous sites that we converted there is no issue because the time span is quite reasonable. So we are given like 3 months to convert one site. We have 2 - 3 trial conversions. But for these sites we are really really short of time, so when we want to get something done it's not as fast as we want to. (...) I think that at least once during the project, the people from various sites who are supposed to work together, should meet. After you've met the person, when we talk on the phone or email later it's easier to communicate. With face-to-face it's easier to express ourselves. And then when we are together it's easier if let's say an issue involves a user then we immediately get somebody in, and we can all discuss together and find on the spot what we think. It's more interactive." - MC, DiskCo-E-1

Still, she could do without these advantages if need be. When we were interviewing, she was working with counterparts in Japan whom she had so far never met before:

> "Currently we are converting for Japan. I never met anyone from Japan. So we still can get the job done. In fact when I write an email I don't know whom I'm writing to. It's just the name and the title." - MC, DiskCo-E-1

During the actual conversion of most sites, she preferred to fly down to assist on-site. Apparently, the criticality of the period around turn-live demanded local presence to ensure fast responsiveness at little effort:

> "With local IT staff we communicate using phone, and emails. And when it comes to the real life conversion, we went down personally for a few of the sites. For the life conversion, especially for those very critical modules, we went down. Because

> communication wise it will be faster and easier. And system performance will also be faster down at the local site." - MC, DiskCo-E-1

Finally, this IT member from Malaysia site A comments on control challenges in a remote project. In a collocated setting, she could observe her counterpart and exert pressure if need be. Distance constrains such direct control modes (Staples, 1997). As a consequence, more weight is put on people to function autonomously and control their own behavior (Dimitrova & Salaff, 1998).

> "I think the important thing is that because we are so far away from each other, people have to be responsible for what they are assigned to. It's different from when we are dealing with local people. If they don't do something, we can always come up to them, personally, face-to-face and tell them: "Ah we need this to be done as soon as possible". But when we are far from each other, if the person is not responsible and does not want to pick up the phone, or doesn't reply email, yeah, then we have a problem. People should be responsible." - MC, DiskCo-E-1

We also had a teleconference with ET - a key user in Inventory Control from Malaysia site A - and a couple of her colleagues. They reflected on their experience working with Singapore site A staff, both locally and remotely. During implementation at their site, IT staff from Singapore site A supported them. According to ET and colleagues, the success of that relationship depends on a mixture of visits and remote collaboration technologies. They appreciate visits at points in the project when tasks are novel and/ or critical, like around kick off and the turn live date.

> "We definitely need to have good communication media, we have Lotus Notes, phone, lease line and all those things so that we can easily communicate with these people. Second thing is that we need to have a database so that we can share the problems and information, and where each site is in. And third, the project team should be here for presentations before and during the implementation, and even more often when we are approaching the conversion, and also after the conversion." - ET, DiskCo-K-1

When Singapore staff is supporting remotely, ET and colleagues experience more of a barrier. They may not reach their counterpart directly, and have to divert to other persons (colleagues in Singapore), communication moments (calling back later), or media (email instead of phone).

> "There is some difficulty if we are not able to locate them, or if they do not respond. That's when we have some problems that we constantly remind them or check with them what's the status, and whether they are working on our project we are not sure. (...) We have sometimes difficulty in getting them, sometimes they have their own thing to do. And even through a call you might not be able get them. So we have to send them a note. At least in this company we are kind of advanced, we are equipped with all the Lotus Notes, and the phone lines so that we can get hold of them. If we can't get hold of their manager, we try to get hold of the person in charge in their office. So basically we don't really have much problem in that sense. In fact we do have good support from Singapore." - ET, DiskCo-K-1

Ideally, ET and colleagues would prefer local, on-site IT support. This would facilitate more informal, impromptu access to IT resources. It would also allow for interactive face-to-face discussions instead of remote communications that are often asynchronous (vmail, email) and textual (email).

"We prefer to have local people supporting here rather than remote of course. If we have a support team locally we can get hold of them as and when we need to. And also the problems will be more or less resolved easier and faster. Also at the same we probably save a lot of back and forth emails in Lotus Notes, conference calls, and phones and so on. (...) [Using electronic media] is definitely not as effective in terms of the prompt response of face-to-face. But that is the only other way we deal effectively with remote communication." - ET, DiskCo-K-1

With remote support, formalization of all user requests - even small ones - is more likely. People must make their requests explicit by entering it into Lotus Notes groupware. They must follow pre-structured standards for prioritizing and problem solving (Ciborra & Patriotta, 1996). All this increases the 'costs' of collaboration. Compared to that, local IT staff could probably solve smaller problems in more low-key fashion that is faster.

"If you are talking about certain requests that you do not have to put in the Lotus Notes (e.g. smaller problems - author), then if you have to work with [Singapore site A team] you probably do that, you'll ask support (by entering the request in Lotus Notes - author). But if we have local support here, this means that we can just pop in their office and say "Hey we want this, just help to resolve it" then maybe it is just a quick fix. But for certain requests (larger ones - author) we need to set up an official Lotus Notes [request] supporting the project, then we will have to do that for local and outside, external support." - ET, DiskCo-K-1

Local support means less dependence on Singapore site A's priority setting and time frame. This would streamline the process of handling user requests from Malaysia site A:

"I would prefer that the programmer is in [Malaysia site A]. Based on the experience that we have is that if [Singapore site A] is supporting the plants of DiskCo, there are 4 plants they are looking at. So of course they're gonna set all the priorities for project enhancements and things like that. If we can have our own programmers here who can do the same thing or just maybe coordinate our work with Singapore, then I think that would be fast. It would really help us resolve a lot of things that we meet from day to day." - ET, DiskCo-K-1

SKL is another key user from Malaysia site A, in the Finance department. She points out that remote support from Singapore site A has its boundaries. When operations in both sites differ at important points, remote communications are not an effective collaboration mode. The risk is that people in Singapore assume that Malaysia operations are similar. (In fact, US staff faced a similar problem with Far East sites). In reality they are not. Therefore, Singapore staff gives incorrect advice, based assumption that are disconnected from real operations in Malaysia. Using Table 29, more information transfer is needed from the site-to-be-assisted (A) towards the site that assists (B). The more diverse operations in A and B are, the stronger that need will be. After some point, this implies that remote communications will not suffice because of limitations like richness and interactivity. Instead, on-site immersion is inevitable, either site A representatives visiting site B, or vice versa. SKL explains this issue for the relationship between Malaysia site A and Singapore site A:

"We face the problem here that we may make a mistake on the ways that we handle our [...] (technical term - author). Just for example: we asked them (Singapore site A - author) how to do a certain set-up of an instance in Oracle by email and even through the phone. And they would tell us to do it that way. But later on we found out that there is a better way for our environment. Because the way we handle the document flow is a little bit different from [Singapore site A].

So that is an instant that we have to have a better understanding. Maybe that we go to their site to understand exactly how the whole flow is through the documentation. Because that will affect the setup. If I have a problem in facing the setup (…) I think the different views (Singapore site A versus Malaysia site A - author) can be resolved through email and phone. But however, when it comes to handling the data, especially like the document flow, I think email is very difficult. Because different sites have different ways, so the best way is we go there to see exactly how they do it. Let's say I create an invoice. If I want to void it, what is the best control how to void it. So these things we have to learn from other sites. For finance we can understand it by email and by phone. But we come to a point of time that we feel it would be much better that we personally see how they (Singapore site A - author) do it when they turn on Oracle. So that we prepare ourselves for that situation when we turn on Oracle. So the key users will go to [Singapore site A] to see what exactly they do. And then they come back and likewise they will change the rest of the stuff." - SKL, DiskCo-L-1

§ 9.2.6.5 Singapore site A and SysCo

The IT project members in Singapore site A outsourced parts of the development work to SysCo, a large software vendor from India. Initially, SysCo programmers worked on-site in Singapore. The Director Applications Development told us the reason for this comparatively expensive phase:

"I think it would be better for them to come down here to understand the environment. They are all experienced Oracle developers. But to do the development for Oracle ERP is quite different because you have to follow the standards, and you need to understand a little bit on how Oracle ERP is designed, the architecture. We also have some [DiskCo] standards that need to be followed, that they need to briefed on. So there is always the practice that for maybe the first 3 to 6 months they will come here to work on site. It's either on a short project basis. But if it's for a long term project, normally we will let them work here for 6 months and then later on they will go back there and support from there." - HHT, DiskCo-B-1

Outsourcing to SysCo can be seen as the creation of an agency or delegation relationship. It implies that SysCo staff - as agents - work for DiskCo, the principal. As shown in Table 29, this creates workflow and knowledge/ information dependencies (see bottom row for the outsourcing relationship discussed here). On a workflow level, SysCo staff delivers programming services, with completed codes as output. On the second level, DiskCo receives information on SysCo's work progress. Vice versa, in an earlier stage, SysCo staff must understand DiskCo's requirements. Following the Director's quote, this knowledge and information 'gap' encompasses a number of areas. First, they must understand the overall DiskCo project environment. Second, they must learn and apply DiskCo standards for project management and software projects (among these probably the SDLC method). Finally, DiskCo staff must become more familiar with Oracle ERP design and architecture.

On-site immersion in DiskCo's environment was considered necessary to equip SysCo staff for the delegated task. At the beginning of such an endeavor, reciprocal dependencies coincide with information and knowledge gaps, i.e., novelty. This combination results from a deliberate decision (outsourcing/ delegating), and unfamiliarity of agent and principal. Concerning the latter, SysCo staff are used to different ways of working, a different organizational context, and even another country. Engaging in a collaborative delegation relationship thus requires first of all getting the agent understand the principal's environment. Since that knowledge is somehow embedded in and sticked to a geographical location (von Hippel, 1994), on-site immersion during the initial project phase is almost inevitable. This enables SysCo staff to explore interactively the new context, and get connected there. They can establish working relationships and acquire knowledge on the specificity of the principal's context.

After this initial phase, remote collaboration is feasible for two reasons. First, the DiskCo context presents less novelty and thus information processing needs to SysCo staff. Second, the nature of the task changes from requirements analysis towards more independent tasks, like coding. This reduces interdependence between SysCo staff and DiskCo project members. And finally, familiarity with DiskCo's environment implies that lean media suffice for even demanding collaborative tasks (Carlson & Zmud, 1999; Gabarro, 1990). The Director Applications Development comments on the reasons for having SysCo staff on-site and the transition towards remote support. As a side note, DiskCo has equipped SysCo offices with extensive IT infrastructure since they are considered a long term partner. But even with this technical connectivity in place, there were reasons for on-site presence of SysCo:

> "I think the communication was quite efficient through mails and phone. Of course it would be preferred that everybody is residing here, but I think that is not possible. It was quite OK, although they are stationed there (In India - author). Initially we have them all on site. So that basically we get them to learn the environment and to also know the people and then understand what needs to be done. And then slowly we phase them out by sending them back there to continue doing some more coding. Plus it's more expensive to keep them here. Anyway, towards the later part of the project they support remotely. Because there is also a big group of people in [SysCo] India who support the US in other projects. So we have hardware, and all the network infrastructure setup in there for them. So they can work from their own office in India."
> - HHT, DiskCo-B-1

An IT member from DiskCo's team in Singapore site A comments on transition between on- and off-site as well. As a reason for on-site presence of SysCo staff, she points at their need for understanding the DiskCo environment and requirements. Once this has been accomplished, work can be continued from a distance:

> "So far, the 3 [SysCo] persons we have they start on site. Because I think that if you can work on-site for the start, then you can get to know more of the basic requirements. When you work remotely it's probably to provide subsequent support. So the most important thing is they must understand the requirement before they work remotely." - OBT, DiskCo-C-1

She continues with more details on working remotely with SysCo staff. In reality, it seemed that SysCo staff were not sufficiently familiar with the Oracle application, despite their proficiency in Oracle development tools. After they returned to India, this lack of knowledge triggered an extensive communications need that taxed DiskCo staff. They attempted to transfer remotely Oracle application knowledge that was required for the development work. The DiskCo IT team member explains the burden of this process, compared to the preceding collocated phase in Singapore:

> "Initially we have 3 [SysCo] persons working on-site for us. Later on we only have 1, and the other 2 went back to India. After some time, one of them they engaged him in another project. So it stopped. And we have 1 working remotely. And there are some problems when they provide remote support. Maybe because of communications, you cannot really get your message across. Probably because they cannot understand you completely. So we need to spend a lot of time explaining through email, or through phone.
> When they work here, you can use a lot of diagrams to help them to understand. Maybe they are good in the development tools, but they are not familiar with Oracle apps (applications - author). So if you need to do customization to be used in Oracle apps, you also need a little bit of Oracle apps knowledge. So because of the distance you need to use a lot of description and explanation. Actually, when you need to prepare some diagrams and you send it through email, you need more time to prepare that. But if you are explaining on the spot and using a diagram to help up, you will save more time." - OBT, DiskCo-C-1

Remote communications demand knowledge on both sides. Lack of common task know-how exacerbates communication needs. Electronic media seem burdensome to support the process of building a common frame of reference. This is because each actor must represent his understanding and context in a format that can be transmitted electronically. Locally, people can share clarifying resources and interact more fluidly.

§ 9.2.7 Using Electronic Communication Media

> "If we communicate face-to-face, I guess it's much easier to make things clear. But anything through remote communication - I suppose that we have to communicate in a very explicit way" - SKL, DiskCo-L-1

Electronic media sustained elaborate patterns of remote, interpersonal connectivity at DiskCo. This section explores how people used media during the Oracle project. It starts with comparing conditions for usage of phone versus e-mail. Then, the role of audio- and videoconferencing facilities is assessed. After these single media categories, we look at forms of remote multi- media contact, like application sharing. The section concludes with factors that surround the use of electronic media, including remote communications behaviors.

§ 9.2.7.1 Phone Calls and E-mail

Of the electronic media at the disposal of DiskCo employees, phone and email were most commonly used. In this section, we explore how DiskCo interviewees used these media in the Oracle project. They emphasized properties of each mode that defined the conditions under which it could be deployed effectively.

Telephone technology support real-time, two-way representation of a person's voice to someone at another site. Compared to e-mail, people do not have to translate their communication intention into a textual format. They can just talk like they would if their counterpart were in the same space. Email on the other hand supports textual exchanges, and document attachment. It supports predominantly asynchronous exchanges (unless people work at the same time and are constantly monitoring their mailbox).

An IT staff member from the core team in Singapore site A experienced phone calls as more direct. He appreciated the almost instantaneous feedback loops. Issues that leave room for interpretation and questions can be clarified within a single phone conversation. With email, interpersonal exchanges become more stretched. They leave more room for guessing as feedback loops take longer or are incomplete.

> "[With email] sometimes you cannot picture whether he (the interviewee's counterpart - author) understand the things in there, and whether it's clear English. Whereas when you talk it will be so interactive and you can explain and you can quote some examples. Because when you write to the person, you think (emphasis in interview - author) that whatever I'm writing can be understood by the other person, but you really don't know what kind of understanding the other person has got, and what kind of questions he wants to ask on this. So basically there is a lot of difference when you put the whole thing through email versus when you talk to the person directly." - GP, DiskCo-D-1

Similarly, SKL - a key user from Malaysia site A - indicated a slight preference for calling. According to her, people can transmit a topic more comprehensively than through textual exchanges. This facilitates the job of the person on the receiving end.

> "I do not really have a preference for different media. They (remote counterparts - author) can either write us an email or go by phone. Preferably we talk over the phone. Because it's clearer. Because if you talk over the mail, there are some things that they answer to us that we may not really catch. We may not really understand the fullness of it. So it's better to communicate through the phone." - SKL, DiskCo-L-1

Phone calls encourage people to give examples and elaborate on a point that is not self-explanatory. JNL from the Malaysia data conversion team prefers calls for demanding technical topics. Email seems less suitable for explaining and understanding their complexity.

> "I do experience that I cannot explain something through email. When you come to things that are very technical and you need to give them an example of something. So I'll try my best to use email, but in any case that I feel it is not practical I call them up." - JNL, DiskCo-F-1

GP echoed the economy of calls for complex topics, especially when multiple actors are involved. In his experience, this would lengthen the time required for explaining and resolving issues. Since email transmits only texts and documents, it takes considerable effort to express complex topics in that format (Daft & Macintosh, 1981; Kraut & Galegher, 1990). On top of that, messages are sent and received in an asynchronous mode. With multiple actors, this leads to confusion and delays. People may jump in a discussion chain at different points, and misunderstand what is going on (Jarvenpaa & Leidner, 1998). From GP's angle, a single teleconference avoids these concerns to a great extent:

> "What drives the decisions whether you write through email or want to talk over the phone is the complexity and criticality of the issues and the problems. The complexity I came across in the whole thing, (...) makes email not very effective. And especially

when there are 2-3 plants involved (…) I find that it is better to have at least one teleconference then trying to communicate everything through email. If it is a one-to-one contact, like if I want something from the US, and there is only one person involved, then email is also effective. Then it's not necessary that we have contact over the phone. But if three plants are involved to solve the problem, like I need some help from [Singapore site A], from [US Pacific site], and from [US Central site], it doesn't really work if you just write through emails." - GP, DiskCo-D-1

SCC, IT core member in Singapore site A, expressed a similar concern on the use of email for complex issues. Task uncertainty triggers multiple requests for clarification that could better be resolved in a single phone conversation: "With email, sometimes it can take a week just to complete a very simple task because of the email flows. And then for the clarifications it takes time also" (DiskCo-J-1).

A key user from the same site - JLL - shared similar experiences. When she asked a colleague for assistance, the answer may not fully answer her question. It may concern a more complicated form of assistance dependence that requires elaborate interactions, not just one question and one answer. Input from her side is needed for clarifying her problem to another colleague. In these situations, email delays problem solving:

"It can sometimes be for a complex problem that you have to go through email. But then they come back to you and tell you: "OK this should be this way". Then you have another question, you will say: "If I'm doing it this way well I'm gonna face another problem in this way". So you have to wait for them to reply again." - JLL, DiskCo-G-1

It happened frequently that people used email for complicated tasks. One reason was the time difference between the US and Singapore site A. In the early stage of the Far East project, Singaporean core team members were not yet familiar with Oracle and the implementation process. They had to rely heavily on US counterparts for assistance. Mostly, people used email for these exchanges because of the time difference, leading to the back-and-forth cycles earlier described. We elaborate on time zones in § 9.2.9 .

Advantages of e-mail
Some interviewees stressed advantageous aspects of e-mail technology. If for instance multiple persons are involved, it may be difficult to arrange a single slot for teleconferencing. Asynchronous communications allow people to maintain their local pace of working without interrupting them:

"If let's say you want to make a teleconference, you must get all the people at the same time. So it depends, sometimes you cannot get everybody that you want to talk to at the same time. But with email, you just send and they can read it. Instantly they can receive it also, it's not that it takes 2 hours to reach them, it's just in less than 2 minutes or 1 minute" - JLL, DiskCo-G-1

A key user from Singapore site A - ST - complained about phone calls that sometimes disturbed her work processes. This happened when people called her for issues that had already been resolved. They picked up the phone too easily in a sense, thereby intervening in ST's tasks. She would rather have preferred them to look at documentation or send an email, instead of opting for a real-time medium like the phone:

> "Sometimes we are very busy, and I still see a lot of calls from [Malaysia sites A and B] and so on. Unless I'm fully available to sit there to answer the calls, sometimes I feel a bit disturbed. If they have any problem, they will just pick up the phone and call you. Sometimes I direct them to the relevant update that they should look for. Sometimes I ask them to write me a mail. Sometimes it's OK that they are calling me - I mean it depends on whether you are very busy or it depends on that person whether he keeps on calling you and asking you the same question again and again, and then you feel very frustrated. So it depends on the person that calls. Sometimes it's really just for convenience sake, they will just call. Or sometimes maybe they really do not understand. I mean it depends on case" - ST, DiskCo-H-1

Email applications like Lotus Notes offer new functionality like broadcasting (Markus, 1994). People's email addresses can be subscribed to a community that is created around a location, department or topic area. HHT explained that DiskCo used several of these lists for local IT groups, and dispersed communities of key users in the same area (like Finance).

> "If you talk about email communication we have distribution groups built up for each location, that is for IT. And we have a special a list of key users for the different sites. So that is how we make sure the right people are being informed on different issues." - HHT, DiskCo-B-3

Distribution lists economize multi-actor communications. With a single email, someone can reach one or more communities. This facilitates updating groups of people, whether locally or internationally:

> "We usually do not have [information asymmetry]. We have a distribution list, all the information will be distributed to the list of people. The same applies for the US sites - When you send to them it's a long list, a distribution list." - ST, DiskCo-H-1

Email lists helped coordinate people involved in modifying the Oracle source code. When for instance someone in the US adapts Oracle, he must check out the code in CCC/Harvest. Once he has completed his job, the code will be promoted for testing and eventually production. Through email lists, he will update IT colleagues from around the world, so that they can prepare the dispersed implementation of the new code. In addition, users are notified through separate lists. CPW explains:

> "We have different teams and all of us are inside different groups. So when it comes to a promotion, the US guy will do a promotion, he knows which address group to send a notification to. And all these people will know that it's a promotion and they will do their job. So there are groups of Oracle IT people, and Oracle users. Certain things we send to this group (i.e., users - author). We establish an address group in Lotus Notes so that they can send to these other people who must be notified." - CPW, DiskCo-A-4

Finally, a key property of e-mail technology is documentation. On the one hand, it increases the costs of communications, especially for complicated topics (Kraut & Galegher, 1990). People must spend time and effort translating their message into textual or graphical format. Yet on the other hand, documentation becomes a point of reference for ex post tracing of communication patterns:

> “Phone and email are almost the same. Except that we have to wait for each other's reply. Sometimes email is in fact better than through the phone. Because we have it black and white, for reference later.” - MC, DiskCo-E-1

Documentation of exchanges may be necessary as a mnemonic device. SCC from Singapore site A referred to situations in which people denied requests they made at some point. This could complicate her position since she had spent considerable effort on that task. To avoid this, she adds email messages to other documents relating to a project request. If need be, she has a comprehensive representation of communications and resources (Markus, 1994:

> “Email also has its good points. Because sometimes we really need to document some things. Sometimes, if you just talk to each other, then they may say that you never mentioned this requirement to them. So email is also a proof of that. Normally for those important emails we attach them to the project (i.e., small projects for handling issues with the Oracle implementation - author). So the important ones normally we will keep it attached to the projects, also as a proof.” - SCC, DiskCo-J-1

Combining phone calls and e-mail

Some people blended the use of phone calls and email to take advantage of each medium’s distinct properties. A key user from Malaysia site A (ET) explained that when she had to contact Singapore site A, she would sometimes call them first. This is convenient and fast. For complicated topics, however, she preferred to submit first an email with documentation and examples so that her counterpart could prepare for a talk on the phone.

> “We use both (email and phone calls - author). If we can reach them through a phone call we will call them first. And second thing, if we need to elaborate more and give them some time we will write to them. We use email of course when we need to send our measurement table, and when we need to talk about some conversion plans. And we use email if you have an example: we can put it in the email as an attachment so they have more clue of what we are talking about.” - ET, DiskCo-K-1

Email provides her counterpart with documentation that represent a question or request. During a subsequent phone call, ET would complement that information. She could elaborate on the background of a requests, and discuss a topic interactively.

> “When we have a request for [Singapore site A], normally we definitely do show them the reasons why we need them. At the same time - if it's a major report - we try to create a new report the way we want it to be, and we update that in Lotus Notes and show them. And then we have to follow up with some phone calls to make sure that we understand each other.” - ET, DiskCo-K-1

A key user from Singapore site A indicated a similar approach. She submits documentation on for instance a data set by email, and follows up with a call. Explaining the context of an issues would require more effort by email (Kraut & Galegher, 1990). This is because of the translation into textual format, and asynchronous nature of this medium. If her counterpart had questions in return, a range of subsequent email loops would be triggered. With a phone call, these exchanges are compressed in a single conversation.

> “I use 2 types of communication. Sometimes I will send data information by email; if I need to explain then I will call.” - ST, DiskCo-H-1

§ 9.2.7.2 Audio- and Videoconferencing

Audio conferencing connects two or more parties through advanced desktop telephone equipment with an external speaker. It enables multiple persons in a single room to group around the equipment and listen to remote counterparts. At DiskCo sites, many telephones features these capabilities. People could easily setup a teleconference call. They could program their equipment for speed dialing. Because of the lease lines, DiskCo paid a fixed charge so that (international) phone calls within the organization were not charged. While conducting research at Singapore site A, we often heard people setting up a conference call, mostly with one remote partner.

People used teleconferencing for multi-party conversations on novel or complicated topics. For instance, ET's user group at Malaysia site A needed assistance from experts in Singapore site A and somewhere else. Setting up a teleconference offered the advantage of real-time dialogue between her group and the experts, and amongst the experts. This interactivity speeds up problem solving compared to flying people in or using email. At the same time, she indicated that the audio-only property of a conference call makes it difficult to interact with more than about 5 people or sites. Above that number, it would be challenging to figure out who is who in a discussion.

> "We use conference for example if you want to ask whether Singapore (site A - author) and maybe some other plant that is going to convert to Oracle but not yet, face the same problem as our plant (i.e., Malaysia site A - author). And sometimes because the person for Oracle support wasn't in their (Singapore site A - author) plant but somewhere remote. So we do conference in such cases. We never really come up to the max level, we can conference up to about 5 persons, 5 parties. But we normally do not conference more than that. Then it's not so effective because we do not really know who is talking." - ET, DiskCo-K-1

GP made a similar point on teleconferencing. He set up a call to receive interactive assistance from two or more sites. During these electronic meetings, back and forth discussions allow for instantaneous clarification. Experts can complement each other's point so that a more complete picture emerges of a problem situation.

> "(...) When there are 2-3 plants involved (...) I find that it is better to have at least one teleconference then trying to communicate everything through email. (...) But if three plants are involved to solve the problem, like I need some help from [Singapore site A], from [US Pacific site], and from [US Central site], it doesn't really work if you just write through emails." - GP, DiskCo-D-1

Alternative remote communication modes could not accomplish this. Separate phone calls between GP and the different experts would lack interaction between the experts. Using email would result in chains of messages and delay the collaborative process.

Videoconferencing

Videoconferencing offers one of the richest remote communication experiences available at this time (Abel, 1990; Daft & Macintosh, 1981). Multinational firms like DiskCo have invested considerably in videoconferencing rooms and high speed audio/ video connections between their key site. DiskCo had videoconferencing rooms available in Singapore site A, Malaysia site A and B, Thailand, and a couple of US sites.

As researchers, we took a look at such a room in Singapore site A. It features a large TV set that is connected to a movable camera. On the main table in the room, a control unit enables directing the camera to cover different people in a group of up to 20 - 30 persons. The unit also shows a list of sites that can be dialed with speed dialing keys. Sophisticated audio conferencing equipment supports voice communications. The room is available for DiskCo staff and must be booked in advance through Lotus Notes.

People mentioned several factors that impeded extensive use of the facilities. In fact, no one really liked used the system extensively. JLL, a key user from Singapore site A, pointed at a basic constraint of this medium. She remarked that the technology is not yet widely available at DiskCo sites. Because of the expenses involved in setting up a room and connection, videoconferencing lacks the “critical mass” required for widespread adoption (Markus, 1990).

> “Videoconferencing we seldomly use that, because we don't have the facility for videoconferencing everywhere. I may have it and the other site doesn't have it. So it's not so convenient - in China they don't have it, in Malaysia I have no idea whether they have it or not. So I can't use it.” - JLL, DiskCo-G-1

CPW referred to a more fundamental issue. When asked by email about the use of videoconferencing, he claimed that visual contact does not add much value to remote communications. At the same time, the costs - in a wider sense (Kraut & Galegher, 1990) - are high: supposed that a site has the facilities, it takes effort to book a room and make other arrangements for the meeting. This makes phone calls and audio conferencing more attractive, since everyone has a phone, and most of these support multi-party connections.

> “We use teleconference much more than video conference. There is no need to have video conference because we don't really need to see each other face-to-face. I think another reason is that it is more difficult or troublesome to set up video conference than teleconference. No other particulate reasons. By the way, we don't have video conference facility in China.” - CPW, DiskCo-A-6

A key user from Singapore site A commented that she experimented only once with Thailand. She did not perceive the added value of that session. The connection was slow and the camera positioning was not flexible enough. While videoconferencing is multimedia in the sense that it combines visual and audio contact, she missed resources for drawing.

> “We did have videoconferencing but it is a bit slow, and you talk first, then you can see them. So after one time we gave up. We did it once with Thailand, (...) talking about standard cost process. For them I don't know, they didn't complain, but for us we didn't find it very effective or efficient. The conference room we don't really have a whiteboard, we can't draw. And you must sit very near. It's a bit slow. You cannot picture so many people. The camera is fixed there, you cannot zoom in” - ST, DiskCo-H-1

A similar concern was aired by JLL. During a videoconferencing session, she could not show documentation that supported a particular discussion. For that reason, she preferred email:

> "I need to use email because a lot of time, let's say when you want to show an example, I can even scan some of the graphs or the report and show them: "Hey this is the problem that we have". But with videoconferencing we can't do that." - JLL, DiskCo-G-1

JPL from the core team at Singapore site A asserted that videoconferencing could be useful for short meetings with not too many people and interactivity. Like Abel (1990) found, the medium does not support large meetings with elaborate discussions and social processes:

> "I think for videoconferencing, my experience is that you only go for short meetings. But if you have a course or a long meeting, a few days or a week I think it's better to be there. Maybe you need just a few hours or one day, then you can use videoconferencing, I think that is acceptable. But I think if you want everybody together in a room, I think to get the rapport, you have to be onsite. I think that is more important if the thing will last for 5 days." - JPL, DiskCo-I-1

§ 9.2.7.3 Multimedia

Electronic media represent elements of one context to another one. They do that selectively. Phone calls transmit only audio conversations, email supports document exchange, and videoconferencing facilitates audio/ visual contact. When people start collaborating remotely, they realize how multi-media face-to-face contact is. In a single conversation, they see their partner, hear him, and they can work simultaneously with the same resources. This defines the economy of such meetings that is difficult to replicate in a dispersed setup. JNL from Malaysia site A described her experience by comparing face-to-face meetings with email contact:

> "(Face-to-face meetings) are very helpful. When I setup a planned meeting with the person in the US, I have some preparation to do on my side. That means, I have to compile the things that I want to discuss with her. And I have all the documents that I need to show her, which is something that you can't do through email. So I can really get the right message across to her with all the examples at the same time." - JNL, DiskCo-F-1

OBT from Singapore site A struggled also with the limitations of remote media. She needed to explain issues relating to the Oracle application to a remote counterpart. To accomplish that, she would like to show the application, submit documents, give a verbal explanation, and answer questions - all in one session. Using either phone calls or email does not suffice. Email lacks interactive talking, and with phone calls she cannot show the resources.

> "I will send them my Lotus Notes, then I paste the screen from Oracle, and send it to them. So I just ask them to look. A diagram itself is not good enough if you haven't any explanation. And sometimes you may also need to show them the applications. How it will affect the application. Some of the applications, the features you may want to show them through demo. But through the phone you can't (emphasis interviewee - author)." - OBT, DiskCo-C-1

OBT's colleague from the same site came closer to simulating a face-to-face meeting. She used NetMeeting to demonstrate the application, while talking to people on the phone. This combined instantaneous access to a common resource with an interactive conversation.

> "We can have this setup on our PC called Windows NetMeeting where we can run an application and they can see what I am doing here. So I can give a demo to them. It's quite good. Anytime they can take over control of the application. So if they want to show me something, sometimes it's very difficult for them to tell me over the phone what they have done and what problems they have encountered. So they can simulate and we can see on the screen after which step they will hit this problem. It's a very good tool. We use the speaker, we can just talk like that." - SCC, DiskCo-J-1

§ 9.2.7.4 Factors Contributing to the Use of Electronic Media

Using electronic media requires special skills and behaviors. Scholars have suggested an interactive process of adaptation between technology and people's behaviors (DeSanctis & Poole, 1994). With remote communication media, people experience a similar process. They develop their unique mode for deploying videoconferencing technology (Abel, 1990), multi-site email exchanges (Cramton, 1997; Jarvenpaa & Leidner, 1998), and groupware (Ciborra et al., 1996; Goodman & Darr, 1998; Majchrzak et al., 2000a). We are interested in distinguishing patterns of adaptation. These are behaviors or conditions that relate to the use of electronic media, and seem to recur in different studies and individual situations.

In this section, we apply this angle to DiskCo members of the Oracle project. We look at factors contributing to the effective use of electronic media. We start with the role of working relationship and knowledge, and continue with contributing behaviors, like preparation, explicitness, regular contact, and more.

Working relationships

CPW established our attention on the connection between collaborative relationships and electronic media. He pointed out that people working at different sites do not meet each other as they would in a collocated office environment. Communications become less frequent and rich, leaving more room for interpretation and - perhaps - guessing. People need supplemental cues to ensure reciprocal understanding. From his perspective, these cues are supplied by collocated collaborative experiences that precede a period of remote contact:

> "At least within the same organization (i.e., collocated - author) you see each other, you know each other fairly well. When you start working together you see each other every day. But when working remotely, we 'see' each other through the phone, we don't really see each other every day. So if we don't have that kind of relationship which is built up beforehand, then it's kind of difficult.
> If you are working with remote sites, you never see each other, and you only work through email, voicemail or telephone. You always have a gap there. Because even over the phone when I talk to you, I never know whether you are really happy, when you say something whether it's a joke, or you mean it, or something. Its different. And without working with you for a while, I cannot judge how you will behave, and whether you are offended if I say something like this." - CPW, DiskCo-A-3

Working together for some time in the same location establishes mutual knowledge and rapport (Krauss & Fussell, 1990). This reduces the threshold of initiating remote conversations, and makes them more economic (Gabarro, 1990):

> "I always believe before the project starts, these people have to know each other, they will need to have some working relationships beforehand. That will help a lot because once you know each other it will be very easy to talk over the phone. And they also feel very easy to pick up the phone and just call you to say: "Hey, there is an issue how are we gonna deal with it". The relationship is very important because that helps to improve the communications. Many times we hesitate to talk to somebody we are not familiar with. Especially you feel very uncomfortable telling them that you have a problem because you don't know what he is gonna think of you. But we really know each other so well since we were involved in all these projects. They all know that this guy is a master in this area, and this guy always helps us when we bring up an issue, and so forth. So that kind of understanding is already there, and that helps a lot because the communication flow is very smooth." - CPW, DiskCo-A-5

Common knowledge

Common knowledge impacts remote communications in an important way. It means people can focus on the novel or special aspects of a topic instead of covering basic know-how (Grant, 1996b). Distributed expertise provides a common framework and coding scheme. It allows for limited media richness and interactivity. People can rely on minimal communications to transmit information and coordinate their jobs.[49]

In the case of DiskCo, one interviewee from Singapore site A (SCC) mentioned knowledge as an important facet of remote collaboration competence. She worked with experts in the US who assisted her with designing Oracle customizations. In that relationship, design specifications played an important role as a boundary object (Karsten et al., 1999; Star & Griesemer, 1989). From her side, she needed substantial insight in the particular Oracle module to understand and eventually sign-off the design documentation.

> "Talking about skills you need for remote communications. I think the technical knowledge about this application is also quite important. Because our design specs are quite technical, it includes a section on the (...) codes of the program. So normally we need to understand what they (US counterparts - author) are writing, because we have to sign off the review of the design before they can proceed." - SCC, DiskCo-J-1

The same applied to her relationship to less experienced IT staff in the Far East region for whom she functioned as expert. Knowledge on the Oracle module streamlines remote communications. It avoids exchanges on top of the issue at stake:

> "Of course if he (Far East counterpart - author) is the person in charge of the module I expect that he has some knowledge on this application. Otherwise it would be very difficult to communicate. Even if you write an email to him you would have to elaborate a lot to make him understand probably just a small piece of thing." - SCC, DiskCo-J-1

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[49] Take, for instance, the brief phrases that are exchanged between Air Traffic Controllers and pilots (Wiener et al., 1993).

Common knowledge played also a role in SCC's contact with SysCo staff in India. At times, she encountered misunderstanding with vendor staff. This was not caused by distance, but depended on the competence of a particular programmer:

> "I did experience misunderstanding with [SysCo]. I think it's not because of the distance, it's because of the quality of the programmer, the developer. If you have a good one, even though they work remotely it's still all right for us." - SCC, DiskCo-J-1

Preparation, explicitness and comprehensiveness

Remote contact demands prepared, precise exchanges. This stretches the usefulness of media with limitations in the sense of cues and synchronicity. A key user from Singapore site A expects counterparts in the Far East region to prepare exchanges with her, instead of just picking up the phone: "I expect them to do some homework before they come and ask the question to me. It's much easier" (DiskCo-H-1).

From Malaysia site A, MC pointed at the fact that remote contact lacks many features of face-to-face meetings. People cannot easily walk in someone's cubicle, ask questions and talk for a while. On a distance, they engage in more compressed communication instances with someone who is perhaps less familiar with their situation than a local colleague. Dealing with these parameters calls for very clear, comprehensive exchanges:

> "Communication at your own site is much easier because in local sites you can meet face-to-face. For other sites we have to make sure that whether in email or through the phone we have to be very clear. And we have to have immediate and frequent follow-up to make sure that the other guy (remote counterpart - author) understands what we are asking for." - MC, DiskCo-E-1

SKL, key user at the same site, echoes MC's point. In her experience, remote interactions call for great clarity and explicitness as compared to face-to-face settings. In a sense, electronic media offer a connecting layer between sites that is at the same time necessary and demanding. Distance can be bridged but at a price: people must invest in familiarizing their counterpart with their own context and situation. In the process, they rely on media that support a limited range of cues, and sometimes require conversion into a documented format:

> "We have to be more explicit when communicating with [Singapore site A]. If we don't make ourselves very clear to [Singapore site A], I guess it's very difficult for them to really help us. Because all communications are through phone and email. If we communicate face-to-face, I guess it's much easier to make things clear. But anything through remote communication - I suppose that we have to communicate in a very explicit way" - SKL, DiskCo-L-1

On a distance, people's expectations seem less self explanatory to their counterparts. They must be stated explicitly, e.g., due dates and urgency of an activity:

> "When we send a mail to them, normally we say: "Please reply by this date", or "Please reply ASAP". We will call at some other time if things are right. Because there are some due dates on the time line that we look forward to." - ET, DiskCo-K-1

> "Email is the main communication with other sites, especially for those sites that have time differences. We just need to state very clearly the urgency of the project and the date by which we need it." - SCC, DiskCo-J-1

Some interviewees go even one step further. They communicate not only their expectations in a clear manner, but format email messages to structure their counterpart's response. JNL from the Malaysian data conversion team adopted this approach when contacting teams at other Far East sites:

> "I think one of the most effective ways is to give them the format that you want them to give you the information. Prepare the format for them so that they would not have to think about how they should prepare the data for you. That would speed up your work." - JNL, DiskCo-F-1

JPL from the core team at Singapore site A formats text of email messages bullet-wise. He denotes exactly what he expects from whom. This reduces - according to him - chances that people would overlook elements of a request:

> "I try to put up my requests in point forms. So when you look at points, people tend to answer to each. But if you put in a paragraph, it's very difficult for people to answer the question. Because he may miss out the question in between the lines. So I think the best communication is: put in point forms. So when people reply, they will answer the point forms. They will put answers to each point form. I think it's always very helpful, because if you go by point form, you don't miss out anything. But if you tend to put a question in a paragraph, then it's harder to answer it. So if you do have that in a form, if somebody never answers that question, I know that that question is not answered, straightaway. This way, you make sure that you don't miss out anything. If there are 10 points, then people know there must be 10 questions on that. For each question it's best that you direct it to the person, put a name in front." - JPL, DiskCo-I-1

In fact, his approach resembles the way bureaucracies tend to communicate with customers, like applications for an insurance (Galbraith, 1973). These organizations pre-format exchanges to fit their internal processes. This ensures consistency, completeness and efficiency. Apparently, remote exchanges may need to some extent a similar level of formality and structure (Jarvenpaa & Leidner, 1998; Majchrzak et al., 2000a; NASA, 1999).

Regular communications

In a dispersed work environment, people operate in different contexts. They are not automatically aware of what is going on outside their local work setting. This information gap surfaces when activities are interrelated across sites. People facing this situation emphasize regularity of exchanges, especially in a high profile project like the Oracle conversion. They need regular (and often frequent) interactions to update others or receive updates.

CPW, head of the Oracle project, emphasized the importance of regular remote contact. Over the years, he and his staff have gotten used to regular meetings or asynchronous messages. These provide staff with an opportunity to identify problem areas. At the same time, CPW in his role as project champion, remains systematically aware of what is going on at dispersed locations:

> "In the Eastern environment (DiskCo Far East - author) we have been working together for a long time, so that we have already established some reporting mechanisms and some expectations. Like for example, when you talk about the conversion, I will expect my director to give me voice mail at every stage of the conversion. They will give me a voice mail and report the status. And as I say, every week we have a meeting. We check the status and cover all areas." - CPW, DiskCo-A-3

CPW mentioned that regular pacing of communications was already established when his former boss was still at Singapore site A. That person valued regular, frequent updates under all circumstances, even when nothing new could be reported. This practice became engrained in the DiskCo Far East organization and facilitated remote communications during the Oracle project.

> Like myself and my boss - the CIO now, he worked here for 2 years - we had a norm that during my conversion (an earlier IT implementation project - author) every 2 -3 hours I will leave him a voice mail. Whether it is good news or bad news, I definitely will. And he will also feel very uncomfortable if I leave him a voice mail and say "Yeah, I won't give any more status reports, because everything is going on fine, so no news is good news." He wouldn't feel comfortable. It's the same for me. And because of that, every time with my staff we do some major project, and they never leave me any messages or anything, I don't fire them but I will remind them many times. And they know, they will be very upset, when they don't give me the status. So that is a standard practice, a procedure we need there" - CPW, DiskCo-A-3

As it seems, regular contact serves in particular people in managerial roles like CPW. In Malaysia site A, JNL expressed a similar point of view. She heads the local data conversion team that assists other Far East sites. Once local teams are starting on the data conversion process, she appreciates regular updates. It helps her monitor progress at different sites. Without pushing regular updates, she must 'chase' local teams for information, a practice she obviously does not like:

> "I have one team that has been providing me the information on a regular basis, while the other one I have to chase them very often. Of course it causes some inconveniences. What we have to do is we just have to pick up the phone and give them a call every day, or every hour of the day." - JNL, DiskCo-F-1

Interestingly, people emphasize remote communications that are not necessarily related to information processing needs (Scott, 1990). What counts is the combination of hierarchical relationship with geographical dispersion. This leads to communication needs to sustain situation awareness. Especially during an important phase, managers value recurrent contact with their remote subordinates (Kurland & Egan, 1999).

Asynchronous media and feedback loops

Asynchronous media like email and voice mail play an important role in dispersed project settings (Jarvenpaa et al., 1998; Meadows, 1996b). They sustain communications when real-time connectivity is inconvenient or hardly possible because of time differences. At the same time, asynchronicity leads to lack of awareness. In face-to-face or teleconferences, feedback loops are automatically part of communication exchanges. People comment almost instantaneously on what the other person says. With asynchronous media, more deliberate attention must be paid to these loops.

SCC, an IT core team member at Singapore site A, explained that she depended on US experts for assistance on her Oracle module. She contacted these persons mainly by email, probably because of the time zone difference. In some cases, her emails remained unanswered for a while. This left her wondering what was going on. Unlike with local colleagues, she could not walk by or just pick up the phone to check on the status of her request. This caused concern since she worked under time pressure.
In response, she used the "return receipt" feature of the email application, or sent subsequent emails to remind them. But instead of doing that, she would prefer her counterparts to tell her that they received her message and by when they could possibly reply:

> "We also sometimes don't know whether they read our mail. So sometimes we have to put in "return receipt" in order to ensure that they read their mail. But even with "return receipt" sometimes they may not reply you after a few days. Some developers are good: they will tell you that they are busy with something. So they will say: "We will look at it and do you specification after some time". But some they will just keep it there. So sometimes you have to write back a mail to them again to check for the status." - SCC, DiskCo-J-1

According to SCC, a (short) feedback note should not wait until people actually elaborate on the topic of a message. It must follow an initial email quickly, independent of the receiver's schedule. This informs the sender on the receiver's situation and thus reduces his task uncertainty:

> "If they request something through email, and I'm not able to attend to it in a moment, normally I will try to reply, instead of just putting it there and ignoring it. Normally we will try to do that. Even the US people they will try to write back to me and say they are busy with something, and they will attend to it probably some time next week. This is important because sometimes we are just wondering what happened, whether they have read the email." - SCC, DiskCo-J-1

OBT, working for the same team, also appreciates fast replies to messages. She mentioned the fact that people have different patterns of reading their email. This leads to varying response times and less predictability. OBT also indicated that within the Far East IT community more homogeneity exists. Within that region, people have an additional advantage: because of the same time zone they can easily place a phone call if need be.

> "Some people they have a habit of reading their mail very frequently, because in our mail we can have some kind of alert when you have new mail it gives you a pop-up box telling you: "You have new mail". Some people may - it depends on their habit - just say: "Oh, I have mail, very good, let's look at what mail is that".
> But some people may not, they maybe read their mail like in the morning, and in the afternoon they read another time. But I believe for IT practice, we read our mail quite frequently. So within Far East we don't really see much problem. And of course, even through the phone we can always leave a message. And when the person come back to their desk they can read their phone mail and then they will just pick up the phone and give you a ring." - OBT, DiskCo-C-1

Proactive attitudes and pushing information
Dispersion impacts interpersonal communication patterns as compared to collocated work environments. People tend to interact less frequently (Cramton & Webber, 1999) and in a

more formal manner (Kraut & Galegher, 1990). This promotes information asymmetries between sites (Vaughan, 1997). It seems a challenge to keep people updated in a polycontextual setting, especially when they encounter new tasks. Ideally, a sort of dispersed holographic system emerges, where information on everyone is available to everyone (Morgan, 1997). Each site would have a similar knowledge base and be constantly aware of what is going on at other locations.

This was not really the case at DiskCo. The Oracle project led to asymmetrical availability of knowledge and information. US sites initiated Oracle conversions and accumulated experience in the process. Next, Singapore site A was depending on that know-how to implement Oracle there. And also to assist subsequently other Far East sites. We assess here how people's remote communications behaviors accomplished dispersion of information in a changing multi-site environment.

Faced with knowledge asymmetry, one could think of two response strategies. On the one hand, the site with accumulated knowledge resources could push information to less endowed sites. This requires effort on their side to anticipate needs from the latter sites and push information through electronic media or visits. An inverse approach depends on novice sites to indicate knowledge requirements and pull information. They would have to understand what they need from whom, and act on that. We elaborate these strategies here for the Oracle project.

A. Expert pushes to novice

Like many multinational firms, DiskCo has certain sites that hosts centers of excellence. These are mostly located in the US, with primary regional spin offs in Singapore and Europe. New concepts, standards and rules - like the SDLC methodology or core team setup - are usually invented and customized in the US, and from there passed on to regional centers and remaining sites. For the latter category, information pushing is key to being kept updated. They expect the centers of excellence to come up with new resources and distribute these proactively to the relevant DiskCo community. Technologies used for this purpose include intranet, Lotus Notes databases, email lists, and email messages.

ET from Malaysia site A shared our view as someone from peripheral site as far as know-how is concerned. She appreciated the fact that the core team in Singapore site A updated her group on modifications to procedure:

> "Document sharing is very important. In fact, every time they change rules or certain mappings or encounter any problems, they (core team Singapore site A - author) do keep us posted. So that sharing of information is very important." - ET, DiskCo-K-1

From the side of Singapore site A, JLL indicated that she felt responsible for keeping her counterparts in Malaysia and China posted:

> "For let's say China, Malaysia and the plants in Singapore that I closely communicate with, I make sure that we have the same understanding. If I have anything new, anything that I think is useful to them, I'll let them know." - JLL, DiskCo-G-1

JLL's manager - HHT - stressed the importance of proactive information sharing by her team. This attitude ensures an even distribution of knowledge since it does not depend on demands from peripheral sites.

> "I normally will emphasize that we really encourage more communication. Because last time (before the Oracle project - author) we did talk quite a bit but maybe not as intensive as we should. But especially the core team I need to encourage the group to be more proactive on talking to them (people from other sites - author) and then transfer knowledge. More an active role than passive in the sense that only when they ask then you tell them things." - HHT, DiskCo-B-3

B. Novice pulls from expert

Interviewees adopted also a converse strategy. Core team members in Singapore and other Far East countries considered proactive 'hunting' for expertise vital for meeting the demanding schedule. They used electronic resources and leveraged their contacts locally and abroad. GP from Singapore described his approach:

> "I would say yes, you have to be pretty proactive. I can give some examples like I found something which is not working. I can take a little bit more time to know what is happening, but what I see it's better to just send a mail to a person from whom I know that he knows this area pretty well. I send a note with: "Hey I'm doing this testing and I'm not coming out successfully. Meanwhile I need help." But I don't stop at my site, I just continue until I have an answer. If I have it soon, I just let them know. It depends on what kind of problem I face and how critical the problem is, and whether the person is willing to help or not." - GP, DiskCo-D-1

SKL - a key user Finance from Malaysia site A - underlined the usefulness of individual initiative and proactivity. She related this to the time pressure on the Oracle project. When facing an issue, she would pull on her network of Finance counterparts at other sites. For technical issues, SKL worked through local IT.

> "The other thing that I learnt is to be always proactive at our site. This means that if we have a problem and the core team doesn't have an answer, we try to get the answer by ourselves by checking two other key users. Or maybe we can get hold of any help at our site. I guess that everybody in the core team is very proactive. This is important because we have a timeline to follow up - each week what is to be achieved. If we are not proactive that means our site can get stuck. Certain things like if it's a Finance issue it has to be resolved over the Finance side. If we are talking about things to do with the system like instability, IT can solve it. But certain things that are exclusively pertaining to Finance issues, we have to resolve it. So every key user must be proactive." - SKL, DiskCo-L-1

C. Blending of pushing and pulling strategies

In fact, people pushed and pulled to avoid asymmetrical distribution of knowledge and information updates. On the one hand, experts would push the latest standards to their counterparts through homogeneous communities. Experts in Finance would update their dispersed peers with new corporate standards. This ensures distributed cognition on a generic level. On the other hand, local people with a specific problem would pull knowledge. They would contact experts in their functional (user) area. For cross-functional problems, they would also ask for support from the local IT department. Together, push and pull strategies formed a distributed exchange pattern that relied on proactive contributions from experts and novices alike. HHT observed this as follows:

> “I think it works both ways. If we try to talk to them (problem owners, novices at other sites - author) more and try to share knowledge more actively, then it's also quite natural in the sense that they know that the core team is the support group that they can rely on for technical aspects of consultancy knowledge. So they will normally come back to us for problems and issues that they have.” - HHT, DiskCo-B-3

§ 9.2.8 Experiencing Technology

Technology played a pivotal role in the Oracle roll out. The project itself concerned a technology transition program: DiskCo implemented an ERP system as a replacement for the MANMAN legacy. In the process, technology sustained connectivity in a multi-site project environment. DiskCo could dispose over a variety of tools, such as intranet, Lotus Notes groupware, email, phone, audio conferencing and for some locations videoconferencing. In this section, we focus on people’s experiences with availability and quality of some of these technologies. It should be noted that the situation at the time of this study (1997) may have changed considerably.

Connectivity at zero variable costs

People appreciated the fixed fee telecommunications facilities at DiskCo. For a fixed fee, the company’s main sites are permanently connected through lease lines. This eliminates variable costs of phone calls, email exchanges, remote database access and the like. ET from Malaysia site A comments:

> “Of course it's very important that people have multiple ways to connect to other sites. That's why I told you it could be Lotus Notes and phone calls. And it's a lease line so it's cheap to call” - ET, DiskCo-K-1

The VP Information Technologies asserted that with variable costs, people refrain from regular and prolonged tele-conversations (Kraut & Galegher, 1990). They realize the costs and budgets associated with telecommunications. With zero variable costs, absence of these concerns promotes more frequent and extensive remote exchange patterns.

> “Sometimes the costs of communication kind of prevents you from communicating too regularly. Because like for example if you need to meet a person from another site, it will costs you a certain amount. So you don't want too many meetings the whole day or week. But within [DiskCo] all our infrastructure is so good that we can talk to each other any time for any number of hours. The costs are already there, it's really fixed.”
> - CPW, DiskCo-A-5

Concerns

At the same time, interviewees aired some concerns on the existing infrastructure. They commented that the lease line capacity was insufficient at times to handle traffic between sites. Like JPL from Singapore site A prefers testing on-site for the Chinese sites instead of working remotely. Co-presence facilitates interaction and avoids reliance on lines that are occasionally overloaded:

> “We have business people from Materials and Finance, with people from Storage and whatever, together in a room to do a whole week of business testing. I think we have to be there, it's quite difficult to support them remotely. Because they may have

pressed you on the spot if they need. Sometimes the lease line is quite difficult to get through." - JPL, DiskCo-I-1

Between Singapore and US he experiences the same problem. This time, time zone differences lead to a peak load during the only window available - Singapore morning and US afternoon (Table 24, Table 30):

"For us (in Singapore - author) solving the problem early in the morning is the best thing we can do. So that's why you can see that most of the time you can't get through the lease line to the US is early in the morning (Singapore time - author). So there are a lot of conference calls always happening about 7 o'clock in the morning which is their 4 or 5 o'clock in the afternoon." - JPL, DiskCo-I-1

Speed of lease lines affected not only phone traffic but also remote system access. MC from the data conversion team in Malaysia site A preferred to come down to a site for the life conversion. This facilitated communications with the local team, and ensured fast performance of Oracle:

"For the life conversion, especially for those very critical modules, we went down. Because communication wise it will be faster and easier. And system performance will also be faster down at the local site." - MC, DiskCo-E-1

For the Oracle development environment, lease line capacity made remote system access for testing difficult. Since DiskCo applied a single source code, any changes affected all sites. Key sites - including Singapore - had to be involved to test modifications. To this end, modified versions of Oracle were replicated to sites with testing facilities. DiskCo decided not test remotely, e.g., from Singapore to the US because of speed issues. CPW described this point as follows:

"US sites may say "OK this week we gonna do a promotion to testing". So it involves all of us (DiskCo sites from around the world - author) that over the week we pull the code from the US. There is a hub, all the code we'll get here is pooled. When we pool we will apply to our test environment. So all the software for testing is the same all across the [DiskCo] world. So I don't have to log on to the US to try testing from here. That is slow. That's why we have our own test base. The program will be exactly the same, and we test over here." - CPW, DiskCo-A-4

Finally, the core team in Singapore site A outsourced some development work to SysCo from India. Staff from this vendor were initially located at DiskCo premises in Singapore. Later on, the moved back to India and supported from there. To DiskCo staff, this was challenging at times. They found phone lines to India noisy, and the English accent from vendor staff difficult to catch:

"Lines from Singapore to DiskCo West Coast HQ are not too bad, because our telephone system is quite good, the sound was quite clear. It's just like talking to anybody else in Singapore. But the sound to India, the lease line is very noisy to them. And their English is also very difficult to understand. It's very difficult to work with those people." - SCC, DiskCo-J-1

§ 9.2.9 Time Zone Differences

> "Before you collaborate, you've got to coordinate. Trouble is, when your customers are spread across time zones, scheduling a meeting through email can quickly dissolve into online Ping-Pong." - (Quain, 1997)

Parties involved in the Far East project were mainly clustered in Singapore, Malaysia, China, Japan, US, and to some extent India (outsourcing partner). Our perspective for time zone differences is mainly Singapore site A, since from there most activities were coordinated (Table 30).
This section is setup as follows. We start with the windows that exist between sites in the Far East and US. Then, we focus extensively on issues related to minimal window between Far East and US sites. We conclude with global conferences that connect real-time multiple sites across different continents.

§ 9.2.9.1 Windows for Collaboration

For the Far East region, time zone differences played a minimal role. Singapore and Malaysia are neighbor countries and in the same time zone - UTC +8. Singapore and China are about 1 hour flying apart but also in the same zone. Singapore and Japan are geographically further apart, but with only 1 hour time difference (Japan is UTC +9). India (SysCo's location) is in UTC +5½, hence 2½ hours apart from Singapore. The US is geographically and in terms of time zones substantially further away. US Pacific is in UTC -8. Since Singapore is in UTC +8, the time difference is 8 hours (see Table 30). With US Central sites (UTC -6) this difference is even 10 hours.

Time zone differences are here considered as one of the gaps between sites. We analyze their impact as perceived by DiskCo interviewees. First, we discuss the role of time differences in the Far East, including India. Then we zoom in on the relationship Far East and US. The section concludes with the challenge of triple continent communications.

For the Far East region (India not included), time differences are absent or minimal. Working days overlap almost completely, allowing for anytime contact across sites. As one key user from Singapore site A aptly noted:

> "(...) the time zone is exactly the same. So when we work, they work, they knock off, we knock off." - JLL, DiskCo-G-1

Technically, DiskCo's strong infrastructure allowed people to connect remotely instantaneously and without limitations. Combined with the limited time differences, this reduced the perception of distance. The Director Applications Development in Singapore site A remarked:

> "Distance wise, for Malaysia and for China I think the communication is not really a problem. Because for us it is just a phone call away. It is quite convenient because we have all the infrastructure set up. And, they are all in almost the same time zone." - HHT, DiskCo-B-1

The low threshold for communications enabled almost instantaneous remote contact with little effort. As the need arose, people could setup up conference calls and solve issues quickly:

> “If there is a time zone difference then it takes longer, but if it's Malaysia, Singapore, and China we are on the same time zone, it's not a problem. (...) We have many activities going on because of the same time zone.” - JPL, DiskCo-I-1

Another interviewee, member of the core team in Singapore site A echoes the short cycle times:

> “Within the Far East, our time difference will be one hour at the most. So if it is a straightforward problem you can probably resolve it within a few hours.” - OBT, DiskCo-C-1

An IT staff member from Singapore compared media choice for connecting to the US or Far East sites. In her perspective, the opportunity to connect real-time in the Far East leads to use of synchronous media, like phone calls and teleconferences.

> “The main tools we are using is email to communicate with the US. We hardly ring them because of the time difference. If let's say other sites like China, Malaysia normally we will try to call them instead of writing an email. It's faster that way in the sense that you are able to reach them.” - SCC, DiskCo-J-1

At the same time, phone contact does not substitute for asynchronous media like email. It rather provides a convenient fall-back option for urgent cases. For the bulk of regular, day-to-day communications people use email, also with people in the same time zone. The project manager for data conversion in Malaysia remarked:

> “Email is a very common way of communication for us. So if there is not a very urgent case, we normally write emails even to those who are local here, maybe a site in Malaysia. For local sites, sometimes we call them up because they are on the same time zone.” - JNL, DiskCo-F-1

From India, SysCo employees supported the DiskCo team in Singapore site A. IT professionals in Singapore receive user requests that they translate into small projects and delegate to SysCo. Staff in India then work on program customizations to the Oracle package. This agency dependence concerns tasks of limited complexity and scope.

Earlier in the project, SysCo staff worked on-site in Singapore as we explain in a later section. Here, we focus on remote collaboration between Singapore and India. Table 24 shows extended working days at both sites. The 2½ hours difference allows for substantial overlap in working hours. Given the limited complexity of the delegated task, asynchronous communications usually suffice. User requests are relayed by email and document attachments. Sometimes, these communications may leave uncertainty for SysCo staff. If DiskCo staff anticipates this, they complement the emails with a richer and synchronous medium: teleconferencing. From SysCo’s side, staff may also initiate phone calls to resolve uncertainty. A DiskCo IT professional summarizes these practices:

"In India they have only about 3 hours time difference from us. So if they really need something like verbal explanation, they can contact us. I do have some user requests that they work on where we do it this way. We will feed back our test results to them through email. And if we think that it is required to give them more explanation so that they really know what we want, then we will call them also" - OBT, DiskCo-C-1

Even just 2½ hours difference may prevent instantaneous contact for site-crossing issues. For instance, issues arising in Singapore in the morning have to wait until SysCo staff comes in the office. The reverse case is worse. While this delay is only a few hours, problems in India's late afternoon remain unattended until the next day Singapore morning (Table 24). This interrupts local workflows and lengthens cycle times:

"(…) We loose time in delays because of the time difference. So your communication, also because of that, you wouldn't get instant response. (…) So the only problem I can see working in this type of relationship is you need more time to develop a program, to complete a program." - OBT, DiskCo-C-1

Finally, time zone differences have the strongest impact on collaboration between sites in the Far East (China, Singapore, Malaysia) and the US. Far East sites are all in UTC +8 (Table 30). US Pacific with DiskCo HQ is in UTC -8, while US Central - a site with important IT resources - is in UTC -6. People in Singapore often contacted counterparts in the US for assistance. Since the US started implementations, their know-how was more advanced and need in the Far East.

The dotted horizontal boxes in Table 30 show windows between Singapore and US Pacific or Central. An extended working day from 8:00 until 19:00 results in a 4-hour window between Singapore and US Pacific. The window is only 2 hours between Singapore and US Central. In the next sections we expand on the impact of time differences on collaboration between Far East and US sites.

Table 30 - Time zones DiskCo sites Singapore and US

	Direction in which day & night proceed										
	UTC +8	UTC +9	UTC +10	UTC +11	UTC+/-12	UTC -11	UTC -10	UTC -9	UTC -8	UTC -7	UTC -6
	Singapore								US Pacific		US Central
Singapore Monday	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00
	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00
	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00
Singapore Monday	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00
	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00
	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00
	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00
	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00
	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00
	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00
	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00
Singapore Tuesday	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00
	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00

	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00
	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00
	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00
	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00
	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
Singapore Tuesday	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00
	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00
	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00
	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00
	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00
	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00
	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00
Singapore Wednesday	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00
	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00

Daylight Saving Time (DST) not applied

§ 9.2.9.2 Impact of Limited Windows (Far East - US Sites)

The windows offer very little opportunity for real-time contact. Says an IT professional from the Singapore site A core team:

> "Sometimes if you really need to talk to them, it depends on which site. Like [US Pacific] normally if we come in early, it will be their evening and we can still talk to each other. But [US Central], the people who are working in that time zone, we can hardly meet each other." - SCC, DiskCo-J-1

Limited synchronous contact affects issues that involve people from both sides and demand quick attention. Like staff in Singapore needs help with the setup of an application. Or in the US people want to explain a new standard to their counterparts in Singapore. If these site-crossing dependencies and workflows originate in the US before Singapore's working day commences, people in the US must wait until their late afternoon. Conversely, the potential delay for Singapore is more severe. Issues surfacing there after the US sites close must be submitted asynchronously and wait until the next working day in the US. Real-time communications must even wait until US Pacific afternoon (Singapore morning).

> "Because US is few hours behind us - when I have a problem now, I write mail to them. Well, we can't call them: they will be sleeping, nobody will be answering the phone. So I'll have to write mail. And I need to wait for a few hours until they start working and until they start reading their mail. And when they read their mail, probably I'm sleeping. So that is why because of the time difference, we cannot really resolve problems in a shorter time. (...) When you work with US people, then because of the time difference you need days [emphasis] to solve the problem. It's some unnecessary delay." - OBT, DiskCo-C-1

Soon, a form of remote ping pong emerges to which Quain (1997) refers. The minimal opportunity for synchronous contact conflicts with the need for back and forth communications. This need is driven by contingencies like task dependence (Van de Ven et al., 1976), uncertainty (Galbraith, 1973), and diversity (Lawrence & Lorsch, 1967b). In traditional organization theory, these factors increase information processing needs, and lead to direct, interactive interpersonal contact. This is not really feasible when multiple time zones separate the actors involved. We explore in the following paragraphs the tension between communication needs and opportunities.

§ 9.2.9.3 Diversity, Novelty and Uncertainty (Far East - US sites)

At DiskCo, people in the US and Far East work in contexts that differ on an operational level. From both sides, insight lacks in how the counterpart context functions. This lack of mutual knowledge affects the way people communicate. They have difficulty framing questions intended for their counterpart. Similarly, answers from remote sites cannot be easily understood (Watzlawick et al., 1967). Diversity requires attention to building reciprocal insight so that counterpart's communicate behaviors can be interpreted and framed according to the context they originate from. From Malaysia, the project manager for data conversion told us:

"When you read their mails you find that they are very open and they are also very helpful when you ask them information. They share them freely with you. But you have to make sure that you ask them the right questions. Sometimes I find that if you do not ask the right questions, then they will come back to you with more questions. So you have to make sure you ask them all the questions together so that you don't waste time to read for them to come back with other questions again. I guess maybe one of the differences is because in terms of our DiskCo business in the US, they are more on the Research & Development side, whereas in the Far East here we are more in the manufacturing kind of business. So they may not fully understand our way of business, and we may not understand their environment there. So sometimes when we ask some questions, they may not be able to visualize what is the scenario that we are working on. So that could explain why sometimes we need to make sure we ask the right questions." - JNL, DiskCo-F-1

In DiskCo's case, US sites focus mainly on R&D. They simulate production runs to improve process technologies. Far East sites on the other hand produce daily thousands of products. This volume leads to very different issues. Operational diversity complicates mutual understanding between Singapore and US sites. It increases uncertainty and clarification cycles. In DiskCo's case, the driver for this need is the form of agency or assistance dependence that exists between the US and Singapore/ Malaysia. On top of that dependence, the system is very novel for everybody. And operations differ across sites. Hence, a mixture of dependence, uncertainty, and diversity emerges that exacerbates remote coordination needs (March & Simon, 1958).
As a consequence, people (e.g. in the US) must reply to a question (from e.g. Singapore) with more questions to understand the background of their counterpart's issues. This triggers more information that allows the person in the US to reframe the issue in his experience and provide an adequate answer. These back and forth loops are in collocated settings familiar and usually resolved through meetings and discussions. Yet time zone differences squeeze this process into a chain of asynchronous communication blurbs.

We use Table 30 to show how the need for an interactive discussion works out in an environment with minimal or no windows. Suppose that IT staff in Singapore comes up with a question on Monday. Since no one is available in the US, the send an email and go home. Next morning, US staff arrives in their US Pacific or Central office. They look at the question and do not understand exactly what the problem us. At that time, it is night in Singapore. So they will write an email back with more questions.

Singapore staff arrives Tuesday morning, to find only more questions to theirs. Most US staff however will be leaving the office at that time, triggering another loop of emails:

"If they (US counterparts - author) need any clarifications they will write back to us, because US and our time is different. By the time they receive my reply they are not in the office." - SCC, IT team member Singapore site A, DiskCo-J-1

When US staff understands and resolves the question with this new information, and reply so that Singapore staff can proceed Wednesday morning. As becomes apparent, this leads to substantial delays:

"Sometimes if the problem can be solved in a day it takes 2 days because it's in the middle of the night (Singapore time - author) and when they receive it's the next day

> for them, and then they send a mail back and again it's the next day." - GP, IT team member Singapore, DiskCo-D-1

If things are still not clear to staff in the US, they fire off more questions for clarification. The chain of email exchanges substitutes for local modes of coordination. Though the end result may be the same, time zone differences change the process. As a key user in Singapore site A remarks:

> "The final result - yes it's the same, but sometimes you have to go through 2 or 4 loops of email exchanges. I mean with email you have to clarify so many times. So that is a bit time consuming. But with the local user you can talk face-to-face, and understand their operation immediately. Especially with US, that is more difficult because the time is different. So it takes more time. We can send them one mail and it's the end of our day, they come back, it's still not clear, you have to wait for another day, for another reply. So that part is the difference if you compare with local." - JLL, DiskCo-G-1

Time zone differences thus lengthens problem solving especially for people collaborating remotely on ill-understood tasks. Several factors may underpin this novelty. People may be new to their job or the organization. Or their counterpart may work in a different context, like in DiskCo's case with US and Far East operations. This novelty triggers exchanges to build up mutual and thus common knowledge. Without that knowledge, (remote) communications are hardly feasible (Grant, 1996b; Watzlawick et al., 1967).

§ 9.2.9.4 Task Urgency (Far East - US sites)

Task urgency refers to the importance of a task in a work process. Urgent tasks define a project's critical path. Delaying them jeopardizes project cycle time (Lock, 1996; Turner, 1993). Our interest in urgency centers on tasks that require contributions from a remote counterpart. (Not those that require purely local inputs). Local critical paths thus become dependent on remote efforts. Here, we consider the role of time differences. In the case of DiskCo's Far East and US sites, these differences allow for a minimal window. Hardly an opportunity exists to connect real-time for contributions from remote counterparts. Says a key user from Singapore site A:

> "I can have a very high priority, but at the time when they are sleeping they won't answer me. It's not that they have to wait for my mail to come in 24 hours and immediately reply me. Same thing with me: when I'm not working, I'm not reading my mail." - JLL, DiskCo-G-1

A tension thus emerges between minimal windows and time-critical inputs from another site. Since people at remote sites cannot be expected to stay stand-by all the time, workflows are simply delayed. One member of the data conversion team in Malaysia also works with US staff. She explains the difficulty of connecting to experts in the US:

> "Yeah, it's all by email. Once a while by phone. Because of the time difference. So we usually use email instead of phone. Yes the time zone differences delay. Especially for urgent issues we have a lot of difficulty. (...) Sometimes we cannot get hold of them then we have to loose one day. (...) We have not a procedure for dealing with delays. But instead, if there is a really urgent issue, then we will contact them at home." - MC, DiskCo-E-1

Beyond a certain level of criticality, people swap from asynchronous messages towards connecting real time. Even when their counterpart is at home or perhaps on the road.
Another IT staff member from Singapore describes how he alternates between asynchronous messages and real time calls. He describes the delays caused by cross-site 'ping-pong-ing'. Depending on criticality, he adapts his own working patterns. For very critical tasks he stays late until US morning. This way, he can exchange emails with US staff to answer their questions and avoid the loops earlier described (see Table 30).

> "Sometimes if the problem can be solved in a day it takes 2 days because it's in the middle of the night and when they receive it, it's the next day for them. And then they send a mail back and again it's the next day. So it is based on the criticality. We used to stay back in the evenings and send a mail and usually they read it in the morning (US time - author). In the morning it is around 8-9 PM or somewhere around that on our time (Singapore - author), and they see it, we receive a reply, send a mail immediately and go. If the issue is not very critical then what I used to is just send a mail in the evening and then next day morning I just come and see." - GP, IT team member Singapore, DiskCo-D-1

This person stretched his working hours to deal with minimal windows, instead of contacting people at home. We focus on these and other forms of adaptation to time differences in the next section.

§ 9.2.9.5 Adapting to Time Zone Differences (Far East - US Sites)

DiskCo interviewees adapted to the minimal windows between Far East and US sites. They found ways to deal with different working hours. First, by choosing particular media, and modifying the way these are used. A second, more far reaching mode is to adapt working hours. We discuss both strategies.

First, people rely strongly on asynchronous media like email. This medium is convenient to use and allows for attaching documents. On the other hand, it is asynchronous and lean, thus less convenient for extensive communication needs (Daft & Macintosh, 1981). An IT team member from Singapore site A emphasizes the fact that email is a next best solution when time zones are involved. Without time differences, phone calls would be preferred to expedite cycle times.

> "The main tools we are using is email to communicate with the US. We hardly ring them because of the time difference. If let's say other sites like China, Malaysia normally we will try to call them instead of writing an email. It's faster that way in the sense that you are able to reach them." - SCC, DiskCo-J-1

She also indicates how email is used. Email is not only asynchronous but also lean. That element necessitates the sender to pay more-than-average attention to the clarity of his/ her message.

> "Email is the main communication with other sites, especially for those sites that have time differences. We just need to state very clearly the urgency of the project and the date by which we need it." - SCC, DiskCo-J-1

Time differences force people to use email for communications that would normally rely on interactive, rich exchanges. This appears feasible but at a price. People must stretch this medium's capability. They become more explicit and structured in their messages. An IT member from Singapore site A describes the way he uses email for connecting with US sites. He is responsible for helping colleagues in China when they face a problem that cannot be solved locally.

> "Time zone may be different, so there is always a delay in getting answers. With China we do not have much of a problem, but between US and Singapore we do. Sometimes when they (colleagues from China) ask me a question I may not be able to answer them, I have to forward it to the US. By the time they give me a reply, it's already night there, it's day here. He may not understand my question properly. So he may not give the right answer. He may just come up with: "Please elaborate more," or: "Give me please one day since I have to go back." (...) So I have to be very very careful in my approaches. I try to put up my question in point forms. When you look at points, people tend to answer to each. But if you put it in a paragraph, it's very difficult for people to answer the question. Because he may miss out the question in between the lines. So I think the best communication is: put in point forms. When people reply, they will answer the point forms. They will put answers to each point form." - JPL, DiskCo-I-1

This person pre-formats and structures messages extensively to minimizes uncertainty for his counterpart. He anticipates possible questions and thus circumvents superfluous email loops to clarify issues, or elaborate.

An alternative is using email to arrange for real-time calls. The project manager for data conversion in Malaysia mentions that under special circumstances she chooses this option:

> "For US for urgent cases, normally what I will do is I will send them a mail to make an appointment with them to have a teleconference so that the next day when we come in early in the morning we are able to catch them in the US." - JNL, DiskCo-F-1

Second, people adapt their working hours. They come earlier and/ or stay later than normal local working days. Or they sacrifice private time (evening, weekend) to reach remote colleagues.
A key user from Singapore site A works with US sites for a project related to Oracle ERP. Seeking to avoid email loops, she mentions how her working hours have changed:

> "(...) I have to communicate a lot with the US site. So now my working time has slightly changed. After work I start work again at 10 PM to 2 AM. I have to do that because I get a lot faster response by just writing mail at my 12 o'clock (Singapore night - author) and they receive it at 8 o'clock (US morning - author). They reply me and let's say I need clarification, I can immediately write back. I can even call them at the time when they are working. I can get faster reply." - JLL, DiskCo-G-1

Singaporeans were pressed to finish tasks quickly. So they decided to create artificial windows with US sites. They worked for instance Saturdays when it was still Friday in the US (see Table 30, Table 31).
US counterparts also accommodated at critical times. They allowed Singaporeans to call them at home during Singapore working days.

> “We have to adjust ourselves sometimes. Sometimes we even come back on a Saturday morning. Because our Saturday morning is their Friday afternoon actually. And if we don’t solve it on Saturday that means we can’t solve it on Monday because Monday is their Sunday. Then we only get an answer on Tuesday. But sometimes people are kind enough: when they hear there is a problem to be solved, they give us their home number. And during our live implementation, they are on stand-by, we have their home number to call. They are also stand-by on email and so. So they understand there is a job to be done. So we sign them in during the dates and so on. So everybody is on stand-by.” - JPL, DiskCo-I-1

Similar experiences are shared by the Director Applications Development, Singapore site A. For the regular teleconferences with US sites, she called from home or came in very early:

> “As compared to US of course we have more problems there, because it’s in a different time zone. So the communication is not as easy (as in the Far East region - author), it’s not really a phone call away in that sense. Because when I call them they are sleeping. And then when they want to have a conference meeting, it’s always we have to either come very early to the office so that they are in the evening time, or very often we have to have conference call from home. So that the call is in their day time. So that can be a bit of inconvenience(…). I would say the first year (of the Oracle ERP project - author), we were having conference call every weeks. And this could take hours.” - HHT, DiskCo-B-1

An IT staff member in Singapore site A explains the two options people have there to create artificial windows with US sites.

> “We have to go back late, or come in early. Because about 10 or 11 o'clock evening here is about 7 o'clock AM in the US maybe around there. So either you may have the habit of coming early in the next morning (Artificial window 2 - author), or you stay late through the night (Artificial window 1 - author).
> (Artificial window 1 - author) But staying late through the night is not a good suggestion because when they come in early they are fresh, they may do not want start on your issue. You need to understand their culture - they first want a cup of coffee, they do not want to do their work that early.
> (Artificial window 2 - author) So it's better you come early in the morning (Singapore time - author), maybe about 6 or 7 o'clock to solve the problem while it's 4 or 5 PM there. So you have given them the time to look at the problem. And this is important for them to understand the problem. Then they get back to you. This is much more fruitful rather than to interrupt them early in the morning. Their early morning is our midnight, you say "Hey I stayed back in the office, can you solve this” - it's quite difficult.” - JPL, DiskCo-I-1

In Table 31, the bold dotted boxes show the two artificial windows between Singapore and US sites. The solid lines indicate working days for the respective sites.

Table 31 - Artificial windows DiskCo sites Singapore and US

	UTC +8	UTC +9	UTC +10	UTC +11	UTC+/-12	UTC -11	UTC -10	UTC -9	UTC -8	UTC -7	UTC -6	
	Singapore								US Pacific		US Central	
	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	
Artificial Window #1	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	Artificial Window #1
	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	
	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	
	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	
	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	
	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	
	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	
Artificial Window #2	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	Artificial Window #2
	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	
	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	
	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	
	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	
	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	
	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	

Daylight Saving Time (DST) not applied

§ 9.2.9.6 Real-time Contact across multiple site and continents

For a global project like DiskCo's Oracle ERP implementation, synchronous communications across multiple sites and continents is sometimes necessary. In the early stages of the project, many questions and issues had to be resolved that involved sites in Europe, US and Far East. This required special arrangements as the Director Applications Development explains:

> We used the AT&T conference facility. We just called in through AT&T. They have to make some bookings, it's not the normal lease line. We call through the lease line, but we don't call to the US office directly. Because there are so many parties involved. Even in the US itself there are 3 main groups (…). Then in the Far East normally it's Singapore, and Thailand, and then Europe would be group in The Netherlands. So it's like at least 6 parties involved. And then of course you involve more than 20 people. In my case, most of the time, we either call in through our office, then mostly we will gather in CPW's (VP Information Technologies, Singapore site A - author) room. Because CPW's room has conference facility to call in. And then if I call from home that will be only myself, I just dial my normal phone. So we were given a phone, they told us what number to call and which PIN number to use." - HHT, DiskCo-B-1

Initially, people tried to split up the parties in two conferences: US - Far East, and US - Europe. Since many issues had a global impact, they changed to a single real-time global conference (US, Europe, Far East). Consequently, some adaptation was required to enable this window:

> "Initially we started with 2 different conference days: US with Far East one, and US with The Netherlands which is for Europe one. Because it's very hard to schedule. The time we normally did was early our morning which is late US time, and then they have another time for Europe. Then later on, we find it's not as efficient as we wanted to. We preferred to have one conference. So later we turned to our night. So our late night which is US early morning and in Europe it is in the afternoon. So that's the time when we had 3 groups at the same conference at the same time." - HHT, DiskCo-B-1

§ 9.2.10 Diversity: Culture, Language and Operations[50]

People from many different countries and sites worked together on DiskCo's Oracle implementation. Table 23 shows locations relevant to this study on the Far East region. In this section we explore some issues pertaining to the role of diversity in distributed work settings. People become dependent on counterparts with different cultural, experiential and lingual backgrounds. We explore these dimensions of diversity, and assess how they impact the way people handle remote collaborative relationships. The section starts with Singapore, China, and Malaysia, and continues with a brief exposé on some other cultures playing a role in the Oracle project..

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[50] This section reflects interviewees' perspective on cultural diversity in the Oracle project. It may contain very subjective views that generalize and stereotype categories, groups or individuals. These are described here for research purposes only, and are not endorsed by the author in any way. It should be noted that the author is Dutch and brings a North-Western European perspective to this research.

§ 9.2.10.1 Singapore, China, and Malaysia

> "For China I must speak to them in Mandarin" - ST, DiskCo-H-1

Within the Far East region, people from Singapore and China experienced little cultural diversity. Emigrants from China moved to Singapore in the 20th century, bringing their customs and language with them. As China has been opening up to business with other countries, these emigrants' children and grand children connect with people who have stayed in China. In the case of DiskCo, representatives from Singapore site A have the advantage of knowing their counterparts in China. They have helped built up local IT, and developed relationships with people they encounter again in the Oracle project:

> "I don't face this problem (cultural diversity of people from different sites - author). Because even before this project, I knew all these people. I have already some working relationships with them before. For China I feel that way. Maybe when you ask me to go to Germany I will feel some cultural difference. But most of the culture here in Singapore is very similar to China, because our grandfathers are all from China. So we do know some of their likes and don't likes. So this won't be a problem." - JPL, DiskCo-I-1

In Singapore, many Chinese communities have maintained proficiency in Mandarin. When collaborating with mainland Chinese, Singaporean professionals can therefore easily fall back on that language. They do not suffer from some of the Chinese who do not have a strong grasp of the English language. A DiskCo professional comments:

> "I speak Mandarin so I have no problem in communicating with people from China. Because even if they don't speak English I can understand what they are talking about. So Malaysia itself is not a problem because they just speak English." - JLL, DiskCo-G-1

With people in Malaysia, English is usually the language of choice for Singaporeans. On top of that, some people from Malaysia site A know Mandarin because of their Chinese background or otherwise. This offers an additional common knowledge base if need be (Grant, 1996b):

> "When we say remote sites, we consider other countries. Because within Singapore we don't really feel the difference. So for us to work with Malaysia site A, we don't really have a problem. Because language wise, they can speak English, they can speak Mandarin. So we can use either one of the languages. So we don't have this communication problem." - OBT, DiskCo-C-1

Even though many of the Singaporean DiskCo speak Mandarin, the VP Information Technologies stresses the importance of English. In an international (American) firm like DiskCo, English is used as a common language. People simply need proficiency in this area to understand corporate documentation and participate in distributed communities. For this reason, proficiency in English is an entry requirement for new Chinese staff. (Jarvenpaa and Leidner (1998) found a similar situation in their research on international student teams.) The VP points out that when he was involved in setting up Chinese plants, he selected people meeting this standard:

> "Now as far as language is concerned, when we first set up the China plant we really made it very clear anybody we cope with must know English written and spoken. So language wise it is not a big issue in that area." - CPW, DiskCo-A-3

From Malaysia site A, the project manager data conversion echoes this view. According to her, command of the English language is a basic skill people need when participating in an international project. Usually, communications are in English in these environments. If people did not really master that language, others would misinterpret their communications, and vice versa.

> "I think in relation to emails, the person at least have a good basic knowledge of English if English is the language that was used. Because sometimes if you don't conform your ideas or your questions in a correct manner, people may misinterpret it. So I think there is some skill required there." - JNL, DiskCo-F-1

Actual experiences with Chinese colleagues differ somewhat. One interviewee from Malaysia mentioned little problems when dealing with IT staff in China: "Chinese is not much of a problem. We are very fortunate that our IT staff their English is not bad." (MC). Other interviewees held a different perception. JPL from Singapore site A prefers to use Mandarin with them. He indicates that his Chinese counterparts are reluctant to use English, especially with oral communications. So he interacts with them in Mandarin on the phone and when visiting their site. English is used for email exchanges.

> "We have phone, and we use email. And sometimes we also use Microsoft NetMeeting if you want to show them some screens. Most of the time we communicate in Mandarin. Because these people are quite shy to use English. Except for email. Because I myself I do speak Chinese, so there is no problem. So most of the time we communicate in Mandarin. In fact when I'm over there, we use Chinese when we communicate amongst ourselves." - JPL, DiskCo-I-1

From the Malaysian data conversion group, JNL comments that she experienced difficulty understanding IT staff members from China. This seems to concern also oral communications:

> "There were no special issues that were unique to them. So I can't recall them. The only problem was really on the communication side. It's a bit difficult for me to understand what they are trying to say. (...) Their use of the English language is slightly different." - JPL, DiskCo-F-1

With her Chinese background, SCC points out that she prefers Mandarin instead of English when dealing with Chinese counterparts: "China people … because the people we deal with can't write very good English it's easier to talk to them. I speak Mandarin" (SCC).

Some members of the Singaporean IT group did not have a Chinese background. They could not speak or write Mandarin, like GP. In his case, oral interacting in English with Chinese counterparts was further complicated by his strong Indian accent. To work around this, he exchanged mainly emails. The textual format of this medium transmits a sender's point explicitly, independent of verbal cues and accents.

> "Most of the times I used emails, but a couple of times I used phone also. I use email because I cannot understand Chinese, their local language. So I found that when I write emails it's very clear to them. (...) I would say that talking directly to them, communication by phone is not very much, maybe 20-30% of the total communication." - GP, DiskCo-D-1

Colleagues from GP confirmed his communication challenge with Chinese IT personnel (DiskCo-J-1). OBT explained that their colleagues in China are more comfortable using Mandarin. Since she and most of her colleagues share fluency in Mandarin, they have in a sense a backup protocol. GP does not have that luxury:

> "China people they are more fluent in using Mandarin. So if you want to explain something to them in English, you find a little bit of difficulties. Because we can speak Mandarin, somehow we can overcome that. But for example GP, one of our team members, he's an Indian, so he can't speak Chinese. He can only use English. So China people they are not so fluent in English. So they may find some difficulties in understanding each other." - OBT, DiskCo-C-1

§ 9.2.10.2 Other Cultures and Operational Diversity

The core sites in Singapore and Malaysia maintained frequent contact with US counterparts. In DiskCo's organization setup, new Information Technologies and procedures were commonly first introduced in the US. From there they spread out to the Far East region and Europe. This led to multiple communities around functional areas, consisting of people knowing colleagues with a similar role in another DiskCo location. For the Far East, key users and IT personnel had been exposed to cross cultural contacts. Often they had visited the US to work directly with their counterparts. In addition, DiskCo sent American expatriate executives around the world (Edström & Galbraith, 1977). This practice not only builds their international experience. It also familiarizes local temporary subordinates to Americans and their culture. All this greatly reduced the impact of cultural diversity in the Oracle project as JNL from Malaysia reports:

> "I think we do not have a problem (with cross cultural collaboration - author) because we are quite open to communication with people from the US. So when we take on this project, it's something that we are already familiar with. (...) On and off we work with them, sometimes we check back with the US on certain issues. And I have worked under some US directors before. So I guess that gives me some experience." - JNL, DiskCo-F-1

HHT from Singapore site A brings another perspective. Through her extensive experience with US counterparts, she has observed considerable differences between American and Singaporean or Asian culture. People have different ways of working and thinking that impact how they relate. An additional issue between US and Singaporean sites was that their operations not the same. Singapore specializes in high volume manufacturing, while US sites do mainly product development. Americans were often not aware of Singapore's local situation, and assumed that worked in the US should work there too. Together, cultural and operational diversity added to strain in the relationship between sites in the US and Singapore (Hinds & Bailey, 2000). Multiple communication loops were needed to clarify and resolve dissimilarities, see also § 9.2.4.3 (Lawrence & Lorsch, 1967b).

For the first time, Singapore site A worked with a Japanese DiskCo location. So far that site had been supported directly from the US. But for the Oracle project, expertise available in Singapore was to be deployed there. In an interview, CPW explained that the Japanese have a very unique culture. They are used to quite formal, polite interactions. His challenge was to initiate - despite these differences - IT and key user communities between Singapore and Japan. The strategy he pursued consisted initially mainly of face-to-face visits. Japanese IT representatives were invited to Singapore for training and to get to know local IT there. Then, Singapore IT staff from the core team went over to Japan. They met not only their IT counterparts but also users. Subsequently, contact lists were elaborated and people started to contact each other electronically. CPW emphasized the gradual build-up of these new relationships, and the role of face-to-face contact. Reciprocal immersion in each other's context seemed indispensable for enhancing mutual awareness and building cross-cultural rapport (Meadows, 1996b).

> "You have to deal with them differently, very politely (...). So we have training (in Singapore - author). Then when we come back here there is some training that needs to be done locally (in Japan - author). So the key user will be sent over (Singapore key user to Japan - author). Again this time we come over not only to know our IT people better, but also introduce them to the key users, who will be going there to help them during the first week of the conversion. So that is how we can slowly establish a relationship." - CPW, DiskCo-A-5

Singaporeans working with Japanese counterparts noticed that their oral command of English was not very strong. This time, however, they did not have a fall back option, like Mandarin for the Chinese colleagues. They reverted to textual exchanges to obviate this problem. Written English was a skill most Japanese mastered sufficiently to make themselves clear and understand others' messages.

> "We worked for the first time with Japan. In Japan they can speak English, but when you come to oral communication, you find some difficulties. But if you use email, there is no problem. Their return in English is OK. So if you can't understand you read it and then you can understand. But through oral communication it's a bit difficult. So you need more time." - OBT, DiskCo-C-1

Finally, some members of the Singapore site A core team worked with SysCo vendor staff from India. SysCo assisted DiskCo with Oracle programming tasks. Remote oral exchanges suffered from noisy lines and the fact that the Indians' use of English appeared challenging to understand for Singaporeans. As it seems, remote connections and voice communication technology must be in good shape to deal with different dialects or modes of utilizing English.

> "Because they are in India, whenever I call them up through phone it's very noise. And their English is also very difficult to understand. It's very difficult to work with those people." - SCC, DiskCo-J-1

The DiskCo case is concluded and cross-analyzed with the CarCo case in Chapter 11 .

Chapter 10 CarCo Case: Offshore-Outsourced IS Development Project[51]

In the CarCo case, we describes and analyze an IS development project that involved CarCo and a vendor firm (SoftHouse). The study traces subsequent phases in the development process. With our research framework as a point of departure, we analyze the project's evolutionary process. Next, a thematic analysis elaborates on tensions and adaptations. The next part contains a more positivist-oriented analysis that frames this case study and the DiskCo case.

§ 10.1 Description

The CarCo case Goldd project is described here along several lines. We start with companies, actors and sites involved in the project. Then, time zone differences are explained for project locations in India, Germany and US. We lay out the project time line, including planned and realized milestones. The situation before Goldd is sketched, and we outline key dimensions of the project's setup.

§ 10.1.1 Companies, People and Sites

CarCo is the focal organization in this case study. The company is a US manufacturer of cars and trucks with global presence. This study zooms in on CarCo marketing units in Europe (Cologne, Germany) and the US (Detroit, MI) that were in need of a new dealer information system. They were assisted by CarCo's Marketing & Sales System (M&SS) group, also located in Cologne and Detroit. For this new system, a project was started called Goldd (Global On-Line Dealer Database). Table 32 shows the key players in this project. Names are represented by 2 or 3 letter combinations to maintain confidentiality. AC stands for Ms Amanda Cijntje.

[51] The author gratefully acknowledges cooperation from CarCo, and Amanda Cijntje. Research executed by Amanda Cijntje has greatly contributed to the case study, including interviews, weekly logs, CarCo documentation, and her thesis. All names in this case study have been disguised to maintain confidentiality. The case study is intended for generating knowledge on distributed work, rather than to illustrate either effective or ineffective handling of an administrative situation.

Table 32 - Companies, sites and actors involved in CarCo case

Company	Unit & Site	People & Role
CarCo	Marketing & Sales System, Project Team Cologne, Germany	HH, Project Leader
		HN, Senior Analyst
		MB, Data modeling
		AC, Project Administrator and co-researcher
	Marketing Europe, Cologne, Germany	Users Marketing
	Marketing & Sales System, Project Team Detroit, USA	ST, Initial senior analyst, team leader
		JF, Replacing senior analyst, team leader
		BM, Data modeling
		Other team members: CS, CK, DM, CP, LF, SK
	Marketing USA, Detroit, USA	Users USA
SoftHouse	Site UK	Management
		BW, Initial independent consultant, onshore liaison, Cologne, Germany
		BJ, Replacing independent consultant, onshore liaison, Cologne, Germany
	Site India, Project Team Bangalore, India	NK, Independent consultant, offshore liaison India
		SA, Executive
		SM, Offshore Project Manager (before him RG)
		SPB, Offshore senior team member, later also onshore liaison
		MD, Offshore senior team member, later also onshore liaison
		Team leaders (e.g. VA)
		Team members

The M&SS group outsourced parts of the project to a company referred to as SoftHouse, a US firm. SoftHouse has a branch office in the UK, and its main programming resources in Bangalore, India. CarCo's German M&SS group worked with SoftHouse's UK branch which delegated the project work to its site in India. It also hired independent consultants from the UK to link the team in India to CarCo's US and German sites. Initially, one consultant was stationed in India (NK in Table 4) and one in Cologne, Germany (BW). NK left the project in its early stage without replacement. BW also left the project. His role was divided between a new consultant (BJ in Table 4, also English), and Indian team members (SPB and MD).

§ 10.1.2 Time Zones and Windows

CarCo and SoftHouse sites span three continents and a large number of time zones. Table 33 uses the format for showing time zones that was introduced in the Theory Section. Horizontally, the same moment in different zones is shown. The columns depict time zones as compared to UTC. CarCo's USA site in Detroit is located in Eastern Standard Time, UTC -5. CarCo Cologne Germany is located in UTC +1. SoftHouse UK is UTC, their Indian site is located in UTC +5.5.[52]

[52] Although the site in India is UTC +5.5, we use UTC +5 for practical reasons.

Table 33 - Time zones and windows CarCo sites

≺ Direction in which day & night proceed ≺

UTC -5	UTC -4	UTC -3	UTC -2	UTC -1	UTC 0	UTC +1	UTC +2	UTC +3	UTC +4	UTC +5
CarCo USA					SoftHouse UK	CarCo Germany				SoftHouse India
20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00
21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00
22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00
0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00
1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00
4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00
5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00
6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00
7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00
8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00
10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00
16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00
17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00
18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00
19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00

Daylight Saving Time (DST) not applied

The bold dotted lines show windows for synchronous collaboration across the sites. (UK site is not included since it was not operationally involved in the project.) We assume a somewhat extended working day from 8:00 o'clock in the morning until 19:00 (7 PM) in the evening.

This results in the following windows:

- USA site - Germany site: from 8:00/ 14:00 until 13:00/ 19:00, i.e. 5 hours
- Germany site - India site: from 8:00/ 12:00 until 15:00/ 19:00, i.e. 7 hours
- USA site - India site: from 8:00/ 18:00 until 9:00/ 19:00, i.e. 1 hour
- Triple sites (USA, Germany, India): 8:00/ 14:00/ 18:00 until 9:00/ 15:00/ 19:00, i.e. 1 hour

§ 10.1.3 Project Timeline

The need for a new dealer information system arouse in CarCo's US marketing group in 1994. They were still using a system from the 1970s that did not longer meet business needs in the 1990s and beyond. Following a strategy of globalization, CarCo decided to setup an international project. European sites became involved although they used a different, more advanced system.

1994 and 1995 were used to define the project. In Spring 1995, the project was approved and received a budget of US$ 1.8M. Around winter 1995 CarCo M&SS staff developed an initial data model. Table 34 summarizes events in separate columns for CarCo and SoftHouse.

Table 34 - Timeline CarCo Goldd project

Date	CarCo	SoftHouse
1994 Summer	▪ USA urgent need for new dealer information system	
1994 Fall		
1994 Winter	▪ Feasibility study for global system	
1995 Spring	▪ Project approval, budget allocation	
1995 Summer		
1995 Fall	▪ Data modeling	
1995 Winter	▪ Decision for offshore development	▪ Vendors invited to bid. SoftHouse involves independent consultants BW and NK
1996 Spring	▪ Development of first PC-based prototype ▪ European workshop to introduce project ▪ HH and HN to USA for feedback workshop - called 'Model Office 1' - on PC-based prototype, with IT staff and users. ▪ Acceptance of SoftHouse bid, development contract signed	▪ BW and NK collaborate with CarCo IT staff and users
1996 Summer		▪ Start programming in India. ▪ NK stationed for only a few weeks in India to liaise offshore with BW onshore in Germany.
1996 Fall	▪ CarCo dissatisfied with deliveries ▪ CarCo Germany warns SoftHouse, escalates conflict, pressures BW and SoftHouse UK.	▪ Initial deliveries little progress from original prototype. ▪ Subsequent deliveries were often late, buggy, not according to expectations.
1996 Winter	▪ Model Office 2 in USA with HH, BW and SPB. Twice delayed because of late deliveries.	▪ CarCo change requests not relayed to India by BW.
1997 Spring	▪ Scheduled final delivery for end of January was not accomplished. ▪ CarCo discovers change requests have not been relayed to India by BW. ▪ Need to redo requirements analysis for Sales and P&A codes functionality. ▪ Model Office 3 skipped because of delays	▪ BJ joins project and replaces BW after a couple of weeks ▪ SPB visits German site for assisting in technical issues. Upon returning replaced by MD.
1997 Summer	▪ Core system deliveries and launch scheduled, delayed for Fall 1997.	
1997 Fall	▪ Expected system launch in USA	
1998 Year	▪ Expected system launch in Europe	
1999 Year	▪ Expected system launch in Europe	
2000 Year	▪ Expected global roll out	

In Winter 1995, CarCo decided to outsource major parts of the Goldd project. After a bidding period, they selected SoftHouse in 1996. A PC-based mock up version of the eventual system was developed in Germany and presented to users in Europe and the US during a Model Office session. These sessions bring users and M&SS professionals together to present the current version of the system and receive feedback. Liaisons (independent consultants BW and NK) worked 6 months with CarCo M&SS professionals and users before offshore development was started. They were expected to channel and bridge collaboration between CarCo and SoftHouse staff in India. NK left in summer 1996, leaving BW to liaise from his German site with staff in India.

In Fall and Winter 1996, the project started to escalate. Staff in India indicated lack of insight in CarCo requirements. BW was challenged by the task of connecting on his own the CarCo and SoftHouse project communities. Numerous change requests was CarCo M&SS and users were not passed on to the team in India. Deadlines were missed and deliveries did not satisfy CarCo. Around Christmas 1997, a second Model Office was scheduled in the US with users, CarCo M&SS staff (USA and Germany), and SoftHouse representatives from India.

Early 1997, BW was replaced by BJ. In addition, two members from the India team (SPB and MD) were alternatingly stationed in Germany. They assisted BW in liaising with the team in India. This new setup improved offshore collaboration. The third Model Office was skipped because of the delays in deliveries. The Goldd core system was therefore launched without further user consultation in the USA in Fall 1997. The project plan was to improve the system, and roll it out across CarCo's global sites in the period 1997-2000.

§ 10.1.4 Situation before the Project

In the early 1990s, new collaborative technologies were widely adopted in organizations. People could email, teleconference and videoconference across corporate units in different countries and continents. They could also do that with other firms, leading to the first offshore outsourcing attempts (Kotabe, 1992; Krepchin, 1993). With new opportunities for remote collaboration, multinational firms became aware that many of their local processes were quite similar yet independently organized. They realized that a more global approach could yield distinct advantages. It would make the company more flexible, cost efficient and integrated (Manheim, 1993). Common business processes and technology avoid redundancy in a multi site environment. While in the past each location or region was self-sufficient, many services could now be consolidated and concentrated. Sites could focus on a particular area, and contribute from their strength. On a network level, they tap into a distributed network of interconnected centers of excellence (Chiesa, 1995). For multinational firms, this implied a considerable shift with strategic, organizational, and operational implications (Marschan, 1996).

This novel strategy applied to CarCo as well. Early 1990s, the company developed a global car, and started to consolidate North American and European operations. It intends to create a single global organization and management team by 2000. A strategic initiative was launched to implement this vision. According to their web site:

"[The initiative] has allowed the company to eliminate duplication, initiate best practices, use common components and designs for the advantage of scale, and allocate resources to wherever they are needed to best serve market needs. [The initiative] combines the power, resources, and reach of a world company with the immediacy, the intimacy, the agility, and the spirit of a small one. This was accomplished with the creation of five vehicle centers." - CarCo web site[53]

The initiative was implemented by means of about 20 'Global Strategic Projects'. In different areas, management identified opportunities for commonality, globalization and cost reduction. One example was the Marketing & Sales System (M&SS) group with main offices in Detroit and Cologne (Germany) for North America and Europe respectively. M&SS develops, implements and maintains information systems for CarCo's marketing and sales organization. This user group is connected to CarCo dealers that sell the various brands to end customers. Within the CarCo organization, they work with units related to car sales, like manufacturing and finance.

Early 1990s, M&SS operated different systems in North America and Europe. In North America (US, Canada, Mexico), a system called Centralized Dealer Database (CDDB) and Customer Information System (CIS) were used as a central source for dealership information. These were text-only, mainframe systems from the 1970s. They did not support current business processes in an adequate manner, and were no longer supported by their supplier. Replacement therefore became an urgent issue. In Europe, M&SS had implemented a somewhat more advanced system called Dealer Information Database (DID). But besides this system, national sales companies in Europe worked with their own IS and local files. In his presentation, HH mentions ironically:

"World-wide there are only 674 ways to define information about dealerships whom we authorize to sell our products to retail-customers" - HH, CarCo-A-4

From a global point of view, CarCo thus operated different information infrastructures that were in part outdated. This proliferation resulted in data redundancy that made little sense from a business point of view. in data redundancy that made little sense from a business point of view:

"Looking world-wide [the] list can be extended easily to 500-1000 files, holding redundantly the same information, but formatted slightly different and adapted to some local, individual requirements." - HH, CarCo-A-4

Diversity of information formatting becomes a problem when other units - like manufacturing - need aggregated data for their own processes. At CarCo, this led to extensive remote communications to ensure data consistency:

"This situation leads to a substantial administrational overhead as different areas are pursuing the similar processes and are communicating via phone, paper or e-mail in order to ensure the consistency and accuracy of these processes or to manage exceptional drawbacks in this process. A typical deficiency of this situation is that vehicles cannot be scheduled, build or delivered, due to some incomplete or

[53] Web address omitted for reasons of confidentiality.

inconsistent information and quite a number of people have to undertake exceptional investigations to resolve the problem." - HH, CarCo-A-4

In 1994, the M&SS group suspected that many local business processes were quite similar. This marked the start of the project studied here. A team was setup to explore the level of commonality in North America and Europe. They assessed the feasibility of a single global dealer information system, called Goldd - Global Dealer Online Information Database. Confirmatory results from this team's study led to the formation of the Goldd development team in the second quarter of 1995:

"A high level of commonalities of business processes in Europe and North America regarding dealer information encouraged the idea to approach to a common Global Dealer Online Information Database Goldd. The feasibility was reconfirmed by detailed investigations and beginning 2Q1995 a global team was formed to start system development. The guideline is: if we can manage to commonize European and North American requirements we will have prepared the foundation to implement Goldd in all [CarCo] locations world-wide." - HH, CarCo-A-4

The Goldd project transformed the urgent replacement need from CarCo North America into a global project with the objective "To develop and launch a common global repository for dealer information and to reduce costs by eliminating redundant sources of dealer information" (AC, CarCo-K-2) . The project leader formulated three 'Key Business Objectives' in one of his presentations (HH, CarCo-A-4):

- Support the management of our world-wide distribution network
- Implement a reliable, centralized warehouse for dealer information
- Concentrate development resources for a single global application

In the next section we discuss main features of the proposed system and how the project was setup.

§ 10.1.5 Project Setup

In the early 1990s, companies in North America and Europe were very short of qualified, affordable IT personnel. Labor markets there could not supply adequately because of the year 2000 problem and implementation of integrated business applications like ERP (Kay, 1998). Consequently, other regions with ample supply became interesting partners for software development, upgrade and maintenance tasks. Examples of such geographical areas include Eastern Europe, the former Soviet Union, India, and countries in the Far East like China and the Philippines. For the first time, offshore outsourcing to these areas became a large scale phenomenon (Ravichandran & Ahmed, 1993). The Goldd project is an example of an outsourcing relationship between CarCo (with project sites in the Detroit, US and Cologne, Germany), and SoftHouse (with locations in the UK and India). In this section, we explore the setup of this offshore project in three stages. First, we discuss the outsourcing relationship between the two companies. Second, we zoom in on the organizational setup of the project, both on a site and meta-site level. Third, we describe project phases and the development process. An assessment is made of work division and dependencies. Finally, technology used in the project is discussed. This concerns the Goldd system, and tools used for system development.

§ 10.1.5.1 Outsourcing Relationship

Late 1995, CarCo invited vendors to bid for the project. Having obtained project approval, project teams from M&SS North America and Germany were formed. They started to work on data modeling and a PC-based prototype. Among the vendors was SoftHouse, a major US-based IT vendor. SoftHouse runs offices across the world to connect to local clients, and channel projects to its programming base in Bangalore, India. The UK office coordinated their bidding process. They hired two independent IT consultants - BW and NK - to estimate the project work and for CarCo costs. The consultants' bid document was accepted and led to a contract between SoftHouse UK and CarCo. The document described the functional requirements, GUI standards, and deliverables for both parties. It specified project activities like planning, reporting, testing and change management. Payments were tied to milestone deliverables that had to be accepted according to certain quality criteria.

SoftHouse UK subcontracted the Goldd project to operations in India. Among the factors that contributed to this decision were ISO certification and a record of successful projects. SoftHouse convinced CarCo that it worked with an elaborate set of quality control mechanisms. Apart from that, offshore outsourcing was cost efficient in the 1990s because of the huge IT work force in India (Ravichandran & Ahmed, 1993).

In his presentation, the CarCo project leader mentioned that "The offshore supplier is committed to a fix price budget and timing for each development phase. A 15% portion of the budget is reserved for unexpected complexity or additional requirements" (HH, CarCo-A-4). Probably to win the contract, SoftHouse UK formalized financial and temporal obligations from the outset, with some possibility of escape for work that fell outside scope of the contract. HH mentions in an interview that they would assess whether unexpected work would fit in the original contract framework. If not, CarCo would arrange for additional funding:

> "The contract had certain criteria in it like a 15% flex that would cover any work that we couldn't foresee. And we had a mechanism of change requests. When something turned up that we would not have estimated, we would see whether it fits within the original contractual scope or not. And if it didn't then we would try to find extra funding for that. We did that on two occasions." - HH, CarCo-A-3

Interviewees mentioned that the complexity of the project was underestimated. Requirements were not known in detail - not even by CarCo M&SS - when the contract was signed (CarCo-G-1). Hence, specifications of the system lacked detail and realism, leading to an incomplete contract situation (Hart, 1991). To handle this uncertainty, parties adopted a prototyping methodology to develop the new system stage-wise through interactions between CarCo users and CarCo/ SoftHouse IT staff.

A contradictory outsourcing situation appeared to emerge. Drawing on Transaction Costs Economics, contracts can be distinguished in classical, neo-classical and relational (see also theory section) (Ben-Porath, 1980; Macneil, 1978; Williamson, 1979). Parties commonly strive for a match between one of these contract forms and the uncertainty of the work undertaken under the contract (Table 35). With classical contracts, precise definition of reciprocal obligations suffices to govern the exchange. This transparency is reflected in MacNeil's (1974: 738) quote: "Sharp in by clear by agreement; sharp out by clear performance". Neo-classical contracts allow parties to handle a certain level of uncertainty since they can fall back on some form of relationship (Williamson, 1991). With relational contracts, reciprocal performances can remain ill-specified since parties know each other and may have a sustainable interest in future exchanges (Ben-Porath, 1980; Kumar & van Dissel, 1996).

Table 35 - Contract modes and work uncertainty

		Classical contracts	Neo-classical contracts	Relational contracts
Uncertainty of contracted work	Low (Anticipation)	Transparency: "Sharp in by clear by agreement; sharp out by clear performance" (Macneil, 1974: 738)		
	Medium		Combination of semi-structuring and relationship for making adjustments	
	High (Reality)			Adjustive contracts that rely on parties' identity and relationship (Ben-Porath, 1980).

The outsourcing contract between CarCo and SoftHouse seems a hybrid arrangement. The contract pins down some key performance criteria (budget, planning). This was probably based on the inappropriate assessment of the contractual situation. Parties assumed low-uncertainty, leading to a classical contract situation. But in reality, the project was more uncertain and complex (see cells for low and high uncertainty in Table 35). This suggests a relational contract mode. This mismatch not only affected the contract mode adopted here. It also led to a project organization setup that was not equipped to handle extensive communication and knowledge transfer needs. We elaborate on these themes in part in the following description sections. A more in-depth investigation follows in the interpretive analysis section.

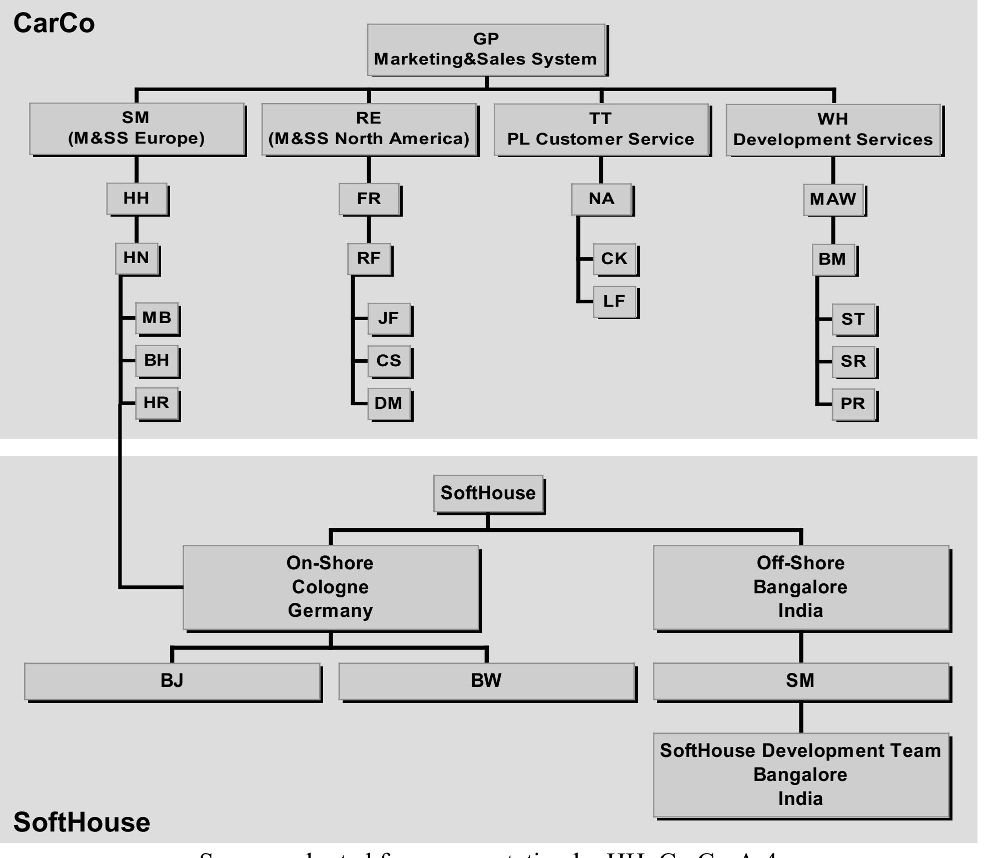
§ 10.1.5.2 Project Organization

Operationally, three sites were involved in the Goldd project: CarCo Detroit (USA), CarCo Cologne (Germany), and SoftHouse Bangalore (India). We use an organization chart from the project leader as a starting point for discussing responsibilities and communications across sites (Figure 51).[54] The top rectangle shows CarCo's involvement. In Europe, HH is project champion for the overall Goldd project. He also leads the M&SS unit working on the Goldd project. His subordinates include HN as senior analyst, and MB for data modeling. Their involvement and expertise was needed because Goldd would be based on the DID.

In North America, JF (M&SS North America) is directly involved in the Goldd project. She coordinates on the US side, working with marketing users and IT staff from other departments (shown in the figure right from M&SS North America). The reason for involving different IT groups in the US was that Goldd would first of all replace two old systems in North America: CDDB and CIS. Teams responsible for these applications had to contribute to the requirements analysis process and (eventually) data migration. Besides that, the Goldd global server database would be physically located in North America. The existing database administration of M&SS would therefore be involved for "providing physical platforms for development, integration test and production and performance and access optimization" (CarCo-A-4).

CarCo has an integrated international management structure as shown in Figure 51. HH and JF eventually report to the same boss for M&SS. Soon after the project started, HH became manager of JF (not shown).

[54] Abbreviation of names follows Table 4.



Source: adopted from presentation by HH, CarCo-A-4

Figure 51 - Organization chart CarCo Goldd project (project leader version)

The CarCo project organization is linked to SoftHouse, the bottom rectangle in Figure 51. At least one liaison - initially BW - from SoftHouse is physically stationed 'on-shore' where HH, HN, and MB work in Cologne, Germany. This person reports to SoftHouse UK. In Bangalore, India, NK (not shown in Figure 51) functioned as counterpart for BW during the first month of the project. NK worked with offshore project manager SM who headed the Goldd team there. This team was split in two units, each headed by a team leader. One group works on the Oracle database system (8 people), the other one focuses on Visual Basic (28 people) (CarCo-E-1).

We use the communications diagram in Figure 52 to illustrate the initial setup of the Goldd project.[55] (There are four phases in total.) BW functioned as first liaison in Germany. NK is shown as offshore liaison between the IT group in India and his counterpart onshore, BW. The latter works with CarCo's M&SS unit in Germany. That team works with users in Europe, and the M&SS unit in Detroit with a similar role for North America. Connecting the three main sites was supposed to rely mainly on electronic communications as HH indicates in his presentation:

> "The co-ordination between the above mentioned activities located on 3 continents will be mainly supported by document and file exchange procedures within PROFS (IBM e-mail system - author) and audio/video conferences. Travel is limited to a minimum and reserved mainly to key persons of the team in order to conduct presentation of the system to customer areas." - HH, CarCo-A-4

NK left after about a month, so that BW had to work directly with SM and the team in India. Figure 53 shows this second phase of the project setup. During that period, BW visited the group in India to work with them on-site.

[55] These diagramd clarify communication lines, not hierarchical positions. They are also used in the analysis sections. Some direct contact existed between the onshore liaison and JF as representative from the US team. This link is not shown in the figure.

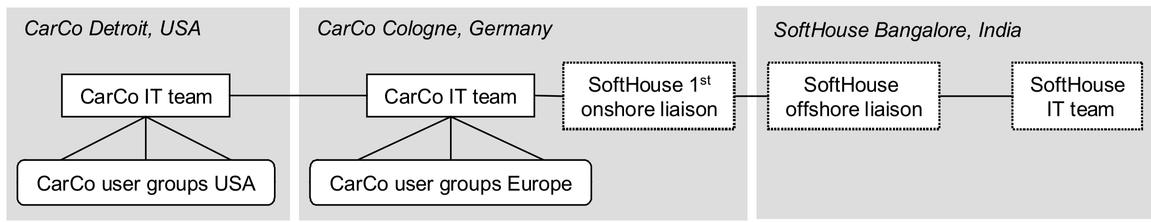


Figure 52 - Communications diagram Goldd project (1/ 4)

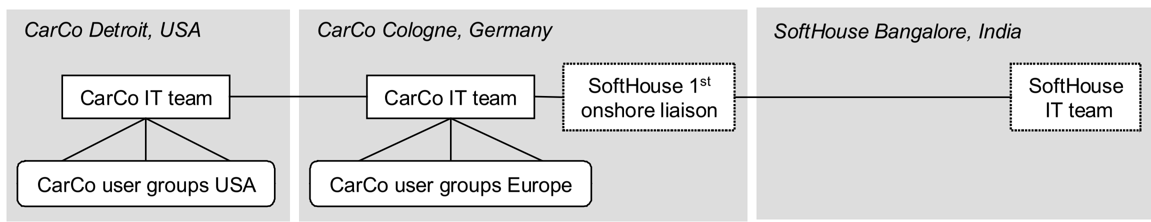


Figure 53 - Communications diagram Goldd project (2/ 4)

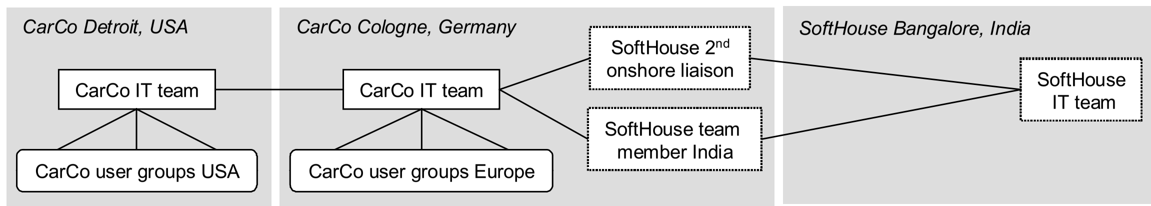


Figure 54 - Communications diagram Goldd project (3/ 4)

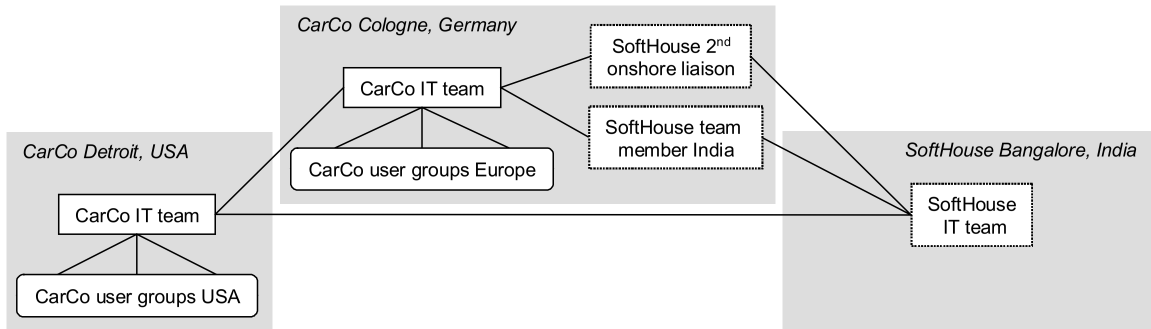


Figure 55 - Communications diagram Goldd project (4/ 4)

By the end of 1996, BW took a month vacation and preferred to leave the Goldd project. He was replaced by BJ - also an independent IT consultant - in January 1997. Since BJ's expertise was predominantly in project management and communications, he needed assistance for technical matters. SoftHouse stationed two senior team members from the team in India in turns: SPB - specialized in Visual Basic - and MD, responsible for development. HH summarized this new setup in his presentation:

> "The Cologne Office of European Marketing and Sales Systems will have a lead role to coordinate the development of the new application by support of an offshore supplier, based in India. As offshore supplier [SoftHouse], based in United Kingdom, has been selected and will develop the system together with [SoftHouse] India located in Bangalore. The co-ordination between [CarCo] in Cologne and [SoftHouse] in Bangalore will be ensured by 2 [SoftHouse] onshore managers in Cologne. One will focus on project management, the second will be responsible for communicating business requirements and technical concepts. These onshore managers will communicate with at least one offshore manager who leads the development team in Bangalore, India." - HH, CarCo-A-4

Figure 54 represents the communications diagram for the third phase. BW is shown as 2nd on-shore liaison. His role is strengthen by team members from India who work directly with the CarCo team in Germany.

The positioning of team members from India in Germany facilitated direct contact with the US team. This was necessary for several reasons. The second Model Office session in Detroit was attended by Indian team members to receive feedback from American IT staff and users. The team in the US provided test data for the team in India. They also worked on the first implementation of Goldd and were preparing their launch site. This required interaction with experts in India (Figure 55).

Comparing the diagrams 1 to 4 suggests several changes. First, the initial setup with two independent IT consultants offshore and onshore was reduced to a single liaison. After that phase, Indian team members reinforced in Germany the connection to the SoftHouse development team in Bangalore. Apparently, direct inclusion by representatives from India in the CarCo context was needed, rather than someone coming to them.
Second, the original structure channels exchanges between the teams in India and the US exclusively through the German site and liaisons. Gradually that connection became more direct. Overall, a triangle-shaped structure emerged instead of a chain.

§ 10.1.5.3 Project Processes and Planning

From early 1996 onwards, operational work started on the Goldd project. In the US, M&SS staff worked with users to clarify new requirements and business rules. They also worked with staff supporting the two older systems - CDDB and CIS - to understand the current situation. Based on these efforts, the M&SS team headed by JF worked on the data model and process modeling. In parallel, HH's team in Germany connected to European marketing and sales users to elicit requirements there. The European DID system was used as a baseline for Goldd since it was implemented quite recently and met most user needs. US staff went over to Germany to discuss the modeling results from both sides and come to a common data model. The German M&SS team then developed a PC-based prototype of Goldd. A European 'Goldd awareness' session was organized in April 1996 for the M&SS user base in Europe. They could give comments on the demo system.

The team then joined up with their American counterparts and organized Model Office session 1. These sessions "are organized as one-week-workshops focusing both on the expert needs of key business areas, and the large number of occasional read-only users. Comments received out of these workshops will be incorporated into the next release of the application. It is planned to go for 3 Model Office sessions before Goldd can be launched in the first location" (CarCo-A-4). During the first session, North American users were invited to look at the proposed system and provide feedback. Around that time, SoftHouse was on board as an offshore outsourcing partner. The team in India received the prototype. They were expected to use CarCo's data model to complete the design of the system and build it. Apart from the data model and business rules identified by CarCo, SoftHouse was supposed to design workflow and security features. In these areas, CarCo lacked expertise. MB - database expert from CarCo Germany - explains work division in this area:

> "The DM design was done by [CarCo], except for workflow and security. Those are the only area where [SoftHouse] does the design. The design was originally proposed by [CarCo], but India needed to amend this to make the proposal in line with Visual Basic. This was all new at [CarCo], especially workflow. With workflow and security, India prepared the database, then it went to Germany and back to India to amend" - MB, CarCo-C-1

CarCo and SoftHouse decided to use a Rapid Application Development (RAD) methodology. This approach relies on recurrent contact between users and the development team (Beynon-Davies et al., 1999). It is used for ill-defined situations where requirements are not known and/ or change quickly. In feedback sessions, users can visualize the system and suggest changes. The project leader - HH - comments on the motivation for RAD in the Goldd project:

> "The problem starts with our users. They would not, and I found that many times, read a specification and put their signature under it. Because they wouldn't understand it. They have not the grasp that requires them to imagine something that's on paper and how it would work. So you're almost bound to have a prototype, and then collect the comments, and go ahead with that." - HH, CarCo-A-3

The prototype was submitted to the SoftHouse team in India in summer 1996. There it was used as a starting point for the development of Goldd. While the data model and physical database development and setup is handled by CarCo, SoftHouse would provide the front-end GUI modules and the back-end server modules (CarCo-A-4). The team in India was connected to CarCo US and Germany through the linking pins BW (onshore) and NK (offshore). These consultants had worked over the Spring with the CarCo teams. They were supposed to transfer their knowledge to the team in Bangalore, and handle all communications needs between Germany and India. Two Model Office sessions were planned in Detroit where SoftHouse representatives from India would team up with US and German IT staff and M&SS users. These sessions would further clarify user requirements and provide feedback to the CarCo and SoftHouse development groups. HN explains this initial setup of the Goldd project:

"It was a prototype approach and the assumption was that doing these Model Offices would be sufficient for the Indians to do the knowledge transfer from the user side, from the business requirements to the programmers in India. That was the assumption. Based on that we did a prototype on a PC (...) that was presented to the users. First of all just as a demo version, then later on we went ahead to watch their feedback and reaction to that. That was the kind of development approach which was chosen to do it. In that sense it was planned that we have two Model Office sessions, we do the first prototype on the PC, then we go ahead with two Model Office sessions and then we receive the final product and test it and evaluate it and improve it and launch it." - HN, CarCo-B-3

Things worked out differently. NK left the project soon after development started. This left BW with the task of building understanding in Bangalore for CarCo's context and requirements. No one from the team in India had been involved in the requirements analysis phase, or even visited sites in North America or Europe. From their perspective, it appeared challenging to develop a system based on the minimal information they were provided. Looking back, the project leader realized that members of the Bangalore development team should have joined early on in the project, when the prototype was developed:

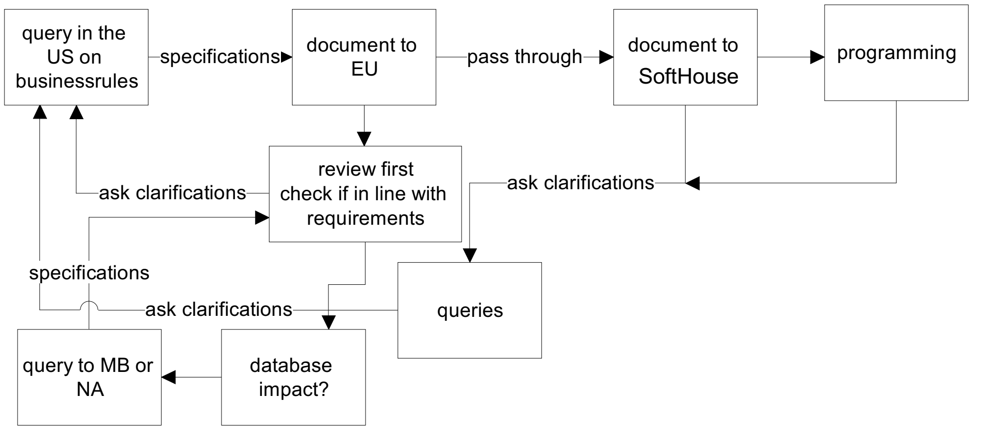
"I would want to have a different balance of people right from the very beginning, more Indians senior Indian people who would participate in the prototyping and the functional analysis." - HH, CarCo-A-3

Based on the resources at their disposal, the SoftHouse development team constructed a first version of the Goldd application. These initial deliveries were late, and according to a CarCo team member not satisfying:

"They made an approach which was quite on the software of the system. I mean it was more a presentation prototype than a functional prototype. The emphasis was always: do we have all the screens, do they look nice and do we see information on it. But that is not a system. So the real backend of it the functions and the business rules which are run behind the surface were not evaluated or analyzed in detail enough in order to make the system launchable in the production." - HN, CarCo-B-3

This lack of quality was a result of a number of factors, such as lack of knowledge transfer between onshore and offshore sites, late involvement of Indian software professionals, and time pressure. We elaborate on these factors in § 10.2 and § 10.3 .

While the Indian team was working on the first version over Fall 1996, CarCo users (especially those in the US) and IT staff initiated numerous change requests. These impacted the data model and had to be taken into account by the SoftHouse team. The requests were communicated to the German onshore liaison, BW. The process for handling change requests and other development issues is shown in Figure 56. Often, an issue started in the US (top left corner). It was documented and sent to the European team (Germany). This group checked the requests and fed back questions of need be (direct feedback loop). An assessment was made of database impact. MB (German team member) or North American (NA) database staff was consulted (bottom left loop). Eventually the German team relayed issues via the SoftHouse liaison to the development group in India (top right corner). These asynchronous messages that went from hand to hand often led to questions in India. Requests for clarification traveled the same route back to German and the US



Source: adopted from CarCo-B-1 as prepared by AC

Figure 56 - Change request process CarCo - SoftHouse

In Fall 1996, somehow BW did not pass on many change requests to the team in India. CarCo found out about this negligence by Winter 1996. All the changes were then submitted at once to the team in India, causing a tremendous setback there (see § 10.3.4.4).

Eventually, a first version was completed for Model Office 2 by December 1996. German and Indian staff traveled to Detroit to meet with US counterparts and users. Over the following months, deliveries became quite regular. The CarCo teams in US and Germany divided testing tasks. This was needed for acceptance and to provide SoftHouse with feedback. Time lacked for a third Model Office that was originally planned in Spring 1997.

Parallel with the development and testing process, the M&SS team in Detroit worked on data conversion from the current legacy databases. Their responsibility was to provide test data to the team in India and prepare conversion to Goldd from CDDB and CIS. This task leads to dependencies with the team in India that develops the database system. Rules for data conversion must be common across sites. However, both teams did not realize the need for coordination, especially with respect to so-called Sales and P&A functionality (see further § 10.3.4.3).
The launch of Goldd was divided into five phases (CarCo-A-4).[56] First, the US launch was planned for Summer 1997, but delayed to the Fall of that year. Goldd would replace CDDB and CIS in US, Canada and Mexico. The second and third implementation phases were in Europe where DID would be replaced. This demanded fine-tuning of North American and European requirements. Phase four - ‘enhanced European / North American

[56] Our research on the Goldd project finalized in Summer 1997. This data is derived from HH’s presentation CarCo-A-4 and may not reflect accurately actual events.

launch' (CarCo-A-4) - provided additional functionality to users in these regions. The final stage covered remaining CarCo locations across the world.

§ 10.1.5.4 Technology

In this section we focus on the technology built and used in the context of the Goldd project. We start with the features of Goldd as compared to the systems it replaces - CDDB, CIS, and DID. The section then continues with the Goldd technical platform and concludes with technology used for (remote) collaboration during the development process.

Goldd system features

Goldd replaces two systems in North America and one in Europe. In the first region, CDDB (Centralized Dealer Database), and CIS (Customer Information System), and in the second one DID (Dealer Information Database). The North American systems were no longer supported by their supplier. The team there was responsible for understanding the logic behind the old systems. This was necessary to model business rules, but not easy as JF explains:

> "It was very difficult to find out the rules and practices of the older system (CDDB). The system is over 20 years old, built somewhere in the '70. There was nothing on paper, there were no people who built the system." - JF, CarCo-D-1

Other than these old systems, Goldd operates in a client/ server environment. It has Graphical User Interfaces (GUI), and operates on-line instead of in batches. The scope of the system is global rather than regional. It supports the management of CarCo's world wide dealer network by offering a centralized warehouse for dealer information (CarCo-A-4). According to the project leader:

> "The new database will become the world-wide repository for all dealer related, static information and will serve global business processes with authorized and consistent information. It will be an enabler for the vision of global ordering and delivery where any product or service offered can be ordered by any authorized dealer in the world without considering the location of production" - HH, CarCo-A-4

Goldd contains two main groups of functionality: Dealer authorization & contract information, and Distribution network & dealer performance. The first area focuses on basic dealership information (CarCo-A-4). This concerns both CarCo owned dealers and franchisers. The second functionality area - Distribution network & dealer performance - supports information management on dealers' operations (Table 36).

Table 36 - Goldd functionality

Dealer authorization & contract information	Distribution network & dealer performance
▪ Name & addresses ▪ Sales agreements ▪ Authorized products/ services (for franchises)	▪ Summary of sales/ stock/ market share performance ▪ Summary of customer satisfaction program results

▪ Local market area responsibility and organizational Alignments (country, regions, districts, zones, sales points) ▪ Ownership and dealer cooperations ▪ Marketing and advertising enrollment ▪ Finance & accounting	▪ Dealer development and appearance improvement actions ▪ Business management information ▪ Facilities & property information ▪ Staff and training ▪ Traffic and routing Information ▪ Hardware/ software vendors & applications

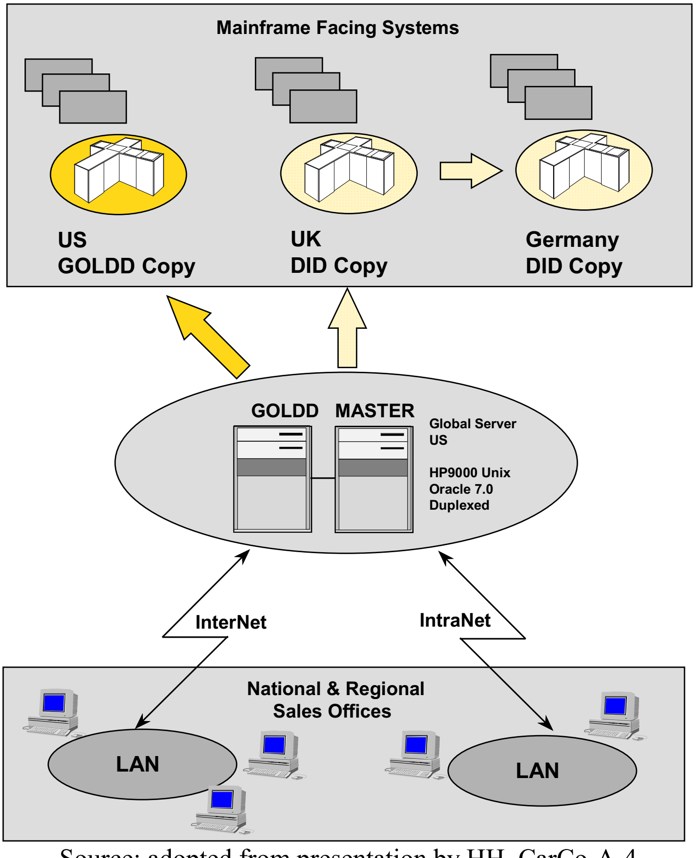
Goldd contains workflow functionality for the dealer appointment process that was designed by SoftHouse's team in India. Candidate dealers must be checked along various criteria before they can be accepted and appointed.

All in all, the requirements for Goldd were incompletely known in advance. The system rather emerged from an evolutionary process. The co-researcher - AC - who participated for months in the German team stresses this fact in her ex post report: "The system is characterized by high ambiguity of the functional requirements, as even the system analysts cannot always specify the requirements in detail" (CarCo-K-2). A senior member of the same team confirms this perception. He admits that the new system was considered simply as some functionality around a database - an underestimation of what the system ultimately encompassed (CarCo-B-3).

Technical platform

Goldd is programmed in Visual Basic with GUI. The application runs in a client/ server environment on Window-clients and one global Oracle Unix server (CarCo-A-4). This server is located in the US and interfaces with three satellite databases in CarCo's major data centers. Figure 57 shows the global setup of Goldd's technical platform with the master server in the middle. Arrows depict data links to satellite servers in US, UK and Germany. The master server is also linked through intranet and internet connections to LAN of national and regional sales offices (bottom of figure).

M&SS personnel in North American was responsible for setting up and optimizing the global master server and satellite server in the US. They also worked on the first conversion towards Goldd, including migration of existing data to the new environment. Goldd was intended for about 2000 users in at least 5 countries (CarCo-G-2).



Source: adopted from presentation by HH, CarCo-A-4

Figure 57 - Global technical platform Goldd

Tools

The development teams in US, Germany and India used a variety of tools for collaboration. They used email for messages and document exchange. Microsoft office applications (Word, Excel) were used at all sites. However, connecting to the Indian site was at times problematic. People could not use FTP[57] for corporate policy reasons, and had difficulty getting PROFS email system. Phone connections were often very noisy, and it appeared hard to reach someone. Linking to the team in India was usually done through the onshore SoftHouse liaison. More towards the end of the project, the teams emphasized a more global communications setup. They managed to organize a three party conference call in which the teams from US, German and India participated.

[57] FTP stands for File Transfer Protocol, a protocol that makes it possible to transfer files between servers over the internet.

Within CarCo, technology was more varied and advanced. The US and German M&SS teams shared a real-time calendar utility so that they knew who was doing what. The teams also shared an issue database that was located in Detroit. They used it to keep track of pending and past major issues in the Goldd project. Both teams had videoconferencing facilities at their disposal and used that very frequently, sometimes daily. Through the CarCo intranet, units could share and upload files on a global scale. Locally in Cologne, the team had access to the same server drive for file sharing.

For data modeling a tool called IEF was used initially under the responsibility of MB (Cologne). This tool had been the standard in Europe, but not in North America. Later they changed to ER-WIN with ST in the US in charge. At that time the US had the master database and most expertise on this tool. The team in India experienced difficulties getting licenses for the tool.

§ 10.2 Interpretive Process Analysis, Fall 1996-Spring 1997[58]

In the period Fall 1996 - Spring 1997, the core system was developed in India (see Table 34). During that same period, our co-researcher - AC - participated in the Goldd project in the German team. She held an administrative position while being allowed the research project through logs, interviews, meetings, and documents. In this section, we report on her experiences when the Goldd system was developed. We rely on her weekly logs (CarCo-K-1) and ex post report (CarCo-K-2) as data sources.[59] The logs were prepared during her participation in the project, while the report was written several months afterwards. Based on these resources, we provide a close-up view on what happened during the abovementioned period. The reason for following this process is that CarCo and SoftHouse changed the organizational setup of Goldd repeatedly. As we will show, these dynamics coincide with underlying problems of communications, formalization and control.

The section closely follows AC's logs and uses quotes from this document. It is organized important events in the period Fall 1996 - Spring 1997. The section concludes with themes that emerged from the process description and other empirical data sources like interviews. These are elaborated in detail in the next analysis section.

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[58] The following sections follow as closely as possible interviewees' perception of their experience with culture and diversity. It may contain stereotyping of people based on their culture, and way of working. However, these experiences should be seen in the light of this case study context and do not necessarily have generic value. The author does not subscribe to, or endorse any of these views, and represents them as authentically as possible for the sole purpose of this research.

[59] Data used from the logs and report is represented as authentically as possible. Some sections are modified, shortened or omitted for clarity and relevance. Dates have been reformatted to US standards to achieve consistency, e.g., 'January 8' instead of '8th of January'.

§ 10.2.1 First Deliveries (September 2-6, 1996)

Early September 1996, SoftHouse started to deliver the first module codes. AC reports on the mixed experience this evoked in Germany:

> "The first delivery made on September 6 did not work fully. Installing was difficult and new, and probably something went wrong there, afterwards it was reported that the modules did run. Additional specs were delivered (submitted from India to Germany along with the deliverable - author). The interest in the specs (in Germany - author) was not very high: the specs merely consisted of screen lay outs, and about what would happen if you would press a certain button. After a while it was decided that [SoftHouse] would not deliver specs anymore, but ready made screens, that would serve as specs. This made the project easier for [CarCo] to review, and cost less work in India. (...) As this was the first real delivery everybody was very exited, but disappointed. The first deliveries resembled the prototype: it seemed that it was just a dumb copy of the prototype." - AC, CarCo-K-1

Based on the contract, the review in Germany was important. It determined acceptance of SoftHouse's deliveries and thus payments. Work division in the Goldd project defined this workflow dependence. In addition, as the log suggests, an information flow was needed that accompanied the software deliverables. This would clarify the product and facilitate the German team's review activity.

Unfortunately, the first deliveries added little to the prototype developed by CarCo earlier that year. In an interview with AC, SPB - a senior Indian team member - would later reveal that the SoftHouse team lacked information and specs from CarCo. One of the reasons for that appeared to be the 'knowledge' link between onshore and offshore. After NK left, BW did not have a remote counterpart whom he could easily connect to. Instead, from Germany he faced a team in India waiting for information to start working on the system.

§ 10.2.2 Crisis (September 9-20, 1996)

In these two weeks, the crisis and conflict between CarCo and SoftHouse became more visible. Between September 9 and 13, some deliverables were made but these could not be installed. From SoftHouse's side, issues with development tools were reported:

> "This week must have been the prelude to the crisis in the next week. No progress was made on the modules or specs, only some progress on the database. Apparently (progress report) modules have been delivered, but could not be installed properly at [CarCo]. [SoftHouse] India seemed to have quit a lot of software problems: with Oracle and Designer 2000 bugs. Also the GUI standards were not incorporated in the screen design." - AC, CarCo-K-1

The following week, tensions escalated. The project leader confronted BW with below-par performance from the SoftHouse side. BW's onshore presence as a liaison positioned him to receive the first wave of client pressure:

> "Date of a crisis. A lot of discussions were made in HH room. All of them followed the same topic: [SoftHouse] did not deliver. According to BW the team in US (JF) and the team in Germany did not deliver either (i.e., any material to work on). Everybody started blaming each other, loud discussions would follow. HN was very dissatisfied with the way work from [SoftHouse] was handed over. BW handed over material that

he had not seen himself before, he would present it in a meeting and already notice all kinds of things that were wrong, instead of seeing these things first and communicating them to India. This of course was due to the enormous time pressure. BW just wanted to deliver things without taking notice of the quality. So the things that were delivered were mostly bad in quality and this irritated the German team. The insults started to become very personal, and tension was everywhere. No progress at all was reported in this week. HH invited HN, MB and BW to his home, to discuss everything in another environment." - AC, CarCo-K-1

Reciprocal blaming referred to key dependencies and flows between CarCo and SoftHouse. These are depicted in Table 37. They underpin the agency relationship between CarCo (principal), and SoftHouse (agent) that was created with the outsourcing contract. The table shows two categories of flows: knowledge/ information, and activities. The former relates to insights that are needed by one party, and delivered by the other one. We distinguish flow 1 towards the agent SoftHouse on CarCo's preferences. And a second reverse flow that clarifies SoftHouse's deliverables. The white row depicts generic needs and flows in agency relationships, while the light gray row applies those to the CarCo case.

The second category - activity flows - consists of two contractual performances. One where the agent delivers to the principal (SoftHouse deliverables). And the final row with counter-performance by the principal, often payment but also results from testing.

Table 37 - Agency dependence and the CarCo case (1/ 2)

		Principal (A)	Direction of flow	Agent (B)
		CarCo		SoftHouse
Knowledge & information flow	Flow 1	A provides information/ knowledge on his expectations/ context to B	➔	B needs information/ knowledge on A's expectations and context
		➔ Specifications, knowledge of CarCo context ➔		
	Flow 2	A needs information on B's performance	←	B provides information on his performance
		← Information on SoftHouse deliverables ←		
Flow of activities	Flow 3	A receives performance from B	←	B performs for A
		← SoftHouse deliverables ←		
	Flow 4	A performs for B	➔	B receives performance from A
		➔ Financial resources, testing results ➔		

The flows from both categories are obviously related over time. A service-based principal/ agent relationship usually starts with flow 1 (like a customer sitting in a haircutter's chair and telling his/her preferences). Then the agent starts to work and delivers flow 3, possibly accompanied by flow 2. In turn, the principal fulfills his side of the contract (flow 4).

The log entry cited here points to multiple disruptions of the generically described process. To start with, BW accuses CarCo for not delivering sufficient information (flow 1). According to him, this affects SoftHouse's capability to perform well, i.e., on time, on budget, and according to expectations (PMI, 1999). Conversely, CarCo, as the principal, reproaches SoftHouse for not delivering quality output (flow 3). This could be traced to a combination of on the one hand the Indian team's performance. On the other hand, BW neglected his quality control task as an onshore liaison. In this stage, the project leader channeled his complaints and pressure to BW. Later, he would escalate hierarchically.

§ 10.2.3 Changes (September 23-27, 1996)

The situation reported in the previous period led to some changes. AC mentions that communications within the German team are modified and that handovers between BW and the CarCo team are formalized:

> The situation was (apparently) better this week. Measures were taken to improve communication. (Ironically, the lack of efficient communication seemed to be a problem within the German team as the measures taken only affected the German team. This causes the impression that there was no lack of communication between the German and the American team.) All handover had to take place in an official meeting, and had to be recorded and tracked as handover by AC. (This practice - both the official meeting and the tracking - was quickly forgotten though.) Not a lot of progress yet, only some specs (which were replaced later on)." - AC, CarCo-K-1

From information on the crisis, it seems that these measures hardly address the underlying issues in the principal - agent relationship. Much earlier in the process, it appeared that the SoftHouse team in India lacks knowledge on the product to be delivered. Moreover, the connection between BW and the offshore team does not function properly. (This is not a surprise since NK left the project.)

Even though the formalization measure offers a partial resolution, it was not enforced. Like in the research by Jarvenpaa and Leidner (1998), some temporary groups attempt to institutionalize routines but fail to embed them in their operational process. Here, the project leader did not or could not (because of the lateral relationship with SoftHouse) implement standard practices for handing over software. Contractual relationships make it often difficult for one party to impose his standard to the counterpart (Bradach, 1997).[60] In the case of CarCo and SoftHouse, standard practices were not part of the contract. This made it difficult to adopt and enforce them in a later stage.

§ 10.2.4 Liaising with Indian team (September 30-October 4, 1996)

People in Germany started to become aware of the Indian team's difficulty to understand CarCo's expectations. BW left for India to fill the group there in. Doing that remotely did not work as effectively. While he was there, AC logs that time zone differences constrained communications with the US (see Table 33).

> "Beginning October 1, (...) BW starts working in India doing knowledge transfer. (...) BW was not in the opportunity to communicate with the US, as the time difference was too big (9½ hours). Some urgent issues with JF could not be solved due to this." - AC, CarCo-K-1

On a more structural level, HH and HN wanted BW to stay closer to the team in India. At this stage, they considered his inclusion there more important than his staying in Cologne. Interestingly, this was discussed with BW's bosses in the UK, rather than with BW himself.

> "On Monday, HN and HH discussed the possibility of BW staying in India with the [SoftHouse] management. BW would have to review the progress there and especially do more knowledge transfer. This option was researched by [SoftHouse] management, but in the end they decided not to station BW in India. All this was discussed at first without BW knowing about it. The [SoftHouse] management pointed out that he also had the right to know and to (jointly) decide. As not a lot could be done for Goldd, HN and AC spent most of their time working for DID." - AC, CarCo-K-1

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[60] Unless one party has a strong comparative powerbase, like Boeing's influence on Baan ERP in te 1990s.

§ 10.2.5 Waiting (October 7-18, 1996)

Like the preceding quote shows, people often waited during these weeks in Germany. The Goldd work division assigned development work to SoftHouse India. During this period, the German CarCo team waited for the codes to arrive in order to start testing.

> "HH on Holiday. BW returned on October 11 to report on progress in Progress Meeting. No progress was reported. (...) HN and BW on holiday. The rest of the team could do nothing else but wait. HH was not informed very well, as he did not talk to HN or BW. The week was filled with waiting. HH had a talk with [SoftHouse management] about the final version 1.0 release date: October 25." - AC, CarCo-K-1

The Progress Meeting was a recurrent US - Germany videoconferencing session in which at least BW, HH, HN and from the US side JF participated. Every Friday, this provided the backbone of cross-Atlantic coordination. In preparation, BW was expected to prepare and share a progress report. Afterwards, AC logged and submitted the meeting minutes.

Attempts were made to establish other procedures, like the formalization of BW's handovers. Or standards concerning communications within the German M&SS team. These were not adhered to, as AC points out:

> "Other official meetings have been setup (both in Germany and cross-continental), but were never complied to for a long period of time." - AC, CarCo-K-1

§ 10.2.6 Core Model Version 1.0 (October 21-November 1, 1996)

The first version of Goldd's core system was slated for October 21. This delivery was a couple of days late and incomplete. In response, HH expressed his concerns to his boss in Germany, SM (see Figure 51):

> "October 21 was the date for installing Core system 1.0. Nothing was delivered. Finally the deliveries arrived on Friday and they were installed on Saturday, meaning that everybody (at least HH and BW) had to work on this day. The delivery consisted of only 20% of the committed content. This triggered something ... A letter exists in which HH writes to his boss SM about the fact that [SoftHouse] has not made a delivery since September 27, mentioning that he is considering a new supplier. (I do not know if this letter has been sent in effect on October 26, but it sure shows how critical the situation was. [CarCo] had no confidence at all that [SoftHouse] was capable of delivery.)" - AC, CarCo-K-1

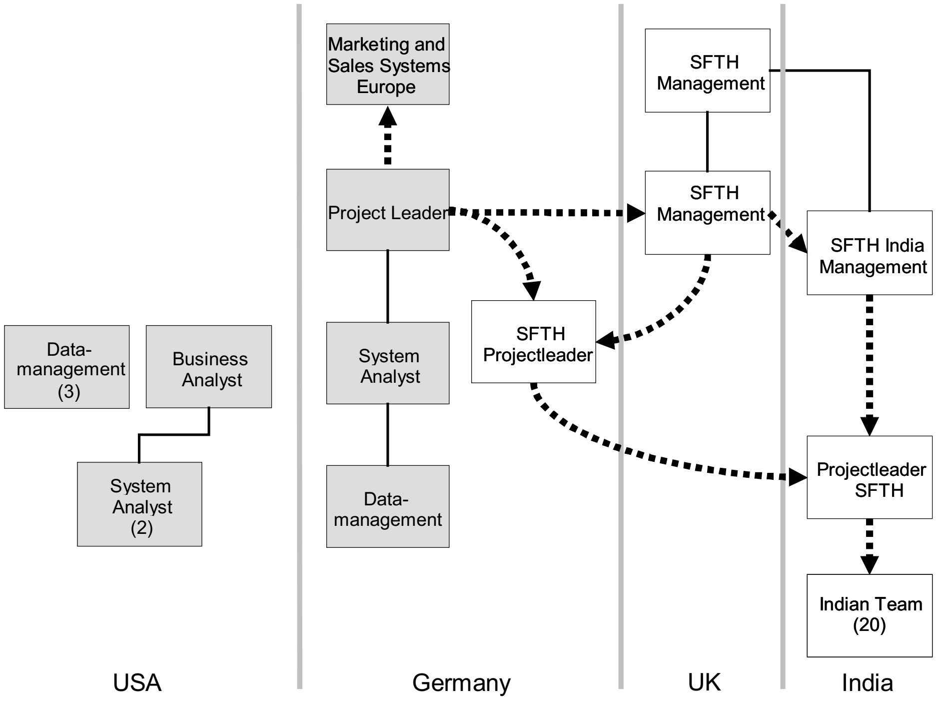
In addition, HH escalated the performance issues to SoftHouse management in the UK. He had notified them before, but increased pressure now in a more formal way:

> "HH contacted [executive] at [SoftHouse] UK to tell him how disappointed he was with the material he had received until now. He warned him that he would write an angry letter and that his boss was informed about all this. He mentioned or hinted that he might stop using [SoftHouse] as a supplier. The letter mentioned that a firm plan had to be delivered before Friday, or else ..." - AC, CarCo-K-1

Using an organization chart developed by AC (CarCo-K-2), we can show how HH handled the vendor's performance issues (Figure 58). The chart shows four geographical sites involved in the Goldd project (USA, Germany, UK, India). It depicts for each site and sometimes across sites hierarchical relationships (vertically). SFTH stands for SoftHouse, the software vendor. The chart can be compared with the project leader's version, Figure 51.

HH increased pressure first of all BW, the onshore liaison. This person was readily available on-site and responsible for SoftHouse's operational interface to CarCo. On the other hand, BW was an independent consultants without any CarCo affiliation, and limited hierarchical ties to SoftHouse UK. BW, in turn, attempted to improve performance through the SoftHouse project leader in India. He tried to remotely and while visiting Bangalore.
Second, HH notified his boss with responsibility for M&SS Europe.
Third, he exerted pressure on executives from SoftHouse UK. He had contracted this company, and could attempt to exact compliance with the contractual stipulations. SoftHouse UK executives could use their association with BW to some extent. They did have an influence on operations in India through management there.
Finally, the project leaders in India were challenged by BW and their local management to submit intermediate deliverables.

All in all, CarCo warned and threatened SoftHouse to accomplish according to the contract. It could not fall back on elaborate working relationships or hierarchical triggers to accomplish this, but relied mostly on the outsourcing relationship (Bradach, 1997).
While ultimately, the objective was to improve performance of the teams in India, HH's pressure worked very indirectly. He depended on multiple nodes. Looking at Figure 58, he could only work through either BW, or SoftHouse executives. Whichever way, people from outside India never contacted the local teams. They always went through the offshore project manager or leaders. These persons handled interaction with local staff. Thus, pressure was exerted through a combination of lateral, contract-based contacts, and hierarchical relationships within an organization.



Source: adopted from CarCo-K-2

Figure 58 - Organization chart CarCo Goldd project (co-researcher version)

Events from the past weeks led HH to communicate on a strategic level only with SoftHouse UK executives, and not BW. It seemed that their influence on the Indian operations worked effectively. Meanwhile, the Model Office and delivery of the core model were postponed:

> "All 'strategic' tinted decisions were made by HH and [SoftHouse] UK. BW was told that he did not have to deal with this level of issues anymore (by HH). The response received from [SoftHouse] UK must have been OK, because the project stayed on track after Friday. On Thursday another delivery had been made, totaling 38% of the promised deliveries. Friday a discussion followed with the management of [SoftHouse], BW, and HH. New planning will be delivered by next week, Friday November 8. This Monday the decision had to be made whether to do the Model Office from November 18-22. The decision was negative. New delivery date for the core model: November 7." - AC, CarCo-K-1

§ 10.2.7 Further Delays (November 4-15, 1996)

Early November, deliveries were late again. AC observed uncertainty in CarCo's willingness to continue the outsourcing relationship with SoftHouse. She also noted that HH's pressure on SoftHouse UK executives seemed effective. He had used his contractual relationship to trigger hierarchical control processes within the SoftHouse organization.

This appeared to work: the teams in India were eager to meet expectations from management in India and the UK.

> "Delivery was late again: this time on November 8 instead of 7. To me it still was not clear if [CarCo] wanted to continue with [SoftHouse]. (...) November 15: 4 working modules were delivered just before the start of the Progress Meeting. Again there was some stress whether or not [SoftHouse] would deliver. Mainly because the big bosses (SoftHouse - author) were watching the project, they had to be kept satisfied. Next Monday (November 18) the decision would be made whether to go ahead with the Model Office in December." - AC, CarCo-K-1

§ 10.2.8 Second Postponement of Model Office? (November 18-22, 1996)

The decision on Model Office 2 was important, but difficult to make. It was important because many people were involved. In addition to Goldd project members from India, Germany, and US, the main group consisted of marketing and sales users who represented North American requirements. Delays and lack of information on activities in India made the decision also difficult.

HH was upset about BW's unawareness of progress in India. When he escalated the issue to the UK, it was confirmed that interaction between the offshore team and BW did not function properly:

> "Monday no decision was made as after the delivery on Friday there was too little to decide on (re. the Model Office - author). HH gave [SoftHouse] another chance to deliver the software on November 21, so that the decision could be made before the Friday Progress Meeting. Delivery by [SoftHouse] was supposed to arrive on Thursday. Delivery was finally made just before the progress meeting on Friday. HH made calls to [SoftHouse] UK, asking why BW did not know that the deliveries were late. There appeared to be a problem: either India was not willing to tell BW, or BW did not contact or he could not contact India to make absolutely sure." - AC, CarCo-K-1

AC logs that HH decided to postpone the Model Office. He could not risk a session when deliveries were delayed and still needed testing:

> "Based on this very important delivery, a decision had to be made whether the Model Office would take place, or whether it would be postponed until the second week of January at the earliest. Considering the fact that the delivery was late (what already made the German team loose its temper (HH and HN)), and that there was no time left to check the delivery before the Progress Meeting, HH took the decision to postpone the Model Office. BW had tried to install the application, but the very important test-data could not be loaded, so no significant testing could be done.
> The atmosphere in Cologne was quite bad. When announcing the fact that the Model Office had to be postponed for the second time, the only reactions in Detroit were some silly jokes. [An IT staff member from US] said that is was more important to deliver a good product that would take some more time. The atmosphere in Detroit was resigned (...)" - AC, CarCo-K-1

§ 10.2.9 Planning Model Office 2 (November 25-29, 1996)

Earlier, we noted that standards and procedures for communications were setup but not adhered to. The same applied to the planning of Model Office 2. In the past week, HH wanted to postpone the session; this week he decided to proceed with Model Office 2 in

December 1996. A range of factors are suggested that contributed to this shift. Among these practical preparations, like flights booked and meetings scheduled. Feedback from this session was needed for the Indian team to continue on the project. Given the RAD methodology, this constitutes an updated Flow 1 as depicted in Table 37. On a strategic and political level, HH and SoftHouse executives wanted to keep their stakeholders satisfied:

> "On Monday the decision was made to go ahead with the Model Office. Most important reason seemed to be that the team could not afford to lose face again. HH had already requested special permission to fly to Detroit, as all flying was not paid anymore during the last months of the year. Telling his boss (…) that he did not need the special tickets after all, would have been a disgrace. So on Monday HH got BW and HN to his room and discussed the matter. Also the senior management of [SoftHouse] was involved in the decision making. They also had a lot at stake at making it work this time. The timing plan was already delayed so many times. The decision was made.
> Other factors that may have played a role: the team in Detroit had made preparations for the second time for the Model Office (including invitations and such I suppose). Postponing the Model Office would cost at least 4 weeks time, due to Christmas and New Year. The Indian team would keep on working during these days, but if there would be no feedback from the Model Office there would not have been so much work left. Postponing would also be bad for the motivation of the team. Maybe personal feelings of HH played the bigger role in this decision ("not looking silly")." - AC, CarCo-K-1

§ 10.2.10 Testing (November 25-December 6, 1996)

Late November 1996, final deliveries for the Model Office session were made. These were tested by the German CarCo team. Testing results in a reverse workflow where the German team feeds back testing results and requests for adaptation. In terms of Table 37, these are examples of Flow 1 (information on CarCo requests) and Flow 4 (testing results). When the German team took on the role of testing, they represented CarCo user groups. This made it somewhat difficult for them, since they were not fully aware of the users' context, routines and expectations.

> "During the week the system had to be tested. Testing was not very easy for the German team, as they were not the users. They could insert the information, but were not really familiar with a "system" that the user would follow. No major bugs were discovered, some errors that made the application crash, but all these were easy to fix. Sometimes during the entering of information one would get stuck, and there was no way out. The critical errors (those that would bother the users the most, not necessarily the "severity one" errors) were sent to India to be fixed." - AC, CarCo-K-1

The first week of December, change requests had been processed in India. They responded timely and precisely so that a workable version was ready for the second Model Office session in Detroit:

> "On Monday a new version of the application was delivered. It had to be checked only for the errors that were chosen to correct. This means that it was decided that some errors could stay in the application for the Model Office. The testing seemed to be OK, a lot of errors had been corrected. Of course, some other errors did also show up, but the team was quite satisfied with the deliveries. Probably everybody was a little bit surprised, the Indians really handled the error corrections well and quickly. December

4 a new, “final” Model Office version was delivered, this appeared to be a draft one though. There still was some room for improvement, and I suppose that the last critical error corrections were reflected in the delivery of December 6. This was the delivery that was going to be used in Detroit, starting next week ...” - AC, CarCo-K-1

§ 10.2.11 Model Office 2 (December 9-13, 1996)

In Detroit, the second Model Office session took place with North American users. From the Goldd team, BW, SPB (from India), HH and American M&SS team members participated. SPB appreciated direct contact with North American users, instead of receiving information through a chain of M&SS CarCo in the US - Germany - onshore liaison - offshore leaders. On his way back, he stayed a week in Cologne for talks with BW and HN.[61]

During the Model Office session, AC worked in Cologne on the comments database containing requests from North American users. She was concerned that many comments were not processed. Apparently, responsibility for this process was not clearly assigned to someone and monitored.

“Model Office 2 with users in Detroit: BW, HH, plus SPB. I did some checking of the old comments DB (database - author) with the latest version. This was disappointing though, a lot of things were not yet corrected. The users must also have experienced this in Detroit, and might have had a feeling like: “They do not listen to me”. This checking of the comments DB should have been done much earlier in the progress. This week there was not a lot of Goldd activity in Germany. Here everybody was waiting for news from Detroit. (...) The Model Office appeared to be a success (according to the Progress Meeting). A considerable diversity of users was available, working on 20 different working stations and they were all impressed by the system. This year turned out to be a success after all.” - AC, CarCo-K-1

§ 10.2.12 Christmas Break (December 16-27, 1996)

Over the Christmas break, the team in India elaborated feedback from the Model Office. In the US, the M&SS group was preparing data loading. While these teams continued over the Christmas break, German team members were on leave. This asynchronous availability complicated situations where members of the US team needed to reach them:

“In this week the holiday more or less already started for the Germans. Not a lot of work was done this week in Germany (...). HH was off two days. (...) I did some archiving of files, there was not a lot of work to be done. December 20 a delivery was made, but nobody had time left to look at the delivery. (...) The Indians would be working on comments for the remaining weeks of December. The Americans were very busy with setting up the data loading. They would not have a holiday. As nobody was available at the German Office this made things more complicated.” - AC, CarCo-K-1

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[61] AC held interviews with SPB when he was in Cologne after Model Office 2, and also late February 1997. We analyze these in the themes section.

§ 10.2.13 New Year (January 6-17, 1997)

The New Year started with a kick-off video meeting between Cologne and Detroit. By request from JF, the Progress Meetings would include less people from both sides to enhance its effectiveness. AC comments on the trade-off of this new setup: it may facilitate the meeting itself, but increases efforts on both sides to update people.

Like on earlier occasions, work was slow in Germany. Since the first implementation was planned for Detroit, most dependencies were in fact between that site and India (e.g. for data loading). The work in Cologne centered mainly on coordinating, planning and testing for acceptance. This suggests some inconsistencies in the organizational setup during this phase: while teams from US and India needed to talk, communications were routed through the German team and the onshore liaison(s). This discrepancy probably drove changes in the communications structure as depicted in Figure 54 and Figure 55 respectively.

> "On January 7 we had an informal videoconference with JF, CK and CS. A lot of issues came up, a lot of work still had to be done. JF proposed to hold the weekly Progress Meeting with less people, so that it could be more focused. (Other members of the team would have even less connections with the work to be done.) Consequently, I was not invited to the next meeting on Friday. On Friday BW would also leave for Britain, to go to India. (...) Due to some technical difficulties the progress meeting did not take place, at least not by videoconferencing, maybe by audio conferencing. BW had already left before any meeting had taken place. It was very important for BW to be in this meeting, as he would take all open issues to India. But this did not happen. This week a new [SoftHouse] project manager would come to [CarCo] (i.e., BJ - author). He did not show up. I did some testing of the newest delivery, whether the comments had been incorporated. (...) The new [SoftHouse] manager would join BW to India, he probably did. Again not a lot of work was done in Germany. (...)" - AC, CarCo-K-1

Initially, BJ - the new SoftHouse onshore liaison - would complement BW. But as things turned out, BW left the project. In her report, AC mentions some of the reasons known at that time for BJ joining the Goldd project:

> "In January BW went to India again to discuss all open issues. BJ, a new [SoftHouse] manager, accompanied BW to India. [SoftHouse] hired BJ because the work BW was doing was too much for one person to handle. Besides that, BW would leave for a four weeks holiday and somebody had to be present from the [SoftHouse] side." - AC, CarCo-K-2

§ 10.2.14 Onshore liaison (January 20-24, 1997)

After their trip to India, BW and BJ arrived in Cologne. He would complement BW's technical expertise with his project management skills. BW would leave for 4 weeks, a surprising initiative given the stage of the project:

> "The new [SoftHouse] manager arrived this week, BJ. Actually he is a replacement for BW. BW will be doing the more technical things and BJ will be doing the actual project management like tracking, change request and such. BW told me that SPB is maybe also coming to Germany in the four weeks he will be on holiday. (Strange to leave the project for four weeks when it is almost finished.)" - AC, CarCo-K-1

On Friday that week, AC observed from her desk how BJ made a conference call to India. It was characterized by confusion, caused in part by the bad telephone line:

> "First thing I heard on Friday was BJ trying to set up a conferencing call with India. He was talking to the secretary to get to talk to one of the project leaders. He did not really succeed. He did try to talk slowly, but apparently the secretary talked too quickly for BJ to understand as the line was bad (echoing). Sometimes he would not hear anything on the other side of the line and started to scream: "Hello". Then he asked the secretary to what room the participants had to go to, in order to be in the audio conference. More confusion followed. Probably BJ had gone red by now, he was almost screaming. Finally he did get a hold of whom he needed to talk to. Communication with India is not an easy thing!" - AC, CarCo-K-1

Before the Progress Meeting on that same Friday, HH talked with HN, BW and BJ. The SoftHouse liaisons made clear that deliveries were late again. This would delay CarCo's testing activities and impact the launch date:

> "BJ and BW did not bring good news to Germany: the promised delivery was again not there and the launch date would be postponed. This meant that [SoftHouse] would not deliver the total system by the end of January for testing as committed." - AC, CarCo-K-2

HH was seriously concerned about these developments, and the fact that BW would leave for 'holiday' for 4 weeks on a row. HH probably felt the limits of his relationship to BW since he could do nothing about BW's choice on a structural level. AC reports in her log:

> "Before the progress meeting, HH, HN, BJ, BW held an discussion. HH was totally pissed off, as the promised delivery for today was again not here. He really started to scream at BW. He also told BW that it is was not right to go on holiday for 4 weeks in a row. There was some problem with the module numbers not being the right way to track progress. (It's the only way we have). The meeting ended with HH throwing everybody out of the room. It seemed like the bad performance of [SoftHouse] had started again." - AC, CarCo-K-1

The report on the meeting also mentions that "(f)or the first time, the roles and responsibilities of the team members were documented" (CarCo-K-2). Like earlier indicated, it appeared difficult in the Goldd project to formalize (and enforce) processes. The reason for this could have been a lack of emphasis by the project leader, or the nature of the relationship between CarCo and SoftHouse.

The Progress Meeting videoconference included team members in Cologne and Detroit. Uncertainty in SoftHouse's deliveries dripped through in the planning. HH seemed challenged to handle the situation. He decided during the meeting to skip the Model Office. This in turn caused concerns in the US where Goldd team members had prepared users for a third session. Without BW, it became clear that BJ lacked content knowledge that was relevant for maintaining a meaningful connection to India. SPB's temporary stationing in Cologne was intended to compensate for this.

> "During the Progress Meeting, the new timing plan was presented, without any space for the Model Office. HH told something very unclear about the Model Office. BJ presented the timing plan, naming all boring things that had to be delivered. It was very clear that he had no idea about what the things meant. It is maybe some help

that SPB will come in place of BW. BJ does have a very firm way of handling, but some knowledge will definitely have to be there before he can manage Goldd. The tension that was there in the afternoon after the screaming meeting made place for total despondency after the Progress meeting. In the US the participants did not have any comment or question on HH's unclear statement about the MO (Model Office - author). Only [an IT staff member from US] seemed to be affected. He said: "Now there won't be another MO with [name] and [name]!! How can I explain that to them. We'll need to have our own mini-session". Out of this I guess that HH had said that the MO will be the launch of Goldd. The systems will be run in parallel and that will be the last real testing of Goldd. (...)." - AC, CarCo-K-1

§ 10.2.15 When BW Left (January 27-31, 1997)

BW went on vacation officially, but wanted to stay away from the team in Germany. In his place, BJ worked on the comments database. When he tried to give AC a central administrative role, he clashed with HH. Like on other occasions, the contractual relationship caused issues on an operational level. From a CarCo point of view, HH was responsible for the overall project. In SoftHouse's perspective, he just represented a customer's point of view. Contractual stipulations between the two companies rule the operational relationship.

BW left an unwelcome legacy. He had failed to communicate many change requests from the US and Germany to India. Since BW had handled exclusively communications to India, the CarCo team did not have a way to notice BW's negligence in an earlier stage. This was the risk of relying on a single link to connect the two contexts (Burt, 1993). SoftHouse blamed CarCo for initiating many changes that were unnecessary.

"BW left this Friday before the Progress Meeting. He told me in confidence that he would not return to Germany because he could not handle HH. (...) He told me he would ask his bosses at [SoftHouse] to either work in Detroit or India. This week BJ concentrated on cleaning up the comments database. He made me 'Queen of comments'. This was not received very well by HH and HN who argued that I could not be the one to decide how things had to be arranged, and that they were not planning to tell me every comment they wanted to see in the comments database. So in meetings that I could not attend they decided what had to happen with the comments. I took the job of getting all comments together and putting them in one database. The database model was frozen. There was quite a crisis surrounding the data model. From India we first got the notice that 320 changes had not yet been incorporated and that it would take probably 80 man-days to solve this. After that it was found out that a lot of these changes had to be made in November (1996 - author), but were not. Then BJ told me that at [CarCo] a lot of changes had been made that were not necessary from a business point of view, like naming conventions etc. And that some things had been changed several times around. At the end the decision was made to copy to the master data model at [CarCo], and not bother with the change requests anymore. However the model was frozen and no changes could be made without the consent of HH. BJ went to India this weekend." - AC, CarCo-K-1

§ 10.2.16 Formalization and Priorities (February 3-28, 1997)

Mid February, AC took some time off. During that period, HN worked on the comments database without her knowing about it. This job was quite important since change requests fed into the development process. However, somewhat surprisingly, it lacked a formal setup and monitoring process in a much earlier stage, see also AC's log from December 9-13, 1996, and January 27 - 31, 1997.

> "While I was away, HN took the liberty of developing a database application in Access to take care of the comments. It was quite a difficult model, but it was OK, I agreed with it after some time. Then we had to look at all the comments and make them conform to certain standard entries. I warned HN not to change anything without my agreement as I was the one responsible. It took him quite some effort not to change anything." - AC, CarCo-K-1

SoftHouse delivered new codes that required testing. When AC was working on that task, she overheard HH and HN having an argument about testing priorities:

> "BJ and SPB left on Friday, so nobody was in Germany. It is really more calm and relaxed when BJ is not here. There was no progress meeting this week, HH was away on Friday. I started testing the new delivery, the type tables. At night, when I was still in the office HH and HN had a fierce discussion on why HN was testing the code tables as there were so much more important things to test. (...) I (...) think testing is a boring job, as it takes very long for the system to get the data from the server in Detroit." - AC, CarCo-K-1

§ 10.2.17 MD in Germany (March, 1997)

Early March, MD from India replaced SPB as on-shore technical liaison. BJ initiated triple site audio conferences to boast information processing between the US, German and Indian teams. This was important as the project was moving to the launch phase in the US. The team there was working on data conversion and loading, while SoftHouse was getting the codes and manuals ready. Setting up the conference call was challenging for reasons similar to those mentioned on BJ's earlier attempt, see log January 20 - 24, 1997. Different expectations on the side of Germany and India led to confusion and delays.

> "MD has arrived in Germany. (...) On Wednesday we held a third time 'historical three-way audio conference' (to speak with HH's words). It took very long to get the connection to India, mainly caused by confusion both on our side and Indian side. Then we could call JF and put her in the conference too. Germany was really doing the coordinating part. This meant: making sure that all parties heard each other, and that they would not talk at the same time. The subject of the meeting was the loading of the test data in India. The process seemed to go well. I talked to MB who told me that the data model was frozen and that only workflow and security was an issue. Kind of sounded that he did not have a lot of work left for the NA (North American - author) part of the data model." - AC, CarCo-K-1

AC concludes her report with some of the events in March and April. Lack of interaction between the teams in India and the US caused problems in the so-called Sales and P&A code functionality. A triple site task forced was setup to sort out and commonalize requirements, somewhat late at this stage.

> "During March and April India made regular deliveries and Germany tested the deliveries. While testing, they discovered that the Sales and P&A codes functionality was not properly designed. This meant that HN had to redo all the work on Sales and P&A codes, trying the understand the requirements. At the end, they made a separate task force and HN flew to the US to discuss the functionalities all over again. Two

Indians also came to the US to discuss with the users and to look into the current system how the codes work in practice. This, and some trouble with the database itself, caused some delays. In June, the expectation was that the system would be launched in August 1997." - AC, CarCo-K-2

§ 10.3 Thematic Interpretive Analysis

As a sequel to the process analysis, we applied an interpretive-thematic angle to the case. This second perspective was loosely coordinated with the DiskCo case and our theoretical focus. This resulted in a couple of key themes: ex ante situation; underestimation; planning, managing, controlling; organizing for distributed collaboration; development methodology; face-to-face versus remote, electronically mediated collaboration; time zone differences; and diverse cultures and ways of working.

§ 10.3.1 Ex Ante Situation

Looking at the situation before Goldd started helps to understand what happened during the project. Here we look at some of the coordination and control practices at CarCo and SoftHouse.

CarCo

CarCo is a global manufacturer that operates increasingly on a globally integrated scale. In the past, remote collaboration occurred but less on an operational level. Managers roamed the globe for multinationals to sustain a sense of coherence (Edström & Galbraith, 1977). But now, operations have become closely intertwined. Correspondingly, management structures have been transformed into global networks of people knowing each other and reporting ultimately to the same bosses. People pursuing a career in the same organization build relationships and skills to handle international assignments. The Goldd project leader - HH - is an example of such a manager. He is embedded in CarCo's distributed hierarchy for M&SS. Members of the Goldd team in the US formally report to him. He reports to his boss in England:

"My boss is in England, he has some local people in the US and part of my group is JF, CS, [other US Goldd team members] (...). They formally report to me. (...) We have always had a [transnational management structure]. It's global now, but it used to be European.
In a previous assignment I had 7 people in England, 7 people here (Cologne - author). And I spent half of my time in England. [CarCo] is moving to global business practices. Certainly the systems organization has been globalized." - HH, CarCo-A-3

Over the years, CarCo has built international agreements and reporting standards that can be leveraged in a global project like Goldd. HH has a counterpart in the US to fall back on should he experience problems with Goldd team members there. That manager reports to the person who is also HH's boss in England. Issues arising in the US on an operational or managerial level can therefore be easily escalated to England.

"I have management mechanisms in place that would ensure that if they (Goldd team members in the US - author) don't perform or if they have problems that I need to help them with, then there is a management structure that allows me doing that. Because my boss is also the boss of someone in the US. There is [CarCo] management structure and agreements that have been in place for quite some time as a working pattern between England and here." - HH, CarCo-A-3

To illustrate the way this works, HH refers to people working in the same office space in Cologne. While they formally report to someone in England, HH has a front-end role. The person in England may not be aware of issues emerging in Cologne, or he cannot respond rapidly enough. For those instances, HH complements the remote supervisor's role. He does that in a coordinated fashion - through regular exchanges with his counterpart in England.

"People in the next cube for example have always been managed by an English supervisor. Still I am the local front-end so any problems with pay, sick-leave, vacation, all these kinds of things are done by me. Also the performance appraisal and so on and so forth - they are all my responsibility. Now I wouldn't do anything serious (...) without discussing it with their functional manager. Still there is a management structure here onsite that guarantees that things are going as they should." - HH, CarCo-A-3

Likewise, HH cannot manage his US team as he would do locally. He depends on his buddy in the US to compensate for his physical absence. HH met this person face-to-face on prior occasions. This established some form of relationship that makes it easy to connect remotely. On top of that, both report to the same boss.

"I have that supporting structure in America. If somebody is sick or if there is a problem that I can't solve on 5000 miles away, I call one of my pals and say "You gotta help me buddy". And they will do. (...) I have been there a couple of times and we have met. We have regular staff meetings with my boss, because we have a common boss and that's very simple. If I don't get anywhere I phone him (HH's boss - author) and say: "Boss I have a problem", and then he will make it happen. See, there is the management structure that supports that, I'm assured of that. In India (i.e., HH's involvement with SofHouse operations there - author) that's not the case, I'm not their boss, not by any standard" - HH, CarCo-A-3

All in all, CarCo's management structure defines and integrates global and local responsibilities. Such a fine-grained network does not exist between CarCo and SoftHouse because the companies never worked before. We elaborate on that topic in the next section.

On an operational level, interviewees experienced often for the first time cross-site collaboration within the CarCo organization. They noticed that people from other sites had different backgrounds. Local operations also differed, although some people noticed a CarCo way of working. From the US, JF comments on her first experience working with the German CarCo group. The kick off phase appeared very difficult, partly because it was remote:

"At the beginning there was a very big difference. I even thought it was scary, it did not know how long we could last working together. They are very rigid, very controlled. Later they were more relaxing, they were more open after I had been there. (...) We really had to grow into it." - JF, CarCo-D-2

From JF's perspective, CarCo has a distinct culture and way of working. This makes it easier to collaborate, even on a distance. It seems that this way of working is tied to CarCo contexts (von Hippel, 1994). It is an organization-specific advantage (Williamson, 1975). This complicates collaboration with other firms, like the Goldd outsourcing contract with SoftHouse. Across organizational boundaries, each firm's unique way of operating adds to the challenge of those interactions on an operational level.

> "The [CarCo] culture is the same worldwide. This depends a little bit on recruitment, but not much. A lot of people who work here are agency people, and they work here 1 or two years and are gone again. (…) I think the biggest thing is learning the [CarCo] style of working. It is easier and you can work faster if you know how to get things done. I do not want to call it politics though. And [SoftHouse] will never learn the [CarCo] way, because you have to be there to learn it." - JF, CarCo-D-2

From Germany, HN echoes the existence of a CarCo culture. At the same time, he points out that project participants come from diverse backgrounds, and bring different levels of knowledge and skills:

> "We all speak different languages, although we all speak English, it is very different. Besides, we have different educations and different experiences. (…) We do have a [CarCo] culture. (…) We don't have the same training. (…) We have the same products and the same knowledge, but not for this product, probably the learning on the job is the same. There is a big gap between [CarCo] US and [CarCo] Germany and India, also in skills." - HN, CarCo-B-2

SoftHouse

SoftHouse is a much less mature organization. It was started only a few years ago, compared to CarCo's decades of history. Consequently, SoftHouse does not have a strong culture or elaborate set of standards to work by. When he was in Germany, SPB commented on operations in India. Compared to Germany, the knowledge base is similar, but operations are less structured and standardized.

> "I think Indians have as good skills as here, but maybe not properly channeled. I think they are equally competent, but they do not work the standard, German way. The Germans want to work with standards, baselines for example, and documentation. (…) In India we do have our own internal standards but they may not be as strong as in Germany." - SPB, CarCo-E-2

His colleague from India - MD - indicates that SoftHouse follows internal rules and standards, although many are not explicit.

> "We do have internal standards. (…) I am sure that there are rules that I follow, but I would not know what they are. [CarCo] has not set rules to follow, except that a document should have a header etc. We do have internal [SoftHouse] rules like with every delivery there should be a delivery note." - MD, CarCo-F-1

Looking at SoftHouse India operations from a German point of view, HN expresses concern on their lack of structure. He would have liked more effort upfront to select a quality supplier and align standards. As things turned out, SoftHouse lacked internal experience and standards to handle the project. They rather had to define the project along the way. CarCo embarked on the project without being sufficiently aware of this situation.

> "I wouldn't say they [SoftHouse operations India] have any [local standards and procedures]. They have to build it up from scratch, they can't take anything off the shelve. Freshly hired people come in, and then they somehow have to form a team. And then they build several rules on how to cooperate. But [SoftHouse] doesn't provide too much coherence." - HN, CarCo-B-3

HN expands on the lack of coherence. In part, that is caused by SoftHouse's workforce. Although IT professionals there have a strong technical knowledge base, they lack collaborative experience:

> "I think it is not a cultural problem, it is more or less an experience problem. They (SoftHouse India employees - author) are simply hired from the university. It is maybe their first or second job, when you do not have much experience, working in larger projects, maybe also not in working in a group, as a group. So they are individuals, have good knowledge in technical skills, as individuals, but I think the gap is the organization, the procedures, the standards, the working together, how do we approach a project. They do not have experience in that area and that's causing major problems." - HN, CarCo-B-3

§ 10.3.2 Underestimation

When SoftHouse signed the contract, they committed to a fixed budget and time frame. Usually, a vendor does that when the project work is well understood in advance, and matches experiences from prior occasions. Williamson (1979, 1991), building on MacNeil (1974), refers to these situations as classical contract relationships. Parties are aware of their own and their counterpart's performance expectations, and they are able to comply under normal conditions. In its extreme form, parties do not even have to know the identity of their partner (Williamson, 1991). Since parties know tasks in advance, contractual enforcement is a matter of following explicit stipulations.

§ 10.3.2.1 Classical Contract?

In the case of CarCo's Goldd project, it seems that both parties assumed something like a classical contract situation. From the side of SoftHouse, people proposed a fixed budget and planning of phases. CarCo did not fully understand the outsourced work. (In fact, that was one of the reasons they hired a vendor.) But they trusted that the vendor would understand the project. SoftHouse was selected for its ISO quality control mechanisms and track record of successful projects (CarCo-A-3). CarCo thus knew that it did not have in-house capabilities to accomplish Goldd. From that position it trusted the supplier's routines to handle the project. Project uncertainty thus depended on an organization's competence and experience, and not so much the work itself. This agency relationship could resemble a patient's visit to a doctor or dentist. The person trusts these professionals to recognize and solve a problem. The CarCo project leader used the following metaphor to describe his relationship with SoftHouse for Goldd:

> "If you compare that to a production supplier doing air-conditioning, all you ever see is the salesman and the engineer. The engineer to discuss technical details, the salesman to discuss the price." - HH, CarCo-A-3

HH perceived the Goldd project work as something known to the supplier, i.e., SoftHouse. All that the latter would have to do is come over, look at the situation, make a deal, develop the product independently, and deliver. This suggests a rather ‘clean’ interface between supplier (agent) and customer (principal). The agent connects only during an initial phase to the principal’s context. After that, the principal waits for the agent’s deliveries, and counter performs (e.g., payments) (Eisenhardt, 1989a; Jensen & Meckling, 1986). CarCo and SoftHouse thought that Goldd resembled this situation, and structured the project accordingly.

§ 10.3.2.2 Reality[62]

The reality in the case of Goldd looked differently. Uncertainty was not only a matter of CarCo’s competence. It traced back to highly ambiguous requirements, and unawareness in the CarCo organization of its needs. AC writes in her report: “The system (i.e., Goldd - author) is characterized by high ambiguity of the functional requirements as even the system analysts cannot always specify the requirements in detail” (CarCo-K-2). The role of these requirements and preferences was more important than CarCo anticipated. It was not a matter of inviting a vendor during a brief window, and letting them develop a perfectly matching system. Instead, the situation resembled more that of a sophisticated hair cutter (in the role of agent). The end results depends on the interaction between the customer’s preferences and the professional expertise. This makes the agency relationship highly uncertain (see also the bottom row in Table 35). Principal and agent work on a joint task that is characterized by close, almost continuous interdependence. In turn, the nature of this relationship (should) drive coordination and control processes.

Table 38 attempts to depict what has been said so far. The columns show two contingencies (uncertainty and dependence), and coordination and control processes. The rows illustrate perception and reality of these constructs. In the case of CarCo, there was a difference between perception and reality. The perception was that SoftHouse could work for a while with CarCo, develop the system locally in India, and implement Goldd after processing feedback from some Model Office sessions. Indirect contact between sites through the onshore and offshore liaisons would suffice. In reality, SoftHouse depended strongly on CarCo’s requirements and preferences. They needed a more frequent and direct connection to CarCo contexts. The resulting mismatch undermined the success of the Goldd project.

[62] ‘Reality’ is used in this section as inter-subjective understanding. That is, the reseacher’s interpretation of empirical data from multiple interviewees.

Table 38 - Perception and ‘reality’ of collaborative relationships

	Uncertainty & dependence	Coordination & control
Perception	▪ ‘Air-conditioning supplier’ ▪ Limited uncertainty and dependence	▪ ‘Clean’ interface ▪ Indirect communication channels
	↑ Difference → ↓	↑ → Impact, mismatch ↓
‘Reality’	▪ (Preferential) ambiguity ▪ Strong, reciprocal dependence	▪ Intertwined operations ▪ Direct interaction needed

We illustrate this reasoning with empirical data. A recurrent theme in the interviews is that Goldd confronted both CarCo and SoftHouse with a number of ‘firsts’. That is, they tried things they had never done before. From the German team, MB explains that the project represented a considerable challenge. For the CarCo units it was the first project with colleagues from across the Atlantic. Goldd was also the first outsourcing experience, and the first time people worked on a client/ server application. This made for an uncertain work environment that lacked (explicit) structure (Van de Ven et al., 1976):

> “As this is a pathfinder project for [CarCo], there are a number of firsts: first outsourcing, first global, first client/ server. There are no standards. We have to find our own path and rules from day to day. The standards change from day to day. (...) The roles are not stable. I have never seen written work specifications. One commits to this, one commits to that.” - MB, CarCo-C-1

In a similar vein, SoftHouse’s onshore liaison - BW - finds it remarkable that goals have been achieved “despite the number of ‘firsts’ being attempted on the project” (CarCo-G-1). He also expresses concern on “unrealistic expectations from senior management both [SoftHouse] and [CarCo]” (CarCo-G-1). This is echoed by HN (senior analyst in the German CarCo team). As for CarCo’s role, he points out that management underestimated the project. They thought that Goldd would encompass basic functionality around a database. Besides, it relied on the successful European DID system.

> “I clearly admit that it was certainly an underestimating of the complexity of the dealer database. It was more seen by [HH] or management generally here as a very simple task. I mean you get a database, you have a table, you stick in information, and retrieve it, and that's it. You don't have too much processing, which is true if you compare with other systems which we have here in manufacturing, which have much more complexity in terms of logic and algorithms, and calculation and volume behind it. So it's a simple task, a simple system for [CarCo], but it is still in some areas quite complex.” - HN, CarCo-B-3

This underestimation had sore effects on (1) the contract and (2) the project setup (see Table 38). First, the contract left little room for adjustments that had to be made during the project. It fixed price and timing as if parties had a solid, realistic grasp on what it would take to develop and implement Goldd. That was not the case, resulting in a gap between the formal outsourcing relationship, and the day-to-day actual work.

"The fixed price and given time without specifying functionality caused aggravation throughout the team. If any idea was raised the answer would be: "This was not in the bid document, this was not included in the price". I am not opposed to fixed price as such, but fixed price in phases. I.e. fixed price for the prototype, fixed price for the reviewing the prototype, etc. Fixed price over the whole project gives no room for prototyping. There was endless fighting about what was in the bid, sometimes based on either misunderstandings (you can interpret a document in 100 ways) or wordings. With the prototype approach, there were endless discussions. Fixed price and prototyping is a contradiction in itself. The bid document was unrealistic with the whole process" - HN, CarCo-B-1

A second effect of underestimation was that the project setup lacked realism in certain areas. To CarCo staff, working with an external partner - let alone offshore - was a new experience. Yet instead of introducing and gradually setting up the remote partnership, people were expected to start straightaway. This rushed project kick off backfired later on when it became clear that Goldd's complexity was underestimated:

"The argument was always: we want to quickly launch something. Quality is second priority. But at the end you see how long it takes. You end up with a lot of embarrassment, and conflicts which don't help. You must start doing it well from the very beginning, to say: "OK this is what it takes". You must have a realistic evaluation of the complexity." - HN, CarCo-B-3

HN's colleague in Germany echoes these concerns. He was surprised that rapport with Indian counterparts was not established, while the American team came over to Cologne.

"In the project we have not been given time to get information about India. We only have time for the project. From the company there is no intention, like: "We have a new strategy "outsourcing", your partner is in India and we will give an introduction. We did have something with the American colleagues when they were in Cologne, a social event, dinner together. It could be helpful to do the same with partner." - MB, CarCo-C-3

Underestimation also concerned SoftHouse. A senior US team member from CarCo adds her perspective on their role. In her view, the company embarked on the Goldd project with little awareness of what was expected and needed. CarCo expected them to play an expert role, but this was not clearly communicated or picked up:

"They (SoftHouse - author) need to understand what they try to accomplish. They took the contract without knowing what was required. As this is the first time for [CarCo] to do client/ server development, we also expected some expertise and suggestions about this development, and until now we have seen very little of this." - JF, CarCo-D-1

One reason for this lack of assistance was that direct contact between the US and India was avoided (see Figure 52). Communications between these sites were channeled almost exclusively through Germany. Rather late in the project did parties realize that a direct connection was needed, as Figure 55 depicts. An example of this was the Model Office in December 1996. From India, SPB traveled with German team members to the US and worked directly with users there. He explains that this contact provided him with a better understanding of user needs. In turn, he could now give suggestions on ways to improve the system, based on his expertise. This changed the relationship between the SoftHouse team and CarCo users. Instead of the pre-supposed, quite simplistic connection, parties realized to some extent that a more intertwined process was appropriate (Table 38 from 'perception' row to 'reality' row). SPB comments:

> "Users (North American users he met during the Model Office - author) do things because they are used to do things, they have certain practices out of habit. The user does not know why he does certain things, he only knows that he has been doing it this way always. Programmers have a more global overview and they can ask users why they do things in a certain way. And often programmers can propose an easier way of doing things, the user would not think of the easier solution." - SPB, CarCo-E-1

AC adds in her comments that "SPB sighed as if this would be the ideal solution" (CarCo-E-1). As the project is already in a late stage (December 1996), she continues: "Of course, it is already too late to built in new business practices in the program. So I ask him if it is not too late already to see the users. SPB agrees that it is very late to see the users, it would have been better if he had been there at the first Model Office" (CarCo-E-1).

What this perspective suggests is that dependencies are more complicated than assumed in a traditional agency relationship (Table 37). More precisely, this concerns the knowledge and information flows. Not only does the principal provide the agent with information on his requirements (Flow 1, Table 37). It is a more interactive process of exchanging ideas, based on the principal's needs and the agent's expertise. Flow 1 is therefore spitted as shown in Table 39. Flow 1a is similar to the one depicted in Table 37. Flow 1b adds a reverse knowledge and information flow. B (SoftHouse) provides A with ideas and suggestions based on his expertise.

Table 39 - Agency dependence and the CarCo case (2/ 2)

		Principal (A)	Direction of flow	Agent (B)
		CarCo		SoftHouse
Knowledge & information flow	Flow 1a	A provides information/ knowledge on his expectations/ context to B	➔	B needs information/ knowledge on A's expectations and context
		➔ Specifications, knowledge of CarCo context ➔		
	Flow 1b	A needs suggestions based on B's expertise	←	B provides suggestions based on his expertise
		← SoftHouse expertise ←		
	Flow 2	A needs information on B's performance	←	B provides information on his performance
		← Information on SoftHouse deliverables ←		
Flow of activities	Flow 3	A receives performance from B	←	B performs for A
		← SoftHouse deliverables ←		
	Flow 4	A performs for B	➔	B receives performance from A
		➔ Financial resources, testing results ➔		

§ 10.3.2.3 Roller Coaster

Reflecting on his experience, the project leader compared the project to a roller coaster. When asked for crises and achievements in the Goldd project, he commented in a more pessimistic moment:

> "It is all a crisis...Did we have successes? The contract, the bid ...Will the roller coaster suffice?" - HH, CarCo-A-1

From his angle, the early phase of the project went wrong. The setup with an on- and offshore liaison did not work. This disrupted the knowledge flow from CarCo to the Indian team members, and undermined their efforts (Flow 1a in Table 39).

> "I think the start went wrong. We got off on the wrong foot. I think basically the two people who were supposed to transfer the knowledge to the Indians did not function for whatever reason. I think one of the reasons was that they were not employees of [SoftHouse]. They were freelancers that had been hired in on a contractual basis. What would have been there incentive to make it happen, other than making a lot of money in a very short time." - HH, CarCo-A-3

Conversely, one of these liaisons (BW) stresses the complexity of the project and number of 'first' attempted (CarCo-G-1). He points out that the project was challenging because of its geographical scope, and technical and organizational complexity. Given these factors, BW criticizes unrealistic expectations from SoftHouse and CarCo management. This resulted in a stressful work environment, and late deliveries.

§ 10.3.3 Planning, Managing, Controlling

In this section we look at three themes that are closely intertwined. Starting with planning, we look at local and cross-site contributions to the planning process. The section then focuses on management and control. We assess control modes and management responsibilities in a multi-site, multi firm project environment.

§ 10.3.3.1 Planning

The Goldd site in Germany is responsible for coordinating and planning the overall project. This is one of HN's tasks, together with the project leader HH. In our interview with HN, we probed for the role of planning in a global project like Goldd. We were also interested in the division of responsibilities and contributions to the planning process.

HN makes a clear distinction between planning on a local versus multi-site level. Across sites, the project is planned in major milestones and phases. HH and HN communicate that plan to the US, and discuss it with the onshore liaison. In the US, local planning efforts complement and elaborate the master plan. Their detailed plans are not shared across sites. HN explains why:

> "On a very detailed level, planning is down to the local responsibilities. They (US team - author) have detailed plans how they do the conversion from CIS or CDDB to GOLDD. That's not really of interest for the other sites, that's for their local

organization how they want to work together in that group. It's more or less day-to-day or weekly business, that's down to the local site. (...) Nobody in India is interested in work in the States on a detailed level as long as their work is not impacted. Then they have nothing to do with it on a very detailed level." - HN, CarCo-B-3

From HN's angle, local work packages are only loosely coupled across sites (Orton & Weick, 1990). Assuming limited dependencies between project locations, he relies on high-level plans on a meta-site level: "Across sites there is just coordinating the major tasks, targets and milestones" (CarCo-B-3). To this end, the German site uses project management tools only "on a high level, milestone level and major task level, not on a very detailed level" (CarCo-B-3). CarCo plans are linked to SoftHouse through milestones. These provide a minimal level of coordination between the two firms as HN explains:

"In the plan we also define the contents, like what one should deliver with some milestone. We only do planning for [CarCo], we link the planning with [SoftHouse] through the milestones. They have to finish on the same date as we for certain milestones" - HN, CarCo-B-2

The project leader makes a clear distinction between his site and CarCo US, versus SoftHouse. In his view, he is responsible for planning activities at these sites, not India. In that role, he uses Microsoft Project to prepare and communicate basic activity charts. These are shared locally in Germany, and in the US:

"I use the Microsoft project tool which for me is adequate because my team is relatively small. Basically five people, two guys here and three guys in the US, and it doesn't take a lot of work to juggle those resources. (...)For me the project plan I develop with Microsoft project has two aims. One to get a full picture of all the activities, and second to communicate that. And anything more complicated than that is difficult to comprehend by the user activity. So a bar chart or a GANTT chart is a fairly neat way of communicating a plan to people. I can send this (points at an example of a chart - author) out and it is pretty self explanatory. It doesn't take a lot of guessing to what the symbols mean. So I'm using that to plan the people and basically also to communicate the status of the project. Usually I write a letter and highlight any major achievements or any setbacks'" - HH, CarCo-A-3

To CarCo's US and German teams, HH presents himself clearly as the owner of the planning process and plans themselves. He emphasizes clarity and simplicity in his planning approach these groups. Recipients of the plan have the opportunity to feedback requests. The plans function as a point of contact between sites. They can be seen as information boundary objects (Star & Griesemer, 1989).[63] Plans provide minimal task representations of local activity contexts. For a polycontextual project, they show where these contexts come together (Engeström et al., 1995).

"That's (the chart he shows during the interview - author) the total work planning including the US people. (...) I send a file every once in a while. I try to be simple, I

[63] 'Information' is added to Star and Griesemer's (1989) construct boundary object to emphasize the non-physical nature of plans. Rather, they represent a process of pre-conceiving work, much like the specifications in the work of Henderson (1991), and Boland and Tenkasi (1995).

> own that paper, I send it around to people asking "give me comments". I work that in. See if there are any written comments, or any need for a discussion, and that's it. (...)You don't use complicated project management tools when you have a team of six people including yourself. You don't need to have any complicated communication mechanism. You do the plan, have a daily meeting, or a meeting every two days or a meeting every week to discuss the plan and any issues. Come back to me. I believe in simplicity. Keep it simple stupid, keep it simple for the stupid." - HH, CarCo-A-3

MB - data modeling expert in Cologne - explains that he uses the overall plan for identifying milestones. Apart from that, he plans work with peers from the US who are also involved in data modeling. Furthermore, the onshore liaison works with a more detailed list of tasks.

> "We have the project plan by HN and also on the data model side we have a plan. On more detailed level, BJ provides lists with tasks but not everyday." - MB, CarCo-C-1

Planning is thus an activity with multiple scopes. It can be seen as an effort to pre-conceive tasks, and tie these to actors and time. A distributed work environment then leads to multiple forms of planning. On a meta-site level, HH plans for US and German CarCo project members, and sub-communities that cross sites have their planning activities. Besides that, local contexts have their own activity structure and planning. Not a single, comprehensive plan and task list covers Goldd activities. On the other hand, people connect their planning activities to some extent. Plans are at least coupled through milestones.

For the US site, JF explains that she uses the overall plan, and prepares a detailed work schedule for her own team. Plans inform her site of activities that are expected. At the same time, she does not take them too serious because of an apparent lack of realism:

> "We have our own schedule. I make a work plan for this team (5 persons). And we also use the overall schedule. Of course we do not meet the schedule, but you have to have it to know what we need to do." - JF, CarCo-D-2

Separate contexts

The integrated operation that exists between the US and German CarCo units does not include SoftHouse India. Even though the teams in Bangalore play a key role in the overall Goldd project, their activity planning remains separate and largely unknown to CarCo. From the start of Goldd onwards, SoftHouse operations were minimally connected to CarCo while their activities are centrally embedded in the overall project workflows. The precise reason for this discrepancy remains unknown. It could be that the exclusive routing of collaborative exchanges through liaisons constrained relationships across sites (Meadows, 1996b). Or BW had difficulty building rapport with the team in India while being stationed in Cologne, especially after NK left. Or HH kept the teams on arms length. As indicated, he was one of the key persons underestimating the complexity of Goldd, and therefore the nature of the relationship between his organization and SoftHouse (see his metaphor of the air-conditioning supplier, CarCo-A-3). Since he did not see the complexity and close dependencies between the work accomplished by his organization and the vendor teams, he felt no reason for connecting to people in Bangalore:

> “I have never been involved in selecting any of the team, or managing the team, even knowing the names. Basically I didn't care too much. The question is should I have cared more than I did? I don't know. (...) If I know more than what is the value added of knowing that. And if I know less, how much more can I concentrate on value added things? I don't know, I can't say that.” - HH, CarCo-A-3

Similarly, he was not aware of their planning activities or tools:

> “What they (SoftHouse - author) use (for planning - author) I don't know, they present me with a Microsoft project work plan every once in a while, but whether they have any other tools, I don't know.” - HH, CarCo-A-3

The frequent use of “I don’t know” in the interview seems to confirm the minimality of ties between the supplier and customer organization. HH seemed not interested in crafting a closer connection to SoftHouse. Only closer to the end of Goldd did the relationship change (see Figure 52 through Figure 55). This was because SoftHouse started to invest in strengthening ties. They sent SPB and MD over to Cologne in December 1996 and Spring 1997. Conversely, BW and later BJ visited Bangalore.

In the later stage of the project, MD from the Indian team worked on-shore in Cologne, together with BJ. She points out that HH as CarCo representative, and BJ as SoftHouse representative elaborate the Goldd plan. Subsequently, MD connects to her counterparts in India to check their time frame. She brings back that information to the onshore group to complete the planning process. (The ‘prayer meeting’ mentioned in the next quote refers to a daily meeting at 10 AM in which CarCo and SoftHouse discuss work progress.)

> “[CarCo] tells what they want, we give an estimate in days, they give expected days, we discuss and together we get a date. Overall planning is done in the prayer meeting by BJ and HH. I have the opportunity to say something if I like.” - MD, CarCo-F-1

One remarkable feature of the project is the short planning horizon. This could be due to the ‘many firsts’ that were tried in the project (CarCo-C-1, CarCo-D-1, CarCo-G-1). The novelty of tasks limits the scope of the planning process to just a few steps ahead. For the longer term, people give only vague indications of tasks to be done.

When he left, BW criticized this situation. He mentions the “Lack of detail, consistency, completeness and topicality of plans, both from India and from [CarCo]” (CarCo-G-1). Especially in multi-context projects that are geographically distributed, plans fulfill an important role (Jarvenpaa & Leidner, 1998; Meadows, 1996b; Staples, 1997). They complement the difficulty of interpersonal coordination. Plans specify and clarify tasks in these environments that include often very diverse contributors. In the case of CarCo, plans played such a role only in a limited sense because of their incompleteness and limited scope. Task novelty and complexity may have contributed to their incompleteness. The limited scope refers to both the planning horizon and the inclusion of sites in the planning process. Inclusion of SoftHouse in the Goldd planning process was minimal and mediated through the onshore liaisons. The two worlds operated independently, a situation that evoked a critical comment from CarCo senior analyst HN:

> “There should be a common project plan between here and India. (…) The project ran on an exceptional basis, always on crisis and urgency. Management by exceptions. Like: “Fix something that hasn't been done yet”. This is only for the Indian site. The American team is always reliable.” - HN, CarCo-B-1

He suggests a more closely coupled operating mode between the SoftHouse and CarCo sites. This would be reflected in a joint planning process that creates more transparency across sites, even though task uncertainty and complexity make detailed planning not possible. A common planning process or at least more document exchange would enhance mutual awareness of work progress. In practice, this would be challenging, though. As we elaborate in a later section, the offshore team put less emphasis on formal planning and documentation.

§ 10.3.3.2 Managing and Controlling

> “I have always been THE person responsible for Goldd and that has not changed” - HH, CarCo-A-1

Scholars suggest that distributedness alters management and control processes. For instance, Staples (1997) and Kurland and Egan (1999) document challenges for managers to operate in a teleworking environment. Perin (1991) and Wiesenfeld, Raghuram et al. (1998) discuss novel forms of control for distributed work environments. These substitute for older ones that applied in single-context operation modes built around co-presence of actors.

In this section, we assess the role of management and control processes in the Goldd case. We give insight in the multiple forms and contexts in which people enact these processes. We start with CarCo, looking at local management and control structures in Cologne, Germany and Detroit, US. We then focus on controls within the CarCo organization but across these two sites. This is followed by a similar piece on SoftHouse, with attention for operations in India, UK, and liaisons in Germany. The section concludes with an analysis of cross-organizational controls. We explore the interface between CarCo and SoftHouse operations.

CarCo

AC - co-investigator for the CarCo case - talked with the project leader on his control modes. As a starting point, HH perceived control processes as offensive. Or rather, he assumes his subordinates would perceive explicit control processes as intrusive. When someone controls another person, it could be interpreted as a signal of mistrust. While all he does not like to discuss control processes, HH stresses his overall responsibility for the Goldd project (CarCo-A-1). This could be considered somewhat paradoxical: someone is in charge of a multi-actor project but downplays the role of controls.

The control environment relies on several aspects. People’s individual competence and professionalism: “It is even more important that you have good people, mature people, motivated people in the other country 5000 miles and six time zones away” (CarCo-A-3). Their membership of the same organization and project environment: “We are all working towards the same goal really" (CarCo-A-3). And last but not least, HH's formal position of authority: "I'm their boss, you see, and that's a fundamentally different thing. I have management mechanisms in place that would ensure that if they don't perform or if they have problems that I need to help them with, then there is a management structure that allows me doing that (CarCo-A-3).

These factors underpin HH's trust in his German and US CarCo team. Trust has its foundation in these mechanisms, and enables, in turn, minimal explicit controls during the project. These controls would have a role if some of the factors mentioned were insufficient to support trust. Since that is not the case here, HH can downplay explicit control modes. Instead, he emphasizes self control and only under exceptional circumstances outcome controls.

> "A lot of it is self-control, or outcome control also. If things go bad, it's outcome control, if things go well: self-control. And that is the way I do it. It is offensive to control. You have to trust people to control themselves. This is for Germany and the US. To India we have outcome control on daily basis, a formal 'prayer'- meeting every morning at 10:00 for an hour, an hour and a half. And that is a good way to check and ensure that things are going as they should. [I usually do not use] behavior control" - HH, CarCo-A-2

Trust-enabling factors are less prevalent in the relationship with SoftHouse. Obviously, the companies connect laterally, not hierarchically. Common goals are also not self-explanatory in a contractual relationship (Ouchi, 1979, 1980). For this reason, HH perceives a clear difference in his control approach towards SoftHouse. He stresses regular meetings to present and discuss outputs.

A similar distinction is observed by HN, one of HH's closest subordinates. In a separate interview, he echoes his boss' view quite closely. People have a formal hierarchical relationships, and they feel responsible for the work they accomplish. These factors justify trust and reliance on self control where people define and monitor their own work. Some degree of outcome control is used to maintain coherence and handle problem situations. On the other hand, for SoftHouse, outcome plays a major role. The factors mentioned for CarCo are absent with SoftHouse (hierarchical relationship), or cannot be taken for granted (common goals and responsibility).

> "HH controls the whole project, I control the content and the timing. (...) We have a hierarchical relationship. A lot of it is self control or outcome control. People feel responsible for their tasks and that is why they use self control. Only when things go wrong, HH is expected to step in. The expectation however, is to use self control. We use both self control (define smaller steps for yourself) and outcome control (time and expected delivery/ contents are checked). For India, we use outcome control." - HN, CarCo-B-2

A final perspective on controls in Cologne is offered by MB, HN's peer. He mentions that HH officially controls his work (CarCo-C-3). People seem to consider hierarchical control relationships as a basic premise of the control structure in the Goldd project. Operational, they experience the vertical element not as very prevalent. It is more something that underlies collaborative relationships. In day-to-day practice, a mixture of hierarchical position and more laterally oriented participation emerges:

“HH is above the team, but there are exceptions, like on detailed items on the issues list he puts his name. Normally a project leader would delegate everything. [The hierarchical difference] is big for some tasks and for some not. If HH is asking me or BM (Detroit, see Table 32 - author) for the status of the DM (data model - author), there is hierarchical difference.” - MB, CarCo-C-3

More importantly than his hierarchical relationship with HH, MB points at the role of lateral peer controls. He works in a sort of distributed team setup with CarCo people working on the data model for Goldd. Participants include HN locally, and some team members in the US, especially BM and ST. Controlling in this environment helps participants to ensure the quality of their contribution. The complex tasks associated with the data model necessitate reliance on peer reviews. The sometimes negative connotation of control does not apply here, as MB explains:

“My work is not per definition checked by someone. But you double check with colleagues like HN, BM, ST to avoid misunderstanding because the data model is very complex. Major milestones are checked like the database freeze, but that is supervision, not checking. HH delegates that either to HN or to myself.” - MB, CarCo-C-1

People involved in the data modeling work have developed a common understanding and agreed on standards. The lateral control process ensures conformance with these. Unlike hierarchical control, the role of controller and controllee rotates here freely, depending on “whoever feels competent” (CarCo-C-3):

“At the end my work is always double checked, in agreement with colleagues in the US. Whoever (me/ ST) feels competent can change something, but only in agreement with the rest. (…) I check data from US, double check if the information is in line with what is agreed, check it with what we think is common understanding. It has occurred that somebody sent a file that was not in line, that created confusion. So all documents that are sent (from the US - author) are checked in Cologne. Or they are sent to India and .cc to the rest, just to make sure.” - MB, CarCo-C-3

The peer control process operates primarily within CarCo, but connects to SoftHouse. CarCo receives deliverables in Cologne for checking and approval. On a high level, HH checks whether these comply with earlier agreements. Detailed control tasks are divided between MB, HN and US colleagues:

“Either HN or BM /ST comment and review my work. For workflow for example I will do the basic control of SoftHouse work and HN the more detailed control. Somebody like HH has to do the control like: right product, timing… (…) We work together in a team, if there is a task to do, we divide the tasks in a meeting.” - MB, CarCo-C-3

CarCo US

In Detroit, JF plays a central role as coordinator of people contributing to Goldd from different departments (Figure 51). In her position at the M&SS department for North America, she works on Goldd and a few other systems. She has a local boss (RF, and above that FR) to fall back on for issues and questions. For her day-to-day work, she functions to a great extent on her own:

> "I do have a manager, but he is only for problems or special requests, not for supervision. (…) My bosses are RF, and above that FR. They are there for problems and issues, if I need to know things or need help in doing things." - JF, CarCo-D-1, CarCo-D-2

Locally in Detroit, JF functions as a central node. She liaises with business users and ensures quality of the IT staff involved in Goldd. She does not have a formal hierarchical position, but took on a central role because of her expertise and experience in the CarCo organization.

> "For my staff, I am the control person in the US, the majority of the work is checked by me. I am the person to have all the information, on the business and applications side." - JF, CarCo-D-2

Control in this local peer group is informal. Controller and controllee roles are not fixed, though JF is positioned to initiate control processes if need be. People know their job and seem dedicated to do it well, so there is little need for strong hierarchical controls.

> "Most of it is outcome control, there is no high level of control, no hierarchical/ management control. Everybody does what he has to do and if there are problems we arrange a meeting. However the outcome of the work defines everything else, like timelines. It controls where we are and what we do. The work is divided in a group decision, everybody will do a piece of the work. Some times I have something to say, but not very often because everybody knows what to do." - JF, CarCo-D-2

For Goldd, she formally reports to HH. This was arranged a few months after the project started. HH frames the overall project, also for JF and her colleagues in the US. JF then uses local meetings to translate that for her group into their own planning scheme. HH trusts JF for taking care of local business (self control). He relies on outcome control to ensure formal coherence between the US group and others involved in the Goldd project:

> "My work is controlled by HH, mostly through outcome control, when do we get it done. But also self control." - JF, CarCo-D-1

> We have status meetings of the work and disseminate it at this side. HH will tell what we need to accomplish and by when. HH is doing the controlling on a high level" - JF, CarCo-D-2

We elaborate on control processes between the US and German CarCo sites in the next section.

CarCo Germany and US

So far, we discussed some management and control practices between the German and American Goldd sites. First, HH, the project leader, could fall back on a transnational CarCo management structure. His boss is in England, and he also heads managers in the US who are formally responsible for Goldd team members there. Second, on a project level, HH was appointed as official boss of some US Goldd members (among them JF, CS). Third, HH has established rapport with JF in Detroit. She is the lead person there. In one of our interviews, HH emphasized the importance of having a strong, competent and motivated individual who coordinates at a counterpart site. The relationship with this key person substitutes for direct managerial involvement with that site. It reduces remote communication needs and makes it possible to deal with limitations of cross-site contact.

> "It is even more important that you have good people, mature people, motivated people in the other country 5000 miles and six time zones away. It is even more important. I don't have to talk to JF on a day-to-day basis. She knows the plan, it has been reconciled with her and she makes sure that it's executed. But if she wasn't as strong as she is, I'd have one hell of a problem. If she'd be here I could kick her around every day. Not that I would, but it is the right kind of people, who do the right kind of jobs, you can always do these things - they almost run automatically. It cannot fail. But if you get the wrong kind of people, then no matter how good you plan it you gonna fail." - HH, CarCo-A-3

Over the course of the Goldd project, a number of factors have contributed to good working relationships and trust between the US and German teams, and the fact that things run "almost automatically" (HH, CarCo-A-3). People are part of the same organizational entity, even though they work from different locations. Formal reporting relationships provide the backbone for solving specific issues. And visits establish reciprocal awareness and bonds that facilitate subsequent remote contact.

> "What I'm fairly proud of is that over the duration of the project, and it started in 1995, the [CarCo] team has kept an excellent working relationship with each other - HN, MB, JF, CS, DM and a couple of people on the sidelines like BM, SK both in the US, and their bosses, we have very very good working relationships." - HH, CarCo-A-3

HH is not the official boss for the complete US team. Still, managing these people appears not difficult. As Figure 51 shows, they report eventually to the same boss in the US. This person reports to an executive in England, who heads also HH's unit. This formal structure facilitates task prioritization and resource allocation across sites. In this case, it also seems to create a positive social climate:

> "I am officially the boss of JF, CS and DM. CP and LF from Process Leadership Customers Services have other manager, as do BM and SK (see Table 32 and Figure 51 - author). [That does not create conflicts with their bosses.] They have good objectives set to work with GOLDD and there is mutual respect. They are not difficult to control. It always works on a consensus basis for all the group. If JF cannot do something, she will tell me." - HH, CarCo-A-2

Together, the factors mentioned here constitute a multi-dimensional basis for remote collaboration. That is, the CarCo teams can rely on formal and informal, task and people oriented mechanisms for ensuring integration of task accomplishment in a polycontextual, geographically distributed work environment. All this allows for minimal remote management and control efforts:

> "For the US the level of control is less. So there is more trust for them to self-control. I do not want to micromanage a team at 5000 miles distance." - HH, CarCo-A-2

So far, we focused primarily on hierarchical management and control. We found that HH could leverage on a solid base for handling the US team. Now we zoom in on lateral controls. Interestingly, people point at extensive control needs there. Goldd presented the CarCo IT staff with a number of 'firsts', i.e., task novelty. Moreover, portions of the new system were ill understood and poorly designed (Sales and P&A codes). Other pieces - like the data model - were quite complex, in part because requirements from different business units in North America and Europe had to be integrated.

> "You double check with colleagues like HN, BM, ST to avoid misunderstanding because the data model is very complex. Major milestones are checked like the database freeze (…)." - MB, CarCo-C-1

Distance between CarCo's US and German team makes this job not easier. In fact, it seems to increase the need for controls. People experience constraints when collaborating remotely. They can establish a channel with only limited capabilities compared to face-to-face discussions. Also, collocation would allow two or more persons to use a tool and give feedback in a short time span, instead of having to work in a more asynchronous mode. These limitations of remoteness necessitate careful checking to detect misunderstanding and errors.

> "There is so much controlling because the only medium is telephone and profs. With telephone you cannot see words and profs is only one way. When discussing face-to-face, with a PC or pen and pencil and you can draw a diagram and make them see what you mean, or you can use the tool immediately instead of waiting for reports from the tool. That would work easier." - MB, CarCo-C-3.

SoftHouse India

Like many software houses in India, SoftHouse built a successful business in the 1990s. They hired technically educated people fresh from the university and put them on projects for customers in Europe and North America. MD talked about this environment when she was in Cologne for Goldd. She is a senior team member from SoftHouse operations in Bangalore:

> "We do a lot of overtime work, but this is only for the software branch, only at [SoftHouse]. Indians are hard workers, they work on Saturdays and also on Sundays. But that is not really a problem because most of us are young and unmarried, and they do not have anything to do on Sundays. (…) We have a lot more fun. Each person of the team brings something to eat and we fight about it, we sing, we listen to the radio and we get the work done. And teasing is a big thing too, they are teasing all the time. (…) The office environment looks like this (CarCo Cologne site - author), but more people in the same space so that they can see what you are doing." - MD, CarCo-F-1

The local style of working is informal. People work in teams and control each other's work. They prefer oral communications over written plans and documentation. The hierarchy in these project environments is not as structured as common in Europe and North America. Interviewees draw organization charts that are different. BJ - the second onshore liaison with extensive consulting experience in India - explains why: "The reason why everybody sketches a different organizational chart is because the hierarchy in India is not very strict" (CarCo-H-1). MD echoes this view on hierarchical control. She seems somewhat puzzled when asked who controls her work:

> "Nobody controls me … VA? (team leader, see Table 32 - author) (…) Yes maybe to VA. No, I report to SM. The hierarchy is not very fixed, it is all very informal. (…) VA will give me a date, I will tell him that it is done. If I did not do it, I discuss with him

why I did not do it. The work is controlled according to standards by VA. And also by the user, the user comes back and tells that he doesn't like that screen." - MD, CarCo-F-1

In her team, MD plays a central role although she is not the team leader. From her position, probably achieved by working for longer time in the Goldd project, she is one of the key persons to control work accomplishment. At the same time, controller and controllee roles are not assigned to people in a very fixed manner. They rotate in the team (Barker, 1993; Smith, 1997).

"I am the person who says: "Okay", I tell if it is right or wrong. If I say it is okay it will be integrated in the system. But it is not so formal, we work like a team. Maybe it is team control. If there is a difference between two people, than a third person will solve it. It is not strict." - MD, CarCo-F-1

MD's colleague from the Indian team - SPB - explains that formally the team reports to a team leader, and he reports to the offshore project manager (SM and before him RG). This manager is officially responsible for the contribution of SoftHouse India to Goldd. If need be, he could escalate to a SoftHouse executive. The main mechanism for control, however, is the group.

"I am supervised by SM, he reports directly to SA. (...) We control in the team. The team leader controls what we do and when he's not there we do it ourselves. SM is a point of escalation if we have problems. VA is the team leader and he controls what we do." - SPB, CarCo-E-2

When people have participated in the Goldd project for a while, their value increases within the SoftHouse operation and on the labor market. Especially in the mid 1990s, the labor market was tight, and many IT professionals were looking almost weekly for a change to improve their job prospects. This led frequently to turnover. In Germany, the perception existed at CarCo that the Indian Goldd team and their contribution suffered because of this phenomenon. HN shares his view in February 1997:

"We had the breakdown of the Indian team. They never came up to speed. The 30 people were never there. At maximum there were 10 people. People were moved from Goldd to other projects. There was never a real Goldd team in India. There should be a common project plan between here and India. A lot of deliveries were late because there was no proper team." - HN, CarCo-B-1

From the Indian team, SPB admits that it is challenging to retain experienced IT professionals:

"People who start with the Goldd project are improving by working for Goldd and this means we cannot hold them at this project." - SPB, CarCo-E-2

Another perception was that the Goldd team members needed stronger management involvement. Many of these recent graduates lacked business experience. They could have benefited from a more structured and professionally managed work environment than the informal, team-based practices described above.

> “The team now consists of 18 people. 18 people need strong management. They don't have a leader. [SM is the project leader] Before SM we had RG. RG was sent away because the data model did not come. Now we have SM and the software doesn't come.” - HN, CarCo-B-1

SoftHouse UK and onshore liaisons
CarCo signed the contract for Goldd with SoftHouse UK. From there, liaisons were stationed offshore in India and onshore in Germany. The offshore liaison - NK - soon left the project. His counterpart, BW, worked until early 1997 in Cologne. While working from there, he reported to his boss in the UK who was responsible for the CarCo account.

Similarly, BJ worked for this person once he started on the Goldd project. In his view, he worked quite independently, with little involvement from the UK office. Occasionally he reports to his boss who has defined only some key parameters like BJ’s budget.

> “There is no control. I send a management report to [my boss] when I want him to know something or when he asks for it. (...) I am not really controlled in the work I do, because [my boss] doesn't understand it. But there is a budget I have to work with.” - BJ, CarCo-H-1

In a later phase of the Goldd project, Indian team members came over to Germany to assist BJ. Once they worked from Cologne, they reported no longer to their boss in India, but to the UK office. In practice, this meant that they worked with BJ onshore.

> “Now that I am in Germany I work for [SoftHouse] UK. So now I work for BJ. In India I would report to SM.” - MD, CarCo-F-1

SoftHouse onshore and offshore
SoftHouse UK and India both operate under a holding structure of a US-based firm. Officially, they have a non-hierarchical relationship. At the same time, SoftHouse UK connects to the European customer base and feeds orders to the Bangalore operations. To SoftHouse India, it is important to satisfy customers since this is in interest of them and the UK unit. Looking at the management and control theme, one can remark that management remains a local responsibility. As indicated, SoftHouse India manages local operations and customer contacts. At the same time, the UK office closes contracts with European customers. Their account managers monitor project progress and customer satisfaction. If need be, like in the CarCo case, UK management can intervene in the project. In our case, they repeatedly pressed SoftHouse India management to improve performance (see AC’s log entries from November 1996). At that time, deliveries from India were late. ‘Big bosses’ from SoftHouse UK had pressed Indian management to speed up and enhance quality. In turn, this pressure worked through within the Indian hierarchy (see also Figure 58).
The SoftHouse liaisons had also some role in the control process. They were directly involved in Goldd on an operational level. Based on their formal position, they had little influence on work accomplishment in India (Galbraith, 1973). Local teams and leaders were responsible for the functioning of the SoftHouse there. BJ explains:

> “I am not really controlled in the work I do, because [my boss] doesn't understand it. But there is a budget I have to work with. I set a plan, but I do not want to

> micromanage what is happening in India. SPB and SM do the controlling in India." - BJ, CarCo-H-1

Liaisons had to rely on a more lateral, relationship-based control mode. In practice, this appeared quite a challenge. It seems that especially BW acted as if he did have formal authority over operations in India. This clashed with local expectations there and undermined the effectiveness of BW's liaison role in Germany (see logs from November 18 - 22, 1996).

In Cologne, HH and HN share some information on the background of the deteriorated relationship between BW and offshore groups. They point at the fact that BW acted as if he had authority over Indian operations. Not only that, his approach seemed authoritarian. This contrasted with the organizational structures in India and led to indignation. Part of this seems the British background of BW that may have contributed to post-colonial sentiments (HH, CarCo-A-3).

The end result was that the Indian Goldd team operated quite independently. Their exclusive link to CarCo did not function well because NK had left and they did not like BW. Things improved somewhat when HH pressed UK executives. These people could use their hierarchical position in the global SoftHouse organization. They worked through local management layers to improve India's performance (Figure 58). A next step that offered a more sustainable solution was when BJ replaced BW. BJ was assisted for technical liaising by SPB or MD. These persons were strongly included in the Indian teams, and could leverage on that relationship, also remotely. Still, these people have a limited say in India because they are senior team members and not local management. HN explains:

> "BW and NK were hired by [SoftHouse] UK, they had never seen [SoftHouse] India, they had probably never been in India. The British - Indian culture: they were fighting each other. The Indian team would say that they are independent, they won't listen. They are annoyed by someone there telling them what to do. NK and BW had no authority, they were not the boss of the team, SM and later RG were. It is the same structure there as here. HH with his team in [CarCo]. HH is not BW's boss and BW is not HH boss. In India the same structure. They could only give advice. SM was independent of NK. NK had no authority to hire/ lay off/ restructure the team. Good advice from [CarCo] would never arrive at SM's team, this is still the situation. BJ has also no formal control, but he is in a better position because of SPB, but SPB is not the boss of the team. Indians are very proud, they don't want outside advice (...). Maybe offshore/ onshore managers of [CarCo] would be better. But they would not accept that in this situation." - HN, CarCo-B-1

The suggestion to use [CarCo] managers for the onshore/ offshore link may seem to make sense from a content point of view. These people could fill in Indian operations on CarCo expectations, and offer suggestions for how things could be accomplished. On the other hand, from a control point of view, they would experience similar problems as the British liaisons. Perhaps even worse since CarCo personnel would have no formal relationship to the SoftHouse organization but the project contract. We further explore the CarCo - SoftHouse relationship in the next section.

CarCo - SoftHouse controls

Having focused on controls within the customer and vendor organizations, we now look at the interface between CarCo and SoftHouse. As a starting point, Goldd was initiated by CarCo's M&SS units in North America and Europe. They were responsible for developing the system and sell it to CarCo business users. To the latter group, M&SS was primarily responsible for the system, like an agent is accountable to his principal. The person ultimately in charge of Goldd from CarCo's IT side was HH:

> "I have always been THE person responsible for Goldd and that has not changed" - HH, CarCo-A-1

This responsibility was complicated when CarCo decided to outsource the project to SoftHouse. With this firm, no prior relationship existed. The contract was closed when the Goldd project work was incompletely understood, both by CarCo and SoftHouse. The vendor seemed to impress CarCo with ISO certification and a track record of successful projects. As things turned out, this image was only in part based on solid organizational practices. SoftHouse assigned Goldd work to a group of junior IT professionals without - as it seems - providing adequate managerial and organizational support. CarCo was unaware of this situation, presumably because they kept SoftHouse as a vendor at arms length (see the earlier described air-conditioning metaphor, CarCo-A-3).

> "At the side of [SoftHouse] standards and procedures were missing. They had nothing there for guidance, they did not have a former project like this, so everything was new. One should check the quality of the supplier before making a contract. And agree on standards and procedures, tools and project plan. You need more agreement upfront." - HN, CarCo-B-2

On top of that, the initial liaison setup failed to connect effectively CarCo and SoftHouse operations. The offshore liaison NK left soon after the project started. BW proved not capable of establishing workable relationships with offshore management and team members. He did not pass on design guidelines and change requests from CarCo to India. This was found out rather late in the project after BW left (early 1997), and implied major setbacks for the CarCo and SoftHouse India Goldd teams. CarCo had made itself exclusively dependent on BW for connecting to SoftHouse India (Burt, 1992). Entrusting the key responsibility to this person appeared a wrong decision. We asked HH whether he had been or had felt responsible for the problems resulting from BW's conduct. His reply was:

> "It wasn't my responsibility to control that. [Question: Would you have liked that responsibility?] No. Absolutely not. Come on - you gotta trust the mechanism or you don't. And when a company sells you on so many successful projects and mechanisms in place for quality control and ISO 9000, and 9001, whatever, then you don't challenge their communication mechanisms. You trust the people that are there, that they are doing what they're supposed to do. There is basically little safeguard against putting on delay. And the guy (BW - author) lied to us. It went both ways: he lied to the Indians, he lied to us. If you have such a person it is devastating." - HH, CarCo-A-3

Early on in the project, CarCo - in particular the project champion HH - took a risk when they outsourced the project to SoftHouse. HH made himself dependent on a contractor that seemed capable of contributing successfully to Goldd because of ISO certification and track records. On an operational level, however, the company lacked quality controls for operations in India and the connection to CarCo. This discrepancy surfaced late in the project. People from CarCo and to some extent SoftHouse started off with confidence in contributors' good intentions and competence. They had little formal controls at their disposal.

Contractually, CarCo had to approve certain deliverables in return for payments. This financial incentive might have worked in a situation where the vendor had extensive experience with offshore outsourcing and projects like Goldd. But for CarCo, it proved not a sufficient tool to ensure achievements. In Fall 1996, it became clear that SoftHouse India could not meet temporal and quality criteria indicated in the contract. Once CarCo - especially HH - started to realize the default, they started to look for control mechanisms. This seems a delayed response. HH admits that he was not sure how to handle SoftHouse at first: "I had not thought about how to control SoftHouse in the beginning, because I did not know what I was getting into" (HH, CarCo-A-2). We discuss here several modes CarCo adopted for controlling SoftHouse.

- *Controlling operations in India directly?*

What CarCo lacked in the first place was direct control over India operations. This was not an option for several reasons. First, the outsourcing relationship simply could not grant the customer control over vendor personnel. That would mix a hierarchical organizational form with the lateral, temporary nature of a contract (Bradach, 1997). HH postulates a clear vision on this topic. He considers SoftHouse a supplier with full responsibility for the contracted services.

> "My managerial impact [on SoftHouse India operations] is nothing. I have no managerial authority over these guys. They are a supplier to me. And I don't make a supplier's personnel decisions, I just want them to deliver a product. (...) If you compare that to a production supplier doing air-conditioning, all you ever see is the salesman and the engineer. The engineer to discuss technical details, the salesman to discuss the price. But you're not gonna be selecting the men on the line and interview them to make sure that he delivers quality. At the end of the day that's the supplier's problem." - HH, CarCo-A-3

In fact, HH delegates part of his responsibility for Goldd work to another firm without loosing formally within the CarCo organization his own responsibility for overall project success. This makes his success with Goldd dependent upon an outside party without having extensive controls and management impact.

Second, distance made remote involvement in day-to-day operations unfeasible. Even for their counterpart unit in the US, HH relied on JF and transnational CarCo management structure to control work there: "We don't have the capacity of managing a team of 20 people 5000 miles away, that's impossible" (HH, CarCo-A-3). Similarly, HN mentions that without distance it would be easier to control SoftHouse accomplishments. CarCo would be more aware of for instance turnover in the Indian team: "There was never a real Goldd team in India. (…) If they would be here, we could see that, now we can't control them" (HN, CarCo-B-1).

Third, cultural diversity would exacerbate the challenge of managing a team in India. Even BJ - onshore liaison from the UK with extensive experience in India - does not take on that role.

> "I don't want to micromanage the team in India, that would be even more difficult because of cultural differences. BJ doesn't do this either. Indians are very proud people, they want to be involved instead of controlled." - HH, CarCo-A-2

> "(...) I do not want to micromanage what is happening in India. SPB and SM do the controlling in India." - BJ, CarCo-H-1

- *Output control*

While direct control proved unfeasible, CarCo focused on outputs. In fact, this was the main mode for checking SoftHouse deliverables. HH points at the important role of regular meetings with the onshore liaison to receive outputs. He learned to do this in the Fall 1996 when problems with deliveries became apparent for the first time:

> "To India we have outcome control on daily basis, a formal 'prayer'- meeting every morning at 10:00 for an hour, an hour and a half. And that is a good way to check and ensure that things are going as they should. [I usually do not use] behavior control. (...) Now I know pretty much how to do it (for India): (1) Daily meeting, (2) Air concerns, (3) Look at results." - HH, CarCo-A-2

Output is not controlled on a person-specific basis. CarCo personnel does not check work from SoftHouse individuals, but only integrated work packages that are received through the onshore liaison.

> "(...) I have no specific assignment of controlling work from India, like work from SPB or SM. There is no direct control to a person. It is task specific, it depends on the subject who is controlling." - MB, CarCo-C-3

The task of checking and testing deliverables is divided among CarCo Germany and US team members, depending on individuals' workloads (CarCo-C-3).

- *Pressing the onshore liaison*

When SoftHouse did not perform according to expectations, pressure was increased on the onshore liaison. To CarCo he was the person responsible for SoftHouse's performance, and for relaying expectations to Indian operations. This basic setup was maintained throughout the project, with initially BW, and later BJ and Indian team members. When SPB and MD from India were in Cologne, control was facilitated by their membership of the teams in Bangalore. In fact, they could maintain some form of peer/ team control even when working for some time from Europe.

On the other hand, during the period that BW was still onshore liaison, his lateral role did not provide him with adequate control tools. As earlier indicated, he had only an advisory role towards India, and was not part of the formal hierarchy there. Besides, he lacked the skills and attitude to build up relationship and informal controls with Indians. BW's control role was further limited by time pressure. Officially he was expected to check deliverables and give feedback to the Indian team before handing these over to the CarCo Cologne. In practice, he skipped these steps because of delayed Indian deliveries. This caused agitation in the German group (see AC's log report September 1996).

At times, HH experienced the limits of being a customer representative in a contractual relationship versus someone's project manager. He tried to dissuade BW from taking a month's leave early 1997 (logs January 20 - 24, 1997). Later, HH disagreed with BJ on work division in Cologne. BJ wanted to assign responsibility for the comments database to AC, while CarCo did not like that idea (logs January 27 - 31, 1997).

- *Pressing vendor executives*

A final control mode was working through SoftHouse UK executives. HH contacted account management there to air concerns and increase pressure. He did that as a representative from the customer's point of view. HH contacted SoftHouse's UK office remotely and in person. He had informal conversations with executives there, and submitted on some occasions formal letters. One threat he could use was stopping the contract (AC logs October 21 - November 1, 1996).
The threat was never materialized. It probably was not a wise thing to do, given extensive investments from both parties in the contracted project work. Still, UK executives got the message and used their intra-organizational position to press SoftHouse India. Contacts with executives in Bangalore enabled them to use the local hierarchy for impacting team performance (Figure 58).

§ 10.3.4 Organizing for Distributed Collaboration

In this section, we zoom in on organizational structure and communication processes in the multi-site Goldd project environment. We look at the seamless office between the CarCo teams in Detroit and Cologne. We then show how this setup was in stark contrast with the connection between these CarCo units and SoftHouse facilities in India. That relationship relied almost exclusively on a linking pins, one onshore and one offshore. The Goldd project was severely impacted when in succession the offshore liaisons left, and the onshore person could not handle his role as a central node. We conclude with changes that were made in the organizational setup, and alternatives that were suggested by interviewees.

§ 10.3.4.1 Seamless Office: CarCo Germany and US

> "Well, the people in the US, we basically know very much what they do" - HH, CarCo-A-3

Collaboration between the Detroit and Cologne office did not come easily. People from the US had hardly worked with other cultures before Goldd. In Europe, people were getting used to CarCo's regional integration process, but had not yet worked on a global scale. Initially, team members from both sides experienced the novelty of this situation as challenging, some even as 'scary' (CarCo-D-2). JF from Detroit describes her experience of working with the German team as "Difficult, we were doing this for the first time. We worked with different platforms, different media, etc.… And it took us time to learn" (CarCo-D-1).

Gradually, however, they built positive working relationships. This was helped in part by visits from some American team members to the Cologne office early 1996. Immersion in the German environment helped them understand the background of their counterparts, and it built relationships. This proved an effective ice breaker for the time when teams had to rely almost exclusively on electronic media like email, phone and videoconferencing to sustain contact across the Atlantic. JF explains:

> "I visited [CarCo] Germany 3 weeks before and 2 weeks after Carnival. And it helped me a lot! The things that were not a part of the job, like the office environment, how people commute to their work, the area they live in. Knowing the background of people helps me understand how they think about the business. And besides that going to Cologne was also good for the work we did together. (...) Later they were more relaxing, they were more open after I had been there. I kick on it when HN sends me a joke. We really had to grow into it." - JF, CarCo-D-2

From Germany, people echo these positive experiences. HN describes his initial experiences with the American team. At that time, he was responsible for integrating European requirements for the data model. These had to be integrated with the American expectations. To this end, HN met his US counterpart BM in Cologne. This meeting as well as the subsequent relationship turned out to be positive and successful:

> "I expected them (US team - author) to be different, but it wasn't with this team. (...) For example. I met BM for only one hour, I brought the European data model, he brought the North American data model. We talked about the data model and agreed on the merging and it was all very positive. How they work and how they think compares to us. Data model is good, it still is. (...) The working relationship with the US is good. Very good cooperation exists and I think that is rare on a distance. We understand each other, there is no conflict in the team. It is open and productive. (...) The data model for instance was a great success. Communication and thinking was very similar." - HN, CarCo-B-1

People reinforced their US - German relationships overtime. After the visit to Cologne, HN and a few others went over to Detroit for Model Office 1 in Spring 1996. this counter-visit helped the Germans in turn to understand more of the US environment. HN gives some comments on his relationship with the US team, and its positive impact on the collaboration process (Gabarro, 1990).

> "I know the team personally. For data modeling the American team came to Cologne. I went to the US for Model Office 1 and for the data model/ justification. (...) It is much more efficient if you know the people." - HN, CarCo-B-1

HN's boss in Germany - HH - makes a similar observation. He praises the fact that teams from the US and Germany have good rapport, and counts it as one of his key achievements in the Goldd project. In his view, this positive climate is tied to people's membership of the same organization. As a single social entity, CarCo provides a common (though physically distributed) environment. Members share practices and goal orientation. With others, like the vendor for Goldd, CarCo personnel cannot count on this similar background. Still, HH would have liked to see that. In fact he expected that it would happen, but he does not specify how it could have been achieved.

> "I feel at home anywhere I go and there is [CarCo]. I mean there is a certain [CarCo] style of working. What I'm fairly proud of is that over the duration of the project, and it started in 1995, the [CarCo] team has kept an excellent working relationship with each other - HN, MB, JF, CS, DM and a couple of people on the sidelines like BM, SK both in the US, and their bosses, we have very very good working relationships. (...) We are all working towards the same goal really. I mean this is not even near the kind of issues we have with [SoftHouse]. And that's the kind of thing I would have liked to see with [SoftHouse]. It just doesn't happen" - HH, CarCo-A-3

On a day-to-day level, good relationships between US and German team members facilitate remote contacting. People respond promptly to communication needs from counterparts. From HH's angle, this implies that he does not have to revert to CarCo's transnational management structures to get work done in the US. While that structure is available if need be, it is replaced in a sense by relationships.

> "[There is] absolutely a seamless office between US and Germany. I can phone them any time for any information, they phone me back immediately. I have no problem. I can't remember that I had a problem which required me to call their boss and say: "Hey, I have a problem please help me solving it." It's always been solved on a working level. And I think that's a very good sign. It's not that their bosses don't know what's going on. We keep in contact and discuss maybe issues. But I have full support on all the levels and that's how it should be. In a company like this that is how it should be." - HH, CarCo-A-3

With SoftHouse, many of these elements are not available. People are not part of the same organization, there is no international hierarchical structure, and relationships did not take off as well.

Good contacts between the American and German teams does not mean that people have to collaborate on a detailed level. In fact, most interaction concerns planning of milestones and checking progress by a few key people from both sides. The contact across sites is thus somewhat channeled through these people as JF explains:

> "[Using liaisons:] This is definitely the case between Germany and the US. Everything goes through certain persons, like business is done by me and HN, and the data model is done by BM and MB (from Detroit and Cologne respectively - author)." - JF, CarCo-D-2

Only on a few occasions was direct cooperation necessary. Like with the data model early 1996, or testing activities early 1997. Often these tasks are planned and divided with members from both sides. Once the work has been done, people report back and integrate results.

> "[Direct, detailed cooperation between US and Germany] is not necessary. For instance on the setup we did it. For that I went over there on a detailed level. We do common testing, then we split up the tasks on testing, then we exchange the results in a daily meeting." - HN, CarCo-B-3

Good working relationships did not substitute entirely for formalized coordination modes as suggested in information processing theory (Thompson, 1967; Van de Ven et al., 1976). Especially with distance, it remains important to adopt plans and standard operating procedures. In the Goldd case, planning and standards played an important role in collaboration processes than spanned the sites in US and Germany. Earlier we referred to the common plan developed and owned by HH. In addition, JF points at the importance of rules and standards for coordinating work and ensuring consistency. Also, interfacing and ownership of particular processes or domains are exclusively assigned to certain individuals to ensure coherence in a polycontextual work environment.

> "It is very important to define standard procedures. You cannot just do things between two continents. Somehow all the documents you send get lost somewhere in the middle, in the ocean. In every area you need somebody to control the documents. One person has to have total knowledge about one area. Otherwise, things get lost and therefore the work does not get completed. (...) We need rules about last version control. That we do not use the same name twice, that the numbers are changed when the version is changed." - JF, CarCo-D-2

§ 10.3.4.2 Minimally Coupled Contexts: CarCo and SoftHouse India

> "The problem might be that there is no direct contact." - HN, CarCo-B-1

The connection between CarCo and SoftHouse was handled through liaisons. This established an additional node between CarCo and SoftHouse India as shown in Figure 52. Initially, BW and NK were supposed to connect the North American/ European contexts with India. After NK left - about a month into the operational phase of the project - BW tried to fulfill this role from Cologne. He was replaced early 1997 by BJ. At that time, Indian team members (MD and SPB) came alternately over to assist BJ with technical details. Throughout these phases, the basic tenet has been that exchanges were routed through the liaison(s).

In Cologne, one of HN's responsibilities was to help coordinate CarCo's relationship with SoftHouse. In that role, his activities included "receiving documents/ handing over documents to onshore managers BW/ NK, BJ/ SPB." He continues with the comment that "all contact goes through onshore managers" (CarCo-B-1). In a later interview, HN distinguishes between connecting to the US versus India. For both sites, key persons or interfaces are used. The difference is that the former relationship relies on remote, direct contact. For the latter, HN works with local liaisons who connect in turn with India. This implies an indirect setup: "We always work across sites with an interface. I will mostly talk to JF, and to India the contact is via BJ or MD" (CarCo-B-2). For India, he later repeats that "direct cooperation doesn't exist between India and Germany. We just work just via the channel" (CarCo-B-3).

In a similar vein, HH stresses the role of liaised contact. Remote, direct collaboration hardly existed. If people were contacted in India, it mostly concerned the offshore project manager SM. On a team leader or even member level, noticeable exchanges did not occur.

> "In India with [SoftHouse] there are about three layers. One is the onshore project man, then there is the offshore project manager, then the offshore team leaders, and the teams. Our involvement of course was 100% with them (onshore project manager - author), about 25% with them (offshore project manager - author), about 5% with them (offshore team leaders - author). So every once in a while, the team leader had a

burning problem he came back to us and asked this question. But more often than that they did it "through". When MD was here, all of that contact was handled through the onshore team." - HH, CarCo-A-3

HH points out that the original setup relied heavily on the relationship between BW and NK. Their rapport and common knowledge base would ensure seamless contact between Germany and India (Gabarro, 1990; Grant, 1996b). "The onshore manager here and the offshore manager over there would be a match-pair and talk to each other and know each other well. (...)" (CarCo-A-3).

The setup discussed so far is summarized in Table 40. It shows from a high-level perspective how work flows are organized. The work flows are depicted as one-way, from the users in North America and Europe towards the team in India. Cells of the three IT teams are shaded. the US and German teams work with users in their region to integrate requirements on that level. They subsequently integrate these and pass them on to the onshore SoftHouse liaison (bottom row). From there, information is passed on to (initially) the offshore liaison, NK. When he left, his role was assumed by the offshore manager, SM.

Table 40 - Overview of initial work flow setup (shown one-way)

Company & Function:	Site location:		
	US	Germany	India
CarCo Users	Marketing users US ↓	Marketing users US ↓	
CarCo IT	↓ MIS US ➔	↓ ➔ MIS Germany ↓	
SoftHouse IT		↓ Liaison Germany ➔	➔ Liaison/ offshore manager India ↓ Team India

The onshore liaison was reinforced when MD and SPB from the Indian team started to support the group in Cologne. They took on an important role there as a first connector to CarCo. MD explains that the team in India often lacked information from CarCo, especially when BW was still onshore. She perceived her role as learning the CarCo in order to help the team in Bangalore. Onshore presence helped her to accomplish this (Tyre & von Hippel, 1997).

"I define what they (team in India - author) have to do. They don't have the complete information so I send it to them. (...) I am the liaison person. Somebody has to learn the [CarCo] process and that is me." - MD, CarCo-F-1

The logic of indirect organizing

Literature and the CarCo case suggest that indirect organizing is often used in distributed work environments, especially with offshore outsourcing (Meadows, 1996b; Millar, 1999). As the literature sources quoted there show, there are many concerns associated with

linking pin structures. We elaborate on these for the CarCo case later in this section. Before doing that, it seems appropriate to look at the logic of indirect organizing. In other words: What were the reasons for Goldd's initial setup with linking pins instead of promoting direct contact across sites?
Interviewees suggested a couple of factors that played a role: avoiding confusion, assumed low dependence and low uncertainty, bridging diverse contexts, capacity for remote contact, and difficulty to connect remotely.

- *Avoiding confusion*

A first reason for channeling communications exclusively through to India was the perceived need to avoid confusion. Between the US and Germany, interfaces were also used to add minimal structure to a remote collaborative relationship (CarCo-D-2). For the CarCo - SoftHouse interface, on offshore liaison was considered not enough. SoftHouse wanted to structure the channel closer to the customer, i.e., in Germany. This would facilitate work for both the CarCo and Indian sites. To CarCo, having an on-site liaison seemed easy since a vendor representative was working literally in their own office environment. The Indian team could feedback their questions and needs to the onshore liaison. This person, in turn, could work as a representative with the customer. He could also handle the reverse flow of questions and concerns from CarCo towards SoftHouse India. MB from the German CarCo team explains this reasoning tat underpinned in part the use of onshore liaisons:

> "Infrastructure was not the trigger for having no direct communications. It was to avoid that nobody knew what the status of a document was. Therefore BW was there, to avoid confusion at both sides. He had to make sure that the right documents were sent with the right version and that questions were answered. (...) An example of a standard process is that every document must go through the onshore manager." - MB, CarCo-C-1

- *Assumed low dependence and low uncertainty*

A second motive lies in the assumption that work flows between CarCo and SoftHouse was only loosely coupled and quite well known. As an earlier showed, CarCo and SoftHouse underestimated both variables. First, they had too simplistic a perception of dependence. In their view, it concerned mainly identifying requirements (CarCo's job), specifying the system (CarCo), building and programming Goldd (CarCo/ SoftHouse), and implementing it (CarCo/ SoftHouse). They considered dependence mostly unidirectional, when in reality it involved more complex, reciprocal work flows (Table 39). The following quote from HN illustrates the idea that work in India and at CarCo sites could be considered fairly independent:

> "Nobody in India is interested in work in the States on a detailed level as long as their work is not impacted. Then they have nothing to do with it on a very detailed level." - HN, CarCo-B-3

Second, uncertainty and complexity of the system was underestimated. Our earlier section showed that the contract was very incomplete and not founded an a solid grasp of the Goldd system and project work. This implied that Indians needed far more information than could be delivered through documentation and the first prototype submitted by CarCo.

Combined, underestimation of dependence and uncertainty resulted in an organization setup that did not realistically reflect communication and coordination needs (Table 38). This led to risks and performance issues that undermined the success of Goldd. The second onshore liaison observed the lack of contact between CarCo and SoftHouse. He pointed out that one of his primary missions was to enhance exchange between the German and Indian teams, and even triple site contact with the US:

> "My tasks are to provide an environment in which you can proceed. And of course to make some procedures and take care of database control and change control. The most important task, however, is to make them talk to each other. I have to identify problems and create an environment in which they can be solved." - BJ, CarCo-H-1

- *Bridging diverse contexts*

Third, it was necessary to bridge functionally diverse groups (Table 40). On the one hand, CarCo users in North America and Germany, totally focused on business. And on the other hand, the Indian teams that were staffed by technically oriented personnel, with little knowledge of business in general, let alone CarCo's environment. Somewhere, a transition had to be made from the business to the IT side. Within the CarCo organization, this came quite naturally, as the M&SS units were routinely involved with user departments. It appeared more challenging to make this transition with an external vendor, SoftHouse.

The initial concept was to absorb business knowledge close to the customer and avoid direct remote contact with the technical teams in India. To this end, BW and NK worked for months in the CarCo organization. Then, they would translate their expertise into a workable format for the IT professionals in Bangalore. In other words, people from outside the team in India would connect to the customer's user contexts, and bring that back all the way to the Indian team. Apparently, this underestimated the difficulty of doing that. In fact, knowledge of CarCo requirements could not really be captured and transmitted in a sufficient manner. It was too complex and ill-defined for that method. Because of those properties, business knowledge was glued to CarCo sites (von Hippel, 1994). That is, it was interwoven with CarCo users, their local routines, and 'thought world' (Dougherty, 1992).

Absorbing and translating that knowledge for the Indian IT professionals could not rely on documented specifications or a prototype system. Rather, some of their own team members from Bangalore had to be immersed in the customer environment. These persons were well included in their home context, and could based on that elicit, select and transmit business knowledge in an effective and efficient manner. Quite late in the project, this need for direct contact of Indian team members became clear. It led to the decision to station MD or SPB in Germany, and to connect SPB also to the US site. This shifted the diversity transition point (i.e., between business and IT) closer to the business sites. Onshore, MD could operate in the CarCo environment as a literal representative of the Indian team.

> "The knowledge/ skills are quite different (in India compared to the team in Germany - author). The difference is that the team in India is only a development team. They talk in code, and I am the interpreter." - MD, CarCo-F-1

With this setup, the remote contact between Germany and India became more homogeneous and therefore easier. After all, MD (and SPB) spoke the Indian team's language. She had close relationships with the team members there, and could leverage on a common base of knowledge and experience (Gabarro, 1990; Grant, 1996b). In her analysis of an interview with SPB, AC makes a similar point:

> "Of course, originally, NK was supposed to be the information source in India. I think however that it is easier to communicate to the Indian team through an Indian team leader. Maybe next time have an Indian team leader available for the offshore-management. It seems that the Indians are also very knowledgeable because they have good technical education. This would be cheaper too." - AC, CarCo-E-3

- *Capacity for remote contact*

Fourth, the M&SS groups in Germany and the US lacked the resources to work directly with the offshore SoftHouse teams. HH expressed his expectation that SoftHouse would provide onshore resources to work with the offshore team. He did not consider it feasible to take on that role with his own group:

> "The way we'd like to see it is that SoftHouse is shielding by means of a liaisons here in Cologne. We don't have the capacity of managing a team of 20 people 5000 miles away, that's impossible." - HH, CarCo-A-3

From the US, JF echoes this point. She would have preferred to have someone from India in the US. This would allow for direct, face-to-face collaboration. A member from the Indian team in Detroit could learn the ins and outs of CarCo, and easily pass it on to his peers back in India. This would be better than either trying to connect directly on a distance to the Bangalore teams. Or working through an independent onshore liaison like BW:

> "I think there should have been more people from [SoftHouse] involved. Too much was going though him (BW - author). It is too difficult to disseminate all the knowledge and pass it over to India. It might have been better to have somebody from India in the US to get the knowledge. There is not enough process in the US to see everything directly from India." - JF, CarCo-D-1

- *Difficulty to connect remotely*

From a work flow dependence point of view, direct remote contact between CarCo teams and SoftHouse India could have been beneficial for the project. It would provide team members on both sides direct access to remote counterparts. They could have asked questions, and provided resources without anyone in between. However, in practice too many barriers existed between these communities. MB and HH list some of these, like multiple administrative layers, technical barriers, and language issues. Together, these factors increased the costs of remote contact, and discouraged direct contact (Kraut & Galegher, 1990). Instead, eventually Indian team members came over to CarCo to handle this connection. To them, these barriers hardly existed since they had been working daily in the Indian context.

> "First of all I would prefer direct communication, person-to-person. If that is not possible I like to call a person. (This because we do not have personal videoconferencing, this of course would be better) But this is difficult to India, because

of the lines: we have to call the satellite first, etc. And then for the connection to the person you want to talk to in India, they will pass you through several departments. So the need for direct communication is done via Profs, but the problem is that it is only one channel." - MB, CarCo-C-3

HH perceived this issue as follows:

"In India with [SoftHouse] there are about three layers. One is the onshore project man, then there is the offshore project manager, then the offshore team leaders, and the teams. Our involvement of course was 100% with them (onshore project manager - author), about 25% with them (offshore project manager - author), about 5% with them (offshore team leaders - author). So every once in a while, the team leader had a burning problem he came back to us and asked this question. But more often than that they did it "through". I mean when MD was here, all of that contact was handled through the onshore team. The team leaders don't speak English, they speak some dialect of English." - HH, CarCo-A-3

Together these factors contributed to Goldd project management's decision to connect onshore and offshore sites indirectly, through BW, and later BJ and Indian representatives.

§ 10.3.4.3 Interfacing Problems

In this section we further explore the difficulties that arose in the Goldd project from Fall 1996 onwards. We focus on the organization of the customer - vendor interface. From that point of view, we explore issues related to the way (remote) collaboration was setup (see Figure 52). After discussing general concerns, we pay specific attention to problems associated with the way BW operated in the next section.

The original project setup relied on two liaisons, one onshore and one offshore, to learn CarCo requirements and bridge the customer context with the vendor teams in Bangalore. Problems started when the offshore liaison - NK - left the project soon after work started in India. Co-investigator AC aptly remarked that NK's departure affected the chained communications setup between CarCo and SoftHouse. To her surprise, CarCo seemed not aware or interested in this event. This could have reflected HH's attitude towards SoftHouse. He emphasized their lateral relationship with little reciprocal involvement on an operational level. As a vendor, SoftHouse was responsible for delivering services. He did not consider it his responsibility to exert influence over their operations.

"NK did not become the offshore manager as [SoftHouse] had no money left in their budget to pay him (HN: "He was an expensive guy, maybe even more expensive than BW"). I do not understand that [CarCo] (as far as I know) did not protest when he went: if he would have been in India, a lot of problems could have been avoided. One major link in the chain was gone! Maybe it would have benefited CarCo more if they had paid NK to stay. But I do not have information why he has gone." - AC, CarCo-E-3

HN explains that when NK left, BW had no counterpart in India through which he could liaise with the teams there (Figure 53). He could not leverage on the relationship he had built with NK when to worked on the bid and requirements phase of the Gold project. Without NK, BW would have to transfer knowledge remotely to people he did not know.

> “The original plan was that there would be two managers: NK and BW. They were at [CarCo] for 6 months and learned everything. But NK left India after 4 weeks. NK never transferred knowledge to the Indian team. BW had no counterpart in India that “spoke the same language”. He had to start building the knowledge from here, and that is difficult if not impossible. That's what SPB says: “We never know anything since NK has left.” I don't believe him though. And you do not know what would have happened if he had been there.” - HN, CarCo-B-1

To AC’s surprise, CarCo did not react to this event. Considering the importance of NK’s role, she suggests more proactive involvement of CarCo in SoftHouse’s strategy. Probably this did not match HH’s perception of the outsourcing relationship as a hands-off contract. As earlier quoted, he compared the outsourcing of Goldd work with a firm supplying air-condition equipment for a car. Little reciprocal involvement would be needed in his view to make this successful. And the same would apply here.

> “NK did not become the offshore manager. [I think the project leader changed more times] as [SoftHouse] had no money left in their budget to pay him (HN: "He was an expensive guy, maybe even more expensive than BW"). I do not understand that [CarCo] (as I know) did not protest when he went: if he had been in India, a lot of problems could have been avoided. One major link in the chain was gone! Maybe it would have benefited [CarCo] more if they would have paid NK to stay. But I do not have information why he has gone.” - AC, CarCo-E-3

Even after things did not work out in the Goldd project, HN insist that the original philosophy underlying the project setup remains valid (Figure 52). He points at conditions for making it successful. In particular, he emphasizes the relationship between the onshore and offshore person. They should have common collaborative experience and good rapport.

> “The theory is OK, from the theory you need to have these two guys, the onshore and offshore project manager. But they need to be experienced, they need to know each other, to have to have experience let’s say several years of experience working with each other so that they really know each other and they should have experience in the sense that they to have done it several times. Then it works out. I mean if these guys really communicate with each other I don’t see any problems.” - HN, CarCo-B-3

As things turned out, there was little opportunity to leverage upon the relationship between BW and NK. This was unfortunate as much had been invested from both CarCo and SoftHouse side. NK’s departure had a strong impact on the teams in Bangalore. The chain or ‘lifeline’ towards CarCo had been interrupted, leaving the teams with little information when they needed it most. In terms of Table 39, flow 1a now stopped in Germany. This information and knowledge link was of vital importance. It provided the agent with insight in the principal’s needs and preferences. Early Fall 1996, the situation was that everyone was looking at the Indian teams to develop the Goldd system using documentation and the first PC-based prototype. Yet they lacked that critical information link. It was only when MD and SPB came over that information exchange between onshore and offshore improved. MD explains:

> “(…) It took us several months to find out what they wanted. The documented work specifications give only an overview, but no details. BW did not give proper information. It is much better now that I am here, somebody needs to be on-site.” - CarCo-F-1

SPB shares this point of view. He confirms that in Fall 1996 the Indian teams were cut off from sufficient information on the customer's expectations. They relied on BW in Cologne for this important task, but hardly knew him.

> "In the beginning it happened that we had days without work, because there was no information to work with. (...) But the core model has been done now, and we have less work, that is why the team is getting smaller. At the beginning we did not know what the user wanted, and it is better to talk directly to the user to know what is better for them." - SPB, CarCo-E-1

SPB appreciated direct contact with users during the second Model Office in Detroit, December 1996. Afterwards, on his way back, he stayed for some time in Cologne. AC took the opportunity to talk to him about his experience in the Goldd project. SPB explained that communications to India are always routed through BW and offshore managers. Whilst he worked in India, he hardly talked directly to BW in Cologne. Only when BW was in India did SPB have an opportunity to meet directly without local administrative layers in between. The moment AC started to talk about the multi-node communication mode between CarCo and India, SPB recognized the issues he had been struggling with. He indicated the difficulty of tying onshore and offshore project workers in such an indirect manner. AC reflects on the interview in December 1996:

> "All communication to India goes through BW. BW talks to SM (Offshore Project Manager, see Table 32 - author) who is more on the Oracle side of the team. On very rare occasions does BW communicate directly with SPB. This would happen if there are very specific issues with screen design and such. This would happen on the phone. When BW was in India, SPB also had the opportunity to talk to him. (...) All other communication is done through SM, via profs (e-mail), fax and phone. Before information reaches the team it goes through SM and through the team leader. I asked him what he thought about the communication lines as they exist: all communication through BW. SPM seemed a little indignant, he got immediately exited about the issue. It was clear that he thought it was troublesome and difficult to communicate in such a way." - AC, CarCo-E-1

SPB points at the disadvantages of having chained communication lines, see Figure 52 and Table 40. It is like the telephone game metaphor used in Meadows' (1996) research, and described in the theory section. The larger the number of nodes in a communication chain, the more likely misinterpretation becomes. Each person receives and relays in his own way, leading in the end to a distorted message that is to some extent disconnected from the original communication intent.

> "After the Model Office (number 2 in Detroit, December 1996) I know what the users want. When the information goes from the users to JF, to HN, to BW, to us, it can get distorted or diluted. When one person in the link has not understood what the user meant, it will show in the product. Errors in understanding will be passed down the link." - SPB, CarCo-E-1

Cutting through this ineffective process requires direct contact with the source of requirements information - the users. For that reason, SPB considered the Detroit meeting very valuable. As AC noted, "SPB was extremely happy with the opportunity that he got to meet the users, and to get first hand information" (CarCo-E-1).

On top of the general problem of routing communications through a chain of liaisons, a specific problem arose in the relationship between US and India. In isolation, the US and Indian teams worked on tasks associated with the database design and data conversion. At some point in early 1997, the US team was preparing data conversion. They loaded data and discovered that database rules worked completely different from the way they expected. This was because both teams had different perceptions of how the database rules were supposed to work. In fact, they had ignored or underestimated dependencies between the US and Indian teams in this phase. In a much earlier phase, people from both sides should have talked about reciprocal expectations.

> “Parallel to that (testing - author) they (M&SS US team - author) completed the conversion. And they started with implementing the batch environment. During the testing we identified that the core Sales and P&A functionality is not properly designed into the system. So they didn’t talk to each other. They do a conversion in the States, you have database and a database design. And they do a conversion from the old system to the new database. So they load data in, then they expected that the Indian rules on that data work as the same as they thought it should work when they did the conversion. But they never talked to each other and that didn’t work, especially not in that area. So when you load these conversion data it was right in their understanding, but the Indians had a completely different understanding. (...) So they have to redo the conversion, do some rework on the conversion. And the Indians have to do something as well. Both have to adjust to a common concept which is now in place for that area.” - HN, CarCo-B-3

§ 10.3.4.4 BW’s Role and Mode of Operating[64]

> “Too much was going though him (BW - author). It is too difficult to disseminate all the knowledge and pass it over to India.” - JF, CarCo-D-1

> “(...) the guy (BW - author) lied to us. It went both ways: he lied to the Indians, he lied to us. If you have such a person it is devastating.” - HH, CarCo-A-3

With little doubt, BW assumed a challenging role in the Goldd project. He had the main responsibility for coordination of work between CarCo and SoftHouse India, without being part of either company’s formal hierarchies. We explore some facets of his role and the way he operated in the Goldd project. The section is based on resources from BW, and employees from SoftHouse and CarCo. We start with information from his own hand, and continue with views from CarCo employees.

BW is an independent IT consultant. He was contracted for Goldd from 1995 onwards, and left the project in early 1997. In his own Curriculum Vitae (version of October 2000), BW represents his experience in the CarCo project as follows:

[64] This section is based on perspectives from SoftHouse, and in particular CarCo employees. It may contain very personalized views on actors and events. These are only included for providing insight in BW’s functioning.

> "Global Off-shore Project Manager - [CarCo]. Initial 3 months extended to 15 months (Nov 95 - Jan 97). Reporting to the Sales Director of a software house (SoftHouse - author), and responsible for preparing the bid for the development of a major new Global, multi-language database system. BW prepared the bid documentation, costed the project with the assistance of another analyst working for [SoftHouse] on-site, and won the contract for [SoftHouse]. He carried out requirements analysis in the USA and Canada with design work in Cologne, with all programming in Bangalore, India. The project team of 35 were based in Bangalore, India where BW worked from time to time to prepare the team, set up quality plans, explain system functionality, carry out RAD development sessions, whilst visiting North America to liaise with users. An Indian project manager then took over on day-to-day team management whilst BW returned to carry out further analysis, change control and user presentation work in Europe, USA and Canada." - BW, CarCo-G-3

BW was involved in the pro-contractual phase. He prepared the bid documentation with NK, and helped SoftHouse win CarCo's contract for outsourcing portions of the Goldd project work. The second paragraph refers to the operational phase. NK's brief role offshore is not mentioned. BW depicts several roles he played for the Indian team, suggesting to some extent as if he assumed management responsibility there. (See phrase: "An Indian project manager then took over on day-to-day team management" CarCo-G-3). In BW's view, he combined these activities for the Indian team with roles oriented towards CarCo users and IT staff.

Whilst working in Cologne, AC asked BW to fill out a semi-structured interview form. At that time BW had left the project and was back in the UK. One section of the form asked interviewees to fill out whom they communicate with during a regular work week. A number of subsequent questions are then asked, listed in the top row of Table 41. Column 2 shows the main topic of a collaborative relationship. For the third column, interviewees could indicate which communication mechanisms they used. A range of options was provided (like face-to-face, mail, fax, videoconferencing etc), including an open, 'other' option. Column 4 refers to the frequency of communications, i.e., number of times a week/ day/ month. The final right column shows results from the question: "What do you communicate about?" We analyze BW's table below.

Table 41 - BW communication patterns

Person you work with	Issue you work on	Communication you use	Frequency	Communication topic
AC (Germany)	Progress tracking	Face-to-face meetings	2x a week	Reporting progress/ clarifications
		E-mail	Occasionally	
		Other: leaving notes on desk	Occasionally	
HH (Germany)	Management issues	Face-to-face meetings	Daily	Delays to project schedules (!)
HN (Germany)	Technical architecture	Face-to-face meetings	Daily	Design issues
MB (Germany)	Data design	Face-to-face meetings	2x a week	Data model design detailed issues
BM (US)	Database design	Phone	2x a week	Data model design detailed issues
		Videoconference	1x a week	

		E-mail	3x a week	
JF (US)	User issues	Phone	2x a week	User design & User acceptance testing issues
		Videoconference	1x a week	
		E-mail	5x a week	

Source: CarCo-G-1

Table 41 gives an indication of BW's communication pattern in the Goldd project. It summarizes his experience for the period Fall - Winter 1996, and early 1997. The table is not complete: it does not include BW's interactions with SoftHouse India or UK personnel. The reason for this is not known. From the table, it becomes apparent that BW maintained an extensive network of contacts on quite diverse topics. He had a desk in the office environment of the German CarCo team for Goldd. The communication patterns can be distinguished in technical and non-technical topics. On the non-technical side, he interacted with AC and HH in Germany on project and process management issues. (Note for HH the exclamation mark in the 'communication topic' column. It indicates BW's difficulty of dealing with HH. BW was the first in line to be hard pressed for SoftHouse delays and poor quality.) With JF in the US he discussed issues concerning the North American user base. On the technical side, he worked with HN on Goldd's architecture and high level design. Some interaction occurred with MB (Cologne) and BM (Detroit) for the data model and database design.

Unfeasibility

After NK left the Goldd project, BW represented the sole link between the CarCo teams in Germany and the US, and the Indian SoftHouse group. He mediated all work flow and information links as shown in Table 39. Another way to look at this is to focus on the variety of activity areas. BW connected people working on similar facets of Goldd on the CarCo and SoftHouse side. To pursue this perspective, we can use the task areas identified by BW in Table 41, second column from left. The 3 non-technical and 2 technical areas are mapped for the CarCo and SoftHouse context in Figure 59.

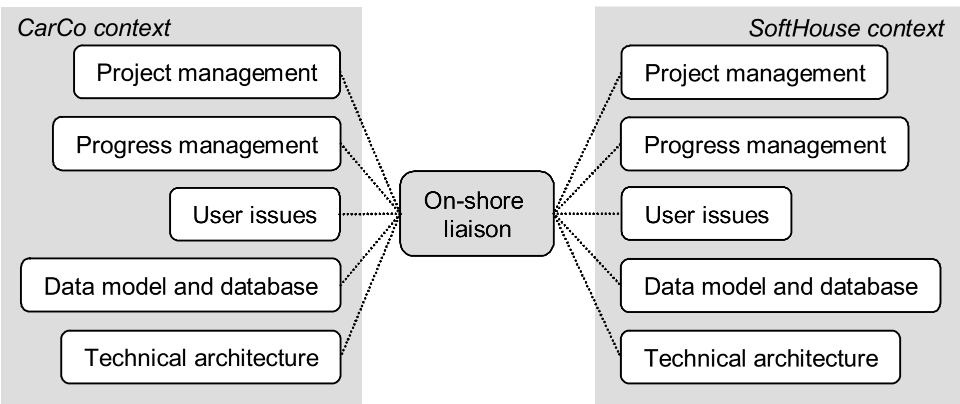

Figure 59 - Connecting contexts with varied activities

One of BW's challenges was to work on so many different topic areas. Some activities were minimally coupled, like planning. As earlier elaborated, CarCo and SoftHouse worked with their own planning process, and coordinated only on major milestones. The same applies to progress management. For technical areas, people had to pursue closer integration. The reason is that development work for the Goldd system and implementation process was divided between CarCo and SoftHouse. The outsourcing strategy was based on an agency relationship. This delegated part of the Goldd development and implementation work to SoftHouse (Eisenhardt, 1989a). In turn, delegation and work division resulted in multiple dependencies and flows between the two CarCo teams and SoftHouse Bangalore operations (Litterer, 1965), as shown in (Table 39).

Unfortunately, it seems that some dependencies and flows were underestimated, and therefore under-coordinated. An example of this is the assignment of an exclusive channeling role to one person as onshore liaison. The unfeasibility of this setup is echoed by AC and JF. AC comments in her logs that BJ was hired from January 1997 onwards to provide some relief for BW:

> "In January BW went to India again to discuss all open issues. BJ, a new [SoftHouse] manager, accompanied BW to India. [SoftHouse] hired BJ because the work BW was doing was too much for one person to handle." - AC, CarCo-K-2

JF remarks that a multi-person interface was needed between her company and SoftHouse. For the US, on-site involvement of Indian personnel would have helped in her view. This would have facilitated the requirements knowledge flow from CarCo towards the Indian teams:

> "I think there should have been more people from [SoftHouse] involved. Too much was going though him (BW - author). It is too difficult to disseminate all the knowledge and pass it over to India. It might have been better to have somebody from India in the US to get the knowledge. There is not enough process in the US to see everything directly from India." - JF, CarCo-D-1

BW faced the challenge of a very comprehensive job: he had to channel and add some value to extensive cross-context information processing needs in multiple areas. But that was not his only problem as the next section discusses.

Mode of operating

To CarCo, BW was the primary person considered responsible for SoftHouse deliverables. Yet within the latter organization, BW's role was difficult. He did not have a hierarchical position vis-à-vis the Indian team. What remained was a lateral, consulting role. He provided the Indian team with vital information, and represented the team's needs in Germany. In this setup, he needed good rapport with the Indian team. This would ensure some commonality of goals, and efficiency of communications. The latter need was even more important because of distance and time zone differences.

In reality, however, BW did not handle his position in an effective manner. He seemed to assume that he could take on a hierarchical role, especially when visiting the Indian team onsite in Bangalore. He also seemed unaware of the Indians' culture and possible sensitivities. Combined, this led to a situation where the Indian project workers did not accept BW as person and in his role as onshore liaison. Obviously, given BW's challenging role, this created considerable problems for himself, the Goldd project, and ultimately HH as project champion. HH shares his view on BW's mode of operating. His perception is probably based in part on discussions with Indian liaisons (SPB and/ or MD) whilst they were in Cologne.

> "BW wasn't able to understand what people were doing in India. (...) He had been there but I think it he was just not that person. He had no authority relationship to India. What I picked up is from both NK and BW is they hated him (BW - author). He came in like ... (...) "You do this, you do that. No questions". That doesn't work. They are very proud, they are mature people, they want to be respected. MD doesn't want to be tossed around. That's how they felt being treated.
> BJ tries to be different. I think he is. That doesn't mean that people don't need to be beaten up every once in a while because they are not doing as well as they should. But it's the way you do that. BW was a gigantic mistake." - HH, CarCo-A-3

HN stresses that BW did not have a hierarchical role in either the SoftHouse India or CarCo organization. In fact, he was independent of the two, and could only attempt to liaise from a lateral position. He would have to rely on his content knowledge, professionalism, and indispensable position for the two groups (Burt, 1993). From a cultural point of view, BW would need extensive insight in the Indian community in order to connect as a Westerner. All the more since he would pay only a few visits to the teams in Bangalore, and would have to rely on electronic media for the remaining time. Instead of realizing these organizational and cultural parameters, BW adopted a quasi boss attitude towards the Indian operations. This was of course not well received.

Change requests
Over Fall 1996, CarCo users came up with numerous small changes that affected the data model. Many of these were quite small, like changing the font size of a screen. The usefulness of these change requests is not certain. BJ mentioned to AC and the author that many of them were unnecessary, or sometimes contradicted earlier requests (log January 27 - 31, 1997). The requests increased information processing needs from CarCo to the Indian SoftHouse team. They created possibly also reverse communication needs for clarification. For some reason, BW did not handle the requests well. It seems that he basically did not communicate them to India. BW's lack of rapport with the Indian team could have played a role here. Once people found out, a sudden flooding of requests hit the Indian team as HH explains:

> "We discovered in the wake of the change of the project managers (BJ replacing BW - author) that a very high number of data model changes had been withheld from the Indian team. They didn't even know about it. So they didn't know the impact and when it hit them it turned out to be 700 detail changes. It went as far spelling errors and changing field size types. Fairly basic things: something that when it happens you just do it and nobody bothers about it. But if you park them, if you tank them, and then bombard someone, it's disastrous. They did a very good job recovering from that. That was because there was a communication breakdown, quite a severe one between the onshore and the offshore team. It just didn't get through, it was held here and never went to India." - HH, CarCo-A-3

MD was in India when the huge volume of requests was passed on to then team there. She mentions that the event affected team motivation strongly. The complexity and internal dependencies of the Goldd system implied that changes had ramified impacts, causing a major work load.

> "The changes. We had close to 800 data model changes and it almost brought the team down. Everybody was very affected by it. The changes in the data model would dribble through to the front end." - MD, CarCo-F-1[65]

On top of the change requests, HH indicates that BW did not communicate CarCo design standards to SoftHouse India. This should have been done early in the project. Unfortunately, it had never been done and was discovered in a very late phase of the project:

> "We just found out another one. We had discussed some early design standards and they were not followed. We discovered that they hadn't even been sent to India. And it's disastrous. So we're still suffering from some very early communication issues." - HH, CarCo-A-3

An important question is of course why no one was aware of BW's omission. In a sense, SoftHouse should have operated quality control measures and additional links in order to avoid exclusive dependence on BW (Burt, 1993). On the other hand, HH was considered responsible for the overall Goldd project. Yet he did not feel a need for control measures from his side. According to him, CarCo selected SoftHouse based on criteria like ISO certification and a successful track record. Basically he trusted the company from then on to contribute the contracted performance (which was in fact ill-specified). HH also did not count on the possibility that BW would operate in the manner described above. In his perception, BW lied to his group and the SoftHouse team in India.

> "It wasn't my responsibility to control that. [Question: Would you have liked that responsibility?] No. Absolutely not. Come on - you gotta trust the mechanism or you don't. And when a company sells you on so many successful projects and mechanisms in place for quality control and ISO 9000, and 9001, whatever, then you don't challenge their communication mechanisms. You trust the people that are there, that they are doing what they're supposed to do. There is basically little safeguard against putting on delay. And the guy (BW - author) lied to us. It went both ways: he lied to the Indians, he lied to us. If you have such a person it is devastating." - HH, CarCo-A-3

HH comments that professionals working in a geographically distributed projects need strong skills in areas like communication, planning, and collaboration. In his view, BW showed major deficiencies in these areas.

> "Communication skills I think are very high on the list of important skills in globally distributed settings. Then planning skills, and interpersonal skills going in both directions. Now the fact that BW lied to us both ways shows me that he had some

[65] In an earlier quote, HH mentions 700 changes. We do not know the correct, exact number.

major deficiency, which made every effort too high. You can't survive with that at the end of the day, people find you out. (...) We discovered it after he left. He basically escaped. He went on vacation. We didn't want him to come back. It was a very carefully planned vacation." - HH, CarCo-A-3

Over Fall 1996, pressure built on BW to perform. For this, he depended entirely on the Indian team, yet he was not capable of building an effective working relationship with them. At the same time, it seems that BW's role in general would have required the proverbial sheep with 5 legs (CarCo-D-1). Unfortunately, he did not realize and/ or communicate this general unfeasibility. In addition, he was not aware of his seemingly lack of social skills. All this resulted in a tense situation, primarily in Germany, with spill-over effects to the Indian team and US CarCo group. Between December 1996 and early 1997 BW decided to leave the project after having tried unsuccessfully to get another position in Goldd.

§ 10.3.4.5 Changes and Alternatives

"First we have an interface between onshore and offshore: SM (offshore project manager - author) and BJ (onshore liaison - author). Also MD (onshore liaison-author), she handles the technical things, BJ the business side. Second, we have an interface between here and the US: HH and MD with JF in the US. At this moment CS also has direct contact with India for data load issues, that is easier and better." - HN, CarCo-B-2

Over the Fall 1996, CarCo and SoftHouse started to realize that their initial organizational setup for Goldd required some modification. In this section, we discuss some of these changes. Interviewees also suggested upon reflection different ways of doing things. We include these ideas to gain a better understanding of workable organization modes for distributed temporary systems. All in all, we discovered the following changes and alternatives in the CarCo Goldd case. First, the onshore liaison role in Germany was extended from a single person to two persons. Second, JF made a suggestion to have a liaising SoftHouse representative not only in Germany but also at least for some time in the US. Third, triple site direct contact was initiated, including SoftHouse India, and the CarCo sites in the US and Germany. Fourth, interviewees mentioned the importance of homogeneous connections across sites, so that people can work with a knowledgeable counterpart. Fifth and finally, people proposed visits from CarCo personnel to the Indian site. The section concludes with a comparative analysis of these strategies.

Reinforced on-shore liaising in Germany

"I would want to have a different balance of people right from the very beginning, more senior Indian people who would participate in the prototyping and the functional analysis." - HH, CarCo-A-3

A first change strategy affected the liaison role in onshore, in Germany. BW fulfilled this position from the operational start in 1996 onwards, after having worked on the SoftHouse bid and requirements analysis since 1995. The onshore liaison was expected to channel communications between the CarCo and SoftHouse India groups. The person in this role would have an exclusive linking pin role and ensure orderliness of cross-context exchanges. His linking pin position was expected to facilitate interfacing between CarCo and SoftHouse. Being stationed onshore, the person would pick up knowledge on the CarCo environment and pass it on to the offshore SoftHouse team. Conversely, he would receive SoftHouse deliverables and check these before handing them over to CarCo representatives. He would collaborate with an offshore liaison stationed in India. This counterpart person was supposed to work on a day-to-day basis with the Indian team and simultaneously connect to the onshore liaison.

A things turned out, this setup did not quite work. NK left the project, leaving to BW the task of connecting directly to the team in India whilst working from Germany. This job proved unfeasible. On a general level, it would be close to impossible for anyone to handle the diverse and comprehensive information processing needs between CarCo and SoftHouse. On a personal level, BW's outlook and attitude hindered his effective functioning as liaison. As the situation became more and more untenable, several change strategies were implemented. It is not clear whether these were based on a clear awareness of the situation people were getting into, or reflect a more an improvised, ad hoc response. We focus here more on outcomes, and not the problem solving cycles themselves. itself.

The outcomes were that BW was replaced by BJ. In addition, MD or SPB from the Indian team alternatingly supported him in Cologne. We expand here first of all on BJ's more of operating and differences with BW. We then look at the role of the Indian liaisons, and the importance of having them onshore.

- *BJ instead of BW*

BJ is a more senior IT consultant than BW. He entered the Goldd project in the week of January 20-24, 1997 (CarCo-K-1). From his first impressions of the Goldd situation, he started to realize the extensive reciprocal communications needs between CarCo and SoftHouse. In April 1997, he mentioned in an interview with AC:

> "Talking, communication is very important, between India and Germany we need communication back and forth." - BJ, CarCo-H-1

He was also aware of his role as a liaison. Presumably, BJ knew that he could fulfill the role of exclusive linking pin as originally envisioned. In fact, he tried to maneuver himself somewhat out of that role. He started to promote more direct contact between Germany and India, and also triple site with the US included. This approach moved the project away from the initial setup with chained communications as depicted in Figure 52 and Figure 53.

Instead, a communications structure emerged that better fitted the reality of the Goldd project: a distributed work environment where one company with operations in India developed a novel, complex system for a customer company with two main sites in Germany and US. The uncertainty and dependencies associated with this situation triggered multiple work and information flows throughout the successive project stages. BJ realized the communication needs and his inability to channel these as an exclusive linking pin. He initiated a reinforced liaison capability onshore by inviting Indian team members Figure 54. He also promoted direct interactions between Germany and India, and US if need be (Figure 55). Together, these measures enhanced cross-site processing capabilities and problem solving. They also lifted some of the burden resting on the onshore liaison role (Burt, 1993).

> “My tasks are to provide an environment in which you can proceed. And of course to make some procedures and take care of database control and change control. The most important task, however, is to make them talk to each other. I have to identify problems and create an environment in which they can be solved.” - BJ, CarCo-H-1

BJ thus changed the communication structure of Goldd. As a person, he also operated in a more effective manner than his predecessor. He showed more respect and emotional intelligence in dealing with the Indian team. BJ was an English consultant who had worked more extensively with Indian organizations than BW. He seemed more aware of the fact that he had no formal, hierarchical role in the Indian SoftHouse organization. Still, without that basis, he found ways to achieve productive collaboration with this team.

- *Indian onshore liaisons*

The German team met for the first time a team member from SoftHouse India (SPB) during Model Office 2 in Detroit, December 1996. Afterwards, SPB stopped over at Cologne for further discussions with the project leader and CarCo team members. He returned to Cologne in February 1997 to assist BJ. MD - also a senior member of the Indian team - replaced him in March 1997. There were several reasons for stationing Indian team members in Cologne. First, the offshore team still lacked business knowledge relevant to the Goldd project. In terms of Table 39, the offshore team was in the agent’s position. A primary need in that role in knowing what the principal wants (see flow 1a in Table 39). Early 1997, they still experienced the aftereffects of BW’s ineffective role fulfillment during Fall 1996. Someone would have to acquire that knowledge and pass it on to the offshore team. It seemed that BJ was not in a position to take on that role, in part because he had joined the project in a late stage. For cost reasons, sending over a couple of Indian team members proved unfeasible.
Second, BJ’s core competencies included primarily handling some of the non-technical processes, see Figure 59. He emphasized cross-site communications but lacked insight in Goldd design and functionality (AC logs January 20 - 24, 1997).

Apparently, interfacing between CarCo and SoftHouse encompasses a variety of areas. A single liaison would need knowledge and capacities along multiple corresponding dimensions to add value. This person would thus embody the multiple facets of the CarCo - SoftHouse relationship. One could apply Ashby’s (1968) law of requisite variety with some modification. According to Ashby, a system would need to reflect the variety of its environment in order to survive (Ashby, 1968). We can transpose this notion to a polycontextual setting that comprises multi-system. Analogously, these systems need to reflect to some extent the variety of their counterparts to enable fruitful collaboration. When systems are not directly connected, the interfacing person needs fulfill that role. He handles the multiple dimensions (i.e., variety) of a relationship between two or more contexts. Figure 59 illustrates this for the Goldd case.

In practice, it seems unlikely that a single liaison would be capable of handling this responsibility. Earlier, when BW was onshore liaison, issues emerged in the communications areas, not the technical ones per se. With BJ, a reverse situation emerged. Though he improved communications and management, he lacked a solid technical background. For this reason, his exercising of the onshore liaison role was incomplete. This was one of the motivations for onshore Indian presence, in addition to problem of business knowledge transfer. HH explains:

> "We had two problems. One was the lack of business understanding (of the Indian team - author). The other one was that we needed some technical support and some meaningful interface between the Indian team and here. And BJ not being a technical man and not having been involved in the project beforehand needed some assistance. I think that is the primary reason why SPB and MD came here." - HH, CarCo-A-3

Compared to Figure 59 a new setup was created as depicted in Figure 60. BW is shown as onshore liaison A, handling mainly nontechnical dimensions of the CarCo - SoftHouse interfacing. The B liaison is added and refers to one of the Indian team members working onshore on technical issues alongside BW.

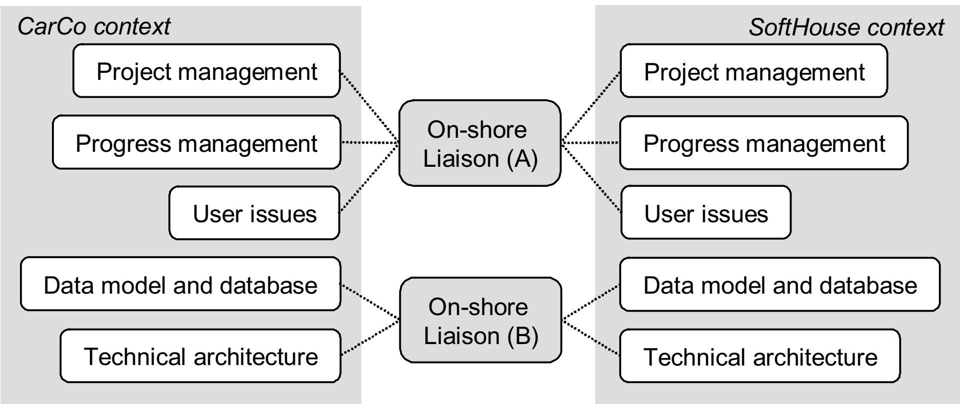

Figure 60 - Connecting contexts with varied activities: enhanced liaison role

The new setup boasts the variety and obviously capacity of SoftHouse's onshore presence. MD points out that she has a very important role as representative of the offshore team. On the one hand, she has the advantage of onshore inclusion in the CarCo context. This allows her to acquire directly knowledge pertaining to CarCo requirements and expectations (Tyre & von Hippel, 1997). On the other hand, she is part of the team in India. Having some history of shared collaboration means that the offshore team accepts her as a senior member. Other than BW or even BJ, she is part of the offshore community. She shares their goals and needs, and knows how to work with them (Gabarro, 1990; Grant, 1996b; Schein, 1992). In a sense, MD (and SPB) remain virtually part of the Indian team while having the luxury of co-presence with CarCo personnel. This appears a strong combination as MD explains:

> "I define what they (team in India - author) have to do. They don't have the complete information so I send it to them. (...) I am the liaison person. Somebody has to learn the [CarCo] process and that is me. (...) SM, SPB and I are the direct contact points

for the team. SPB in Germany and I in India or the other way around to do the coordination between the two countries." - MD, CarCo-F-1

In this role, SPB and MD worked for the first time on structuring collaboration processes between CarCo and SoftHouse. So far, little standards and rules had been elaborated for this interface. Somehow, nobody felt the responsibility for this area. Even at local sites, standards and formalization played a minimal role as MB points out:

"As this is a pathfinder project for [CarCo], there are a number of firsts: first outsourcing, first global, first client/ server. There are no standards. We have to find our own path and rules from day to day. The standards change from day to day. (...) The roles are not stable. I have never seen written work specifications. One commits to this, one commits to that." - MB, CarCo-C-1

Between the Goldd sites, even basic guidelines for communications were lacking. This added to the complexity of cross-site interactions and caused sometimes irritation as one German team member describes:

"We use Word documents with questions, and everybody answers in different kinds (even colors) of font. It goes back and forth; at the end it gets very confusing." - MB, CarCo-C-3

From the Indian side, MD confirms the modest role of standards, especially for collaboration with CarCo:

"We do have internal standards. (...) I am sure that there are rules that I follow, but I would not know what they are. [CarCo] has not set rules to follow, except that a document should have a header etc. We do have internal [SoftHouse] rules like with every delivery there should be a delivery note." - MD, CarCo-F-1

From February 1997 onwards, onshore presence of MD or SPB put them in a position to improve this situation. They enhanced the structure of exchanges between the onshore and offshore teams:

"At this moment we are fixing rules for collaboration with CarCo, because before we never had a point of contact. Now we have MD and me." - SPB, CarCo-E-2

As a side effect, MD and SPB brought the Indian team closer to the German CarCo group. Their onsite presence greatly facilitated direct contact with everybody onshore: HH, HN, and MB. To illustrate this, Table 42 gives an overview of MD's communication patterns when she worked onshore in Germany, in March 1997. She focused on technical liaising between the Indian SoftHouse and German CarCo teams. As far as India is concerned, she collaborated very closely with SPB. (In fact, very much like BW and NK should have collaborated in the initial setup.)

Interestingly, the onshore presence of an Indian team member led to more direct remote communications then with a non-Indian liaison like BW or BJ. These people were independent consultants and did not have the social, cultural and organizational situation awareness that comes from prolonged inclusion in the Indian context. As an illustration, AC comments on one of her interviews with SPB. He explained that when BW worked onshore, contacts were almost exclusively routed through the offshore project manager SM and team leaders. Direct contact happened only during BW's visits to India:

"All communication to India goes through BW. BW talks to SM who is more on the Oracle side of the team. On very rare occasions does BW communicate directly with SPB. This would happen if there are very specific issues with screen design and such. This would happen on the phone. When BW was in India, SPB also had the opportunity to talk to him. (...) All other communication is done through SM, via profs (e-mail), fax and phone. Before information reaches the team it goes through SM and through the team leader. I asked him what he thought about the communication lines as they exist: all communication through BW. SPM seemed a little indignant, he got immediately exited about the issue. It was clear that he thought it was troublesome and difficult to communicate in such a way." - AC, CarCo-E-1

With an Indian onshore liaison, things were different. Familiarity of that person with the Bangalore context facilitated remote contact. As the second row of Table 42 shows, MD worked at times directly with programmers, and not exclusively through the offshore project manager SM.

Table 42 - MD communication patterns

Person you work with	Issue you work on	Communication you use
SPB (India)	On everything	Profs: 10 a day, call when urgent (1 every two days on average)
2 programmers (India)	Workflow, Sales and P&A codes (data model and functionality)	All communication is done by SM's profs, but we do speak directly on the phone
HH (Germany)	Data model changes and CCAR	Talk, daily prayer meeting
HN (Germany)	Data model, functionality and screen design	Talk, forward mails
MB (Germany)	Data model	Talk, forward mails

Source: CarCo-F-1

While onshore, MD collaborated with key German CarCo staff - HH, HN, and MB (Table 42). These communications consisted of face-to-face talks, emails, and meetings. They focused on data model issues, functionality and procedures for handling certain change requests (CCAR). Onsite presence of MD or SPB changed communication patterns. It promoted direct contact between them and a range of local people in Germany. This is comparable to BW's visits SoftHouse India (AC, CarCo-E-1). During these trips, BW met SPB and other local team leaders and team members. Whilst in Germany, he would not contact these people directly.

Having MD or SPB onshore triggered other communications effects too. Since these liaisons knew people at the counterpart site, they enabled direct remote contact too. That is, communications that are not channeled through liaisons. With SPB in Cologne, for instance, German CarCo team members would work directly with team leaders in India.

"I worked more and more with SPB when he was here. And also through audio conference we have direct contact with the coordinators of the team in India. The first

> approach was that we had an onshore and an offshore manager, NK and BW. The advice was then: all official things through managers. (...)
> Infrastructure was not the trigger for having no direct communications. It was to avoid that nobody knew what the status of a document was. Therefore BW was there, to avoid confusion at both sides. He had to make sure that the right documents were sent with the right version and that questions were answered." - MB, CarCo-C-1

This did not happen when BW was onshore liaison, and also not with BJ. As it seems, Indian onshore liaisons reduced to some extent indirect routing of communications offshore. MD and SPB could leverage on their collaborative history in the Indian team. This simplified remote communications and avoided the confusion people were seemingly afraid of. The role of the offshore contact person seems therefore less relevant.

AC and HN further expand on the advantage of having both onshore and offshore liaisons from the Indian team. According to them, the background of these people would facilitate communications. It would also increase acceptance of the liaison by the Indian team, since they would be part of the hierarchy there and probably hold senior positions.

> "As far as I understand, it would be better for the Indians to have an Indian project manager here (onshore in Germany - author). That would be better for them, easier for them, they would listen more, communication would be better" - HN, CarCo-B-3

> "Of course, originally, NK was supposed to be the information source in India. I think however that it is easier to communicate to the Indian team through an Indian team leader. Maybe next time they could have an Indian team leader available for the offshore-management. It seems that the Indians are also very knowledgeable because they have good technical education. This would be cheaper too." - AC, CarCo-E-3

SoftHouse liaison in US

Indian involvement in onshore liaising could have been extended to the US too. From JF's angle, information processing between US and India relied on too many nodes. More specifically, she observed that too much emphasis was placed on the SoftHouse liaison in Germany. This single person in the original setup had at least two disadvantages. First, he was not physically located in the US, from where most requirements originated. This made his awareness of the US situation more difficult (Tyre & von Hippel, 1997), all the more since requirements remained quite fluid throughout the Goldd project. Second, he was alone, responsible for liaising between India and both US and German client sites.

> "I think there should have been more people from [SoftHouse] involved. Too much was going though him [BW]. It is too difficult to disseminate all the knowledge and pass it over to India. It might have been better to have somebody from India in the US to get the knowledge. There is not enough processing capacity in the US to see everything directly from India." - JF, CarCo-D-1

JF points out that BW's position in Germany proved unfeasible. According to her, direct contact between her team and India would also not be possible since her group lacks the experience and capacity to do so. An alternative scenario would have been to station one or more Indian liaisons in the US, working directly with their counterparts in Bangalore (Figure 61). This would be similar to the situation that emerged in Germany with SPB and MD. This onsite representative could benefit from on the one hand his background which facilitated direct remote contact. On the other hand, he could easily connect on-site to the US team and users.

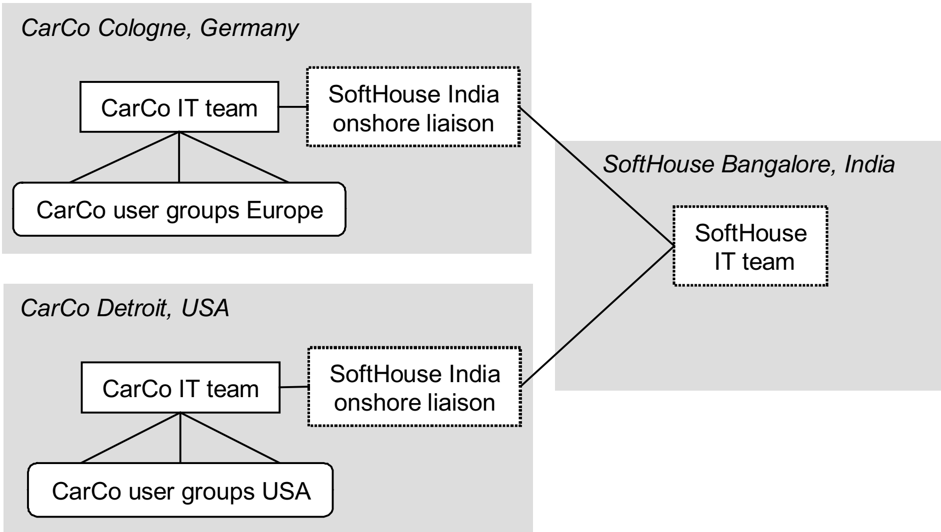

Figure 61 - Alternative communications diagram (CarCo US proposal)

Triple site direct synchronous contact: Collocated and remote

A third direction of change was the increasing role of triple site direct contact. We refer to synchronous communications that included people from the three operational teams: CarCo US, CarCo Germany, and SoftHouse India. We discuss in this section two forms of this interaction mode: collocated and remote.

- *Collocated triple site direct contact*

The first opportunity for direct contact between the three teams was Model Office 2 in Detroit, December 1996. From India, SPB traveled to the US, joining BW and HH from the German team. For SPB, it was the first opportunity to meet CarCo IT counterparts and North American users in person. We describe his experience here in detail. Next, we pay attention to a second moment of triple site, collocated contact, i.e., the Sales & PA code taskforce that was setup in Spring 1997.

In December 1996, AC talked extensively with SPB during his stay-over in Germany after Model Office 2. SPB greatly appreciated the opportunity to talk directly with users and CarCo IT personnel, instead of receiving information through BW and offshore liaisons. On-site presence in Detroit boosted his insight in CarCo requirements and expectations.

> "I understand a lot more after the Model Office, there is no comparison between what I knew then and what I know now. The data model helped us understand quite a lot about the business, as it was also logical. With the data model we understood a lot, about 70 - 75%. But the more important thing to know is what the user wants, and that is the most difficult and the most critical thing to understand. They do not ask so much: they just want a product that is like the former one, or much better. They only

> want it to be user-friendly as they have to work with it everyday. The user wants something easy, he wants to be able to access certain screens in one step, at the most 2 steps. That is what we are going to try to develop now." - SPB, CarCo-E-1

Before the Model Office meeting, SPB and his peers worked mainly with documentation they received from BW. This reflected BW's explicitated interpretation of CarCo requirements based on his involvement with the company since the inception of the Goldd project. Figure 62 illustrates the setup in a simplified format. During Act 1, system analysts (BW and CarCo IT staff) work on site 1 with users. Their communications result in knowledge of user requirements. They explicitate this understanding in documentation and ship that to the offshore team in site 2 for the second Act - programming.

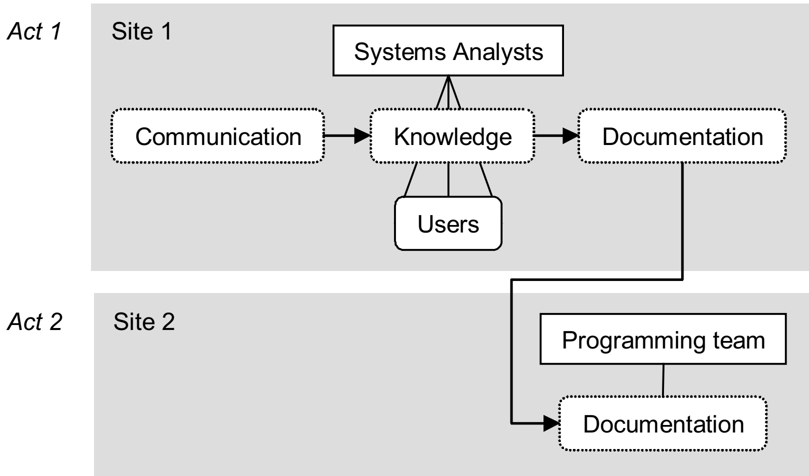

Figure 62 - Transfer of requirements knowledge across sites (1/ 2)

This mode of knowledge transfer presented two disadvantages to the Indian team. First, it reflected someone else's (BW) interpretation as each node in the link between US/ Germany and India added a potential bias:

> "After the Model Office (number 2 in Detroit, December 1996) I know what the users want. When the information goes from the users to JF, to HN, to BW, to us, it can get distorted or diluted. When one person in the link has not understood what the user meant, it will show in the product. Errors in understanding will be passed down the link." - SPB, CarCo-E-1

And secondly, the Indian team had to rely mainly on documentation. This textual communication mode transmits less cues than of instance instead BW telling them directly in person (Daft & Lewin, 1984). Documented information does have some value as a boundary object (Star & Griesemer, 1989). But it may not suffice for distributed work settings characterized by novel cross-site workflows and lack of collaborative history. Consequently, as far as the Goldd case is concerned, the team pulled BW and indirectly the CarCo teams for more information: "They wanted things in writing more than we would be able to deliver easily" (CarCo-A-3).

The combined effect of the setup depicted in Figure 62 was that the Indian teams lacked insight into CarCo requirements. The documented information they received was not enough to mentally envision what the Goldd system should look like. AC reports:

> "I also know why the deliveries were late: the Indians had enough information but they just didn't know were to start, they had no idea at all what the users wanted exactly. They seemed to be pretty confused about what was to be delivered." - AC, CarCo-E-3

For SPB, the Model Office was the first opportunity to 'jump' over the liaisons and talk directly with users. This enhanced his view on CarCo needs, something he could not achieve apparently through documented specifications from someone else. An added advantage was that he could share his insights back in Bangalore with the team there. Transfer of requirements knowledge thus remained a human-to-human process, instead of relying on intermediate explicitations. SPB explains:

> "The Model Office helped a lot. Now we know WHY they want things in a certain way. I will share this information with the team and it will make us much more confident about what we are doing. The Model Office has helped me see the concept behind the screens, the business. What the users want is a usable product, it has to be user-friendly. It is much easier to know what somebody wants when communicating person to person." - SPB, CarCo-E-1

Figure 63 depicts this new setup which can be contrasted with Figure 62. In Act 1, the programming team representative (SPB) works with users onsite in Detroit to elicit requirements. He then returns physically to the team in Bangalore (Act 2) and communicates interpersonally his expertise (early 1997).

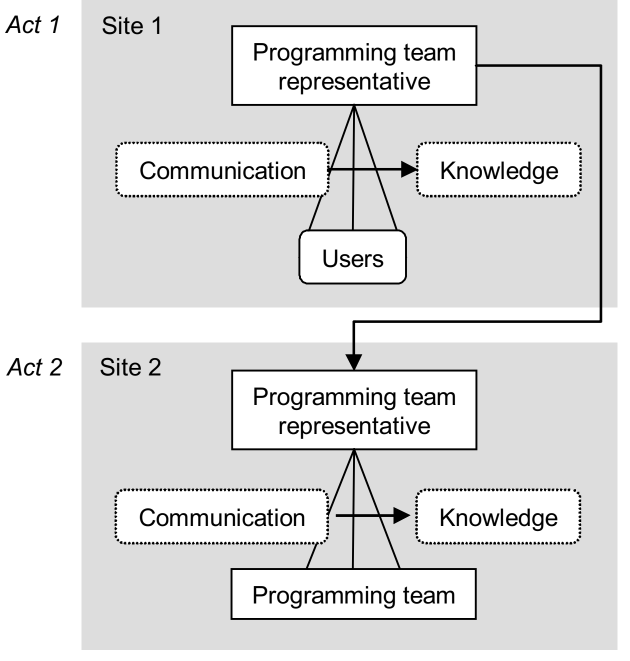

Figure 63 - Transfer of requirements knowledge across sites (2/ 2)

Looking back, people realized that direct contact with representatives from all the sites should have been done much earlier. When describing her interview with SPB in December 1996, AC noticed that he would have liked to participate in the first Model Office session, back in Spring 1996.

> "SPB seems to sigh, as if this would be the ideal solution. Of course, it is already too late to built in new business practices in the program. So I ask him if it is not too late already to see the users. SPB agrees that it is very late to see the users, it would have been better if he would have been there at the first Model Office." - AC, CarCo-E-1

Similarly, HH recognized the importance of Indian participation in earlier requirements analysis and prototyping sessions. In his perception, having senior representatives from Bangalore would have facilitated knowledge transfer and subsequent remote collaboration. Rather than depending on consultants hired from outside (BW, NK, BJ), a more direct form of collaboration would have been feasible and probably more successful.

> "I would want to have a different balance of people right from the very beginning, more senior Indian people who would participate in the prototyping and the functional analysis. We went to the US for two and a half weeks to review the prototype (Model Office 1 in Spring 1996 - author). At that time it would have been very very helpful to have the Indians to be with us here (Germany - author) and in the US. " - HH, CarCo-A-3

A second instance of collocated collaboration was a taskforce that was setup for redesigning Sales & PA code functionality in early 1997. This part of the Goldd system should have been designed jointly by professionals from CarCo US and SoftHouse India. However, lack of interaction between these groups led to a situation where each held a different understanding of this piece of functionality. People did not realize their dependence and failed to coordinate their efforts. This disconnection surfaced rather late, in the stage when the US team prepared the conversion. We represent here HN's perspective.

> "During the testing we identified that the core Sales and P&A functionality was not properly designed into the system. They (CarCo US and SoftHouse India) didn't talk to each other. They do a conversion in the States, you have a database and a database design. And they do a conversion from the old system in the new database. So they load data in, then they expected that the Indian rules on that data work the same as they thought it should work when they did the conversion. But they never talked to each other and that didn't work, especially not in that area. So when you load these conversion data it was right in their understanding, but the Indians had a completely different understanding." - HN, CarCo-B-3

Initially, people tried to resolve the issue remotely. In Germany, HN worked with colleagues and users, trying to understand the Sales and P&A code concept and requirements. As things turned out, the topic was too complex for HN to solve on his own. People held very diverse perceptions that appeared difficult to integrate (Dougherty, 1992; Lawrence & Lorsch, 1967b). All the more given the fact that HN had to liaise in part remotely with users and IT staff. Eventually, people involved in the Sales and P&A code problem decided to form a taskforce, and meet face-to-face in Detroit.

> "We prepared the document here (in Germany - author), tried to come to a conclusion and agreement with the users. So we had about two weeks regular almost daily meetings. First we started with documents, I started trying to understand what they needed, what is Sales and P&A code at all, what do they require, what is their current business practice. And then I tried to specify that, document it, and communicate it. I had a lot of questions, and I tried to get answers to these questions by reading. But that didn't work out, it was always: "But we have this and this case, and this and this exception to the rule". And then we decided we have to make a separate task force on that issue." - HN, CarCo-B-3

HN traveled to the US and met with US IT staff and users. He also had the opportunity to look into the current old systems in use there. This was not possible from Cologne. From SoftHouse, the offshore project manager and a team leader joined the taskforce. Interactive face-to-face discussion clarified people's perceptions. It helped forge an acceptable common understanding that was used for subsequent adjustments in the US and India. The US CarCo team adapted conversion procedures, and in India results from the meeting were incorporated in new deliveries.

> "So I prepared my understanding of it as much as I could, went over there (Detroit - author), and discussed it with users. (...)The meeting in Detroit was in May (1997 - author). The Indians came also to Detroit, 2 of them: SM came and VA (team leader - author). SM is the offshore project manager and VA the system, he is developer. I stayed there 10 days. (...) I looked into the current system run, how it works, discussed it with the Indians, which was when we agreed on the final concept, which has been implemented just now. (...) So they have to redo the conversion, do some

rework on the conversion. And the Indians have to do something as well. Both have to adjust to a common concept which is now in place for that area. (…) We expect next week the first delivery based on that discussion." - HN, CarCo-B-3

- *Remote triple site direct contact*

When BJ started as the new onshore liaison, he recognized the value of direct contact amongst representatives from the three sites. This meant a considerable departure from the initial communications setup. Instead of arranging communications as a chain from the US via Germany towards India, BJ promoted a triangular setup. (Compare Figure 52, Figure 53, and Figure 54 with Figure 55). BJ thus overruled the first concept from HH and SoftHouse.

From a technical point of view, only audio conferencing proved feasible. Videoconferencing facilities were available between the CarCo US and Germany units, but not with India. In February and March 1997, a number of triple site conference calls were setup. At that time, MD had arrived in Germany. She joined the meeting there, as did JF from Detroit (AC log March 1997). Afterwards, MD praised the added value of triple site conference calls. To her, it meant direct contact with Goldd IT staff from remote sites. This clarified CarCo expectations, and facilitated work for the offshore team. Direct contact boosts information flows towards that team, and encourages interactions to clarify these (see also flow 1a and 1b in Table 39).

"One of our achievements is the three-continent-conversations. A lot of things have been clarified that way. Direct communication with the customer is required to know what they want." - MD, CarCo-F-1

Direct homogeneous contacts across sites

A fourth modification was direct contact between professionals from different sites, working on similar areas. The original Goldd organization setup relied on linking pins between sites. Only on a major task and milestone level did sites coordinate their work. The assumption was that local teams had their own share of the project, and could work fairly independent from the other Goldd sites. This applied in particular for the relationship between CarCo and SoftHouse.

According to the project leader, minimal dependence existed between the firms, as if there were an almost classical transaction (Macneil, 1978). His earlier quoted metaphor of the air-conditioning supplier and car manufacturer illustrates this perception. Similarly, one senior project members of the German CarCo team asserts that local tasks have little impact on work accomplished at other sites. This assumed limited dependence warrants minimal cross-site contact on a detailed level. Like for India and US, HN mentions:

"Nobody in India is interested in work in the States on a detailed level as long as their work is not impacted. Then they have nothing to do with it on a very detailed level." - HN, CarCo-B-3

Direct cooperation between India and Germany also relies almost exclusively on liaisons: "Cooperation between India and Germany is just via the channel" (CarCo-B-3). And for the US and Germany sites, HN indicates: "(…) Direct, detailed cooperation between US and Germany is not necessary. For instance on the setup we did it. For that I went over there to work on a detailed level" (CarCo-B-3). Many times, people switched to face-to-face meetings with site representatives to resolve issues that have an impact on other locations. These are exceptions to regular collaboration that took mostly place on a milestone level, and relied on remote exchanges.

- *Direct contact US - India*

Over the first months of 1997, direct contact between the US and India became more than an exception. In the wake of BW's departure, people realized that CarCo standards had not been communicated to the offshore team. Also, lack of coordination between the US and India resulted in problems with data loading and the conversion process. (Goldd was to be implemented first in the US.) Given the time pressure on the project, this led to more direct communications between these groups and reduced the coordinating role of the German site.

HN explains that direct US - India collaboration concerned CarCo standards, and became especially relevant for resolving data loading issues.

> "Let's say for certain technical issues like the tool we are going to use there is direct communication on a detailed level. What are the [CarCo] standards, what are the [CarCo] guidelines, then there is technical advice (from CarCo to SoftHouse - author). For this we should or sometimes do communicate directly. And that has improved over the recent weeks or months. There is some direct communication going on between India and some [CarCo] experts in the States. For instance on the database design, physical standards, or setup. There is some direct contact going on on specific issues, if certain things are technical issues. Another example would be between India and [CarCo] US on the data conversion. They do the data conversion, they load the data onto the server in the States and send it to India and then they all of a sudden they can't load it in India. They can't start testing the data. And then they (SoftHouse India - author) feedback directly to them (CarCo US - author) which issues they identify when they try to load the data, and then they (CarCo US - author) say: "OK the data is wrong or the index, or the database format is wrong"." - HN, CarCo-B-3

Direct contact had its advantages. Going through the onshore CarCo group and SoftHouse liaison means an additional layer of people who have to understand an issue, and must relay that to the next party in the chain. In an interview in April 1997, HN identifies both the regular communication patterns (with linking pins), and the case for direct communications between US and India.

> "First we have an interface between onshore and offshore: SM (offshore project manager - author) and BJ (onshore liaison - author). Also MD (onshore liaison-author), she handles the technical things, BJ the business side. Second, we have an interface between here and the US: HH and MD with JF in the US. At this moment CS also has direct contact with India for data load issues, that is easier and better." - HN, CarCo-B-2

The quote suggests that direct contact is 'easier and better' at times. Skipping liaisons speeds up collaboration between experts working on similar issues, like here the database design. In the next subsection, we elaborate on HN's suggestions to base a distributed project organization on direct communications instead of Goldd's indirect contact.

- *Direct homogeneous contacts across sites as an alternative design strategy*

A key reason for using liaisons was to avoid confusion in the Goldd project, in particular concerning the CarCo - SoftHouse interface. The project presented contributors with a number of 'first': first time outsourcing, first time offshore collaboration, first time client/ server technology and so on. This meant that people had little common experience and understanding to leverage upon. They lacked standards and similarity in their ways of working. On top of that, the project itself was so new to them that it lacked ex ante structure. People held unrealistic expectations and hardly defined the project in advance (CarCo-B-3, CarCo-G-1).

This increased the likelihood of confusion, and motivated a 'sealing' strategy. CarCo and SoftHouse operated as two independent entities, exclusively linked through liaisons. Communications between these entities had to go through gatekeepers, both ways:

> "I check data from US, double check if the information is in line with what is agreed, check it with what we think is common understanding. It has occurred that somebody sent a file that was not in line, that created confusion. So all documents that are sent (from the US - author) are checked in Cologne. Or they are sent to India and .cc to the rest, just to make sure." - MB, CarCo-C-3

> "Infrastructure was not the trigger for having no direct communications. It was to avoid that nobody knew what the status of a document was. Therefore BW was there, to avoid confusion at both sides. He had to make sure that the right documents were sent with the right version and that questions were answered. (...) An example of a standard process is that every document must go through the onshore manager." - MB, CarCo-C-1

This channeling did not adequately address the confusion problem. It did not solve the lack of structure on a site and meta-site level, but merely added an administrative layer. A more fundamental issue was the fact that people did not define and divide work in a clear manner, and connect back to their remote counterparts. They also did not establish rapport across the CarCo - SoftHouse organizational boundary. From HN's angle, task uncertainty and time pressure led to a rushed approach that lacked attention for processes and details. Absence of a priori project definition and relationship building limited transparency of local work accomplishments to counterpart sites. A case in point are some of HH's remarks that show his lack of insight in SoftHouse operations:

> "I have never been involved in selecting any of the team, or managing the team, even knowing the names. Basically I didn't care too much. The question is should I have cared more than I did? I don't know. (...) If I know more than what is the value added of knowing that. And if I know less, how much more can I concentrate on value added things? I don't know, I can't say that. (...) What they (SoftHouse - author) use (for planning - author) I don't know, they present me with a Microsoft project work plan every once in a while, but whether they have any other tools, I don't know." - HH, CarCo-A-3

The lack of structure, transparency and relationships complicated direct connections. It made seem indirect collaboration attractive since no one would have to deal with the unknown. In turn, the liaised contact did not encourage people to deal with the lack of structure and connectivity. They seemed all right within their own context, somehow hoping that things would fall in place. One aspect of this was the lack of specialization.

Locally and remotely, it was often not clear who was responsible for which area of Goldd. This made direct remote contact more difficult, and therefore less likely.

> "[Something] which I would change is that you do the prototyping more on an area basis. You need to have some experts on every side (German and Indian site - author), also in India specialized in certain business areas. You can't expect that everyone is the expert in every piece of the system. You have to break that somehow down into functional areas and assign people to these areas. So he is the expert for Sales and P&A code, he is the expert for database design, he is the expert for Marketing & Advertising, he is the expert for Workflow & Security, and so on.
> That did not happen. It was full scale, full functionality, everyone doing a little bit everywhere. No clear focus. There was not enough time to focus in each of these areas. So you connect on a very general broad basis some requirements, but you don't have the time to really specify, or come to the details, analyze in detail what is needed." - HN, CarCo-B-3[66]

As a follow-up to this concern, HN elaborated on an alternative setup that would resolve the issues mentioned above, and in fact reduce the need for liaisons. Along these lines, HN would prefer local specialization combined with remote homogeneous connectivity. People would focus clearly on a task area, process or subsystem like those mentioned in Figure 59. As the next step, they would tie back to their counterparts, resulting in multiple expert-to-expert connections across sites (Figure 64)

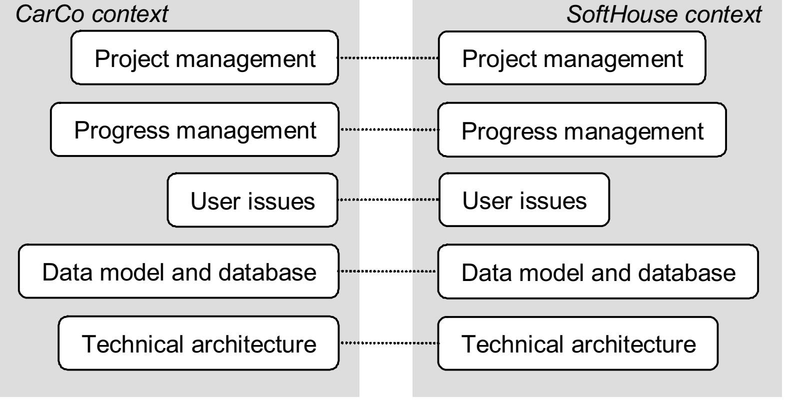

Figure 64 - Connecting contexts with varied activities: direct contact

According to HN, direct contact becomes possible when combined with specialization and homogeneous cross-site connections. He points at a sequential process setup that would be more effective than the one adopted in Goldd. It would rely on face-to-face meetings of

[66] The situation described here could relate to the informal operation mode of SoftHouse India as elaborated in a later section on cross-cultural differences. Indians seem to advocate role specialization and task assignment that are less strict than Germans prefer.

area representatives from different sites, following a phase of intense local preparation. After the collocated meeting, people would walk away with a understanding of a particular area and work package. They could elaborate that in a minimally coupled manner.

> "There should be direct contact between the experts from different sites. When you go for that approach and say: "OK we look just at the Sales and P&A, we just look into workflow today," then all the people involved in that should come together in one place from week to week, prepare the design for that area and then you go through it with the users, with the programmer, with the business analyst. And then you design it and that's on paper, then they split apart and do their job. And then the programmer and the business analyst have contact on this area. That would be more effective." - HN, CarCo-B-3

Alternatively, specialists in each area could work in parallel. They would connect with their remote counterparts, so that multiple distributed expert communities can elaborate on their work area. However, as HN was quick to point out, this would require similar variety across sites (Ashby, 1968). That is, each site would need a portfolio of people specializing in different areas:

> "Or you could be doing several models in parallel: one working on Marketing Advertising, one on Workflow, one on Sales and P&A, and then work out a plan which allows them to do that in parallel. But that needs more people on our side as well. Because you need one expert for each of these areas, but there are certainly ways to organize that if you want that." - HN, CarCo-B-3

Compared to the Goldd setup, this would change the role and organization of the CarCo sites, both in the US and Germany. CarCo would have to take on a more active role instead of depending on SoftHouse team members from India coming onshore in Germany and perhaps the US. They would, however, build more intra-organizational competence that would be relevant for other projects and Goldd support.

CarCo representatives to Indian site

A final proposal emphasizes CarCo's involvement with SoftHouse. Their onshore personnel could work in more or less temporary positions with the offshore team, and tie back to the US and European CarCo organization. This approach was also mentioned in Meadows' (1996: 109) research as the following quotes suggest:

- "Having on-site designers transfer to off-site is enormously helpful" (Manager, Finance Co. #1; Manager, Finance Co. #3)
- "Major lessons learned: get the on-site coordinator over here early on to train our off-site project members in functionality" (Manager, Finance Co. #2 Project)
- "What really helps with a shared way of talking and doing things is having on-site people come back off-site" (Manager, Computer Co. #3 Project)

In the Goldd project, some interviewees mentioned this option. They indicated that knowledge transfer from CarCo to SoftHouse did not have to rely on SoftHouse liaisons and representatives coming over to CarCo. Instead, key CarCo people could visit the offshore team and update them on the client's expectations and requirements:

> "How about business knowledge transfer. We assumed that it could be done by 2 managers. Maybe it can be improved by sending a [CarCo] manager instead or in parallel with the offshore manager, to provide a general vision of the system in 1 or 2 weeks." - MB, CarCo-C-3

CarCo staff could bring their context to Bangalore and take care of the offshore - onshore linkage. This could make sense as far as knowledge transfer and supervision of work accomplishment in India is concerned. However, according to HN, it would conflict with the SoftHouse local hierarchy in India. CarCo representatives there would have no formal saying in local processes. To do otherwise would undermine the lateral contract situation.

> "Maybe offshore/ onshore managers of [CarCo] would be better. But they (SoftHouse - author) would not accept that in this situation." - HN, CarCo-B-1

Conclusion: Comparing the Strategies

This section discussed changes and alternatives to the initial setup of the Goldd project. We elaborated on five strategies as shown in the left column of Table 43. These can be compared in several ways. First of all, the involvement of CarCo and SoftHouse in the organizational setup. Early on, CarCo focused mainly on its own operations, with little attention for SoftHouse management and teams. SoftHouse invested in visits and onshore liaisons to tie their Bangalore team to the client organization. Gradually this setup was adjusted.

The first strategy as shown in Table 43 reinforced SoftHouse's involvement with CarCo. BW was replaced by a person with stronger project management and communication skills, BJ. In addition, MD or SPB assisted BJ onshore with technical details. The second proposal - SoftHouse liaison to US - further extends the notion that SoftHouse must connect closely with their own personnel to CarCo contexts. The balance shifts to a more equal distribution of involvement with the third strategy. Representatives from the different sites collaborate - face-to-face to remotely - as peers in a single global project environment. In the same vein, the fourth proposal reinforces direct collaboration across sites along lines of specialization. The final strategy shifts the responsibility for the CarCo - SoftHouse interface to the former. CarCo would handle inter-organizational communication links and enable the offshore team. From a governance point of view, this strategy could conflict with SoftHouse's autonomy. It could imply that CarCo determines to some extent SoftHouse operations which is not common in a lateral, contractual relationship (Bradach, 1997). In practice, CarCo was very hesitant to get involved with SoftHouse India. They rather preferred to rely on liaisons. Later in the project, they moved towards a more equally divided responsibility for cross-site collaborative processes.

Table 43 - Organizing for distributed collaboration: changes & alternatives (1/ 2)

Changes and alternatives:	Relative involvement CarCo and SoftHouse		
	SoftHouse liaisons to CarCo sites	Direct homogeneous contact	CarCo liaisons to SoftHouse site
1. Reinforced on-shore liaising in Germany	BJ and SPB/ MD onshore		
2. SoftHouse liaison in US	Extended SoftHouse involvement		
3. Triple site direct synchronous contact: collocated and remote		Equivalent collaborative involvement	
4. Direct homogeneous contacts across sites		Similarity of local expert variety	
5. CarCo representatives to Indian site			CarCo involvement with offshore team and on-/ offshore liaising

A second framing of the strategies is reflected in Table 44 (comparable in setup with Table 28). This matrix combines two dimensions. First, in the column, direct versus indirect collaboration from an organizational perspective. Direct contact means that people connect to counterparts without having to go through liaisons. Liaised contact implies the opposite: reliance on a middle man for communications with someone from another site. Second, the rows demarcate collocated interactions versus remote ones. The latter depend on electronic media.

The rows are divided in transparent and light gray cells. The transparent ones show the original setup of collaborative relationships in the Goldd project. With reference to cell A, CarCo Germany and the SoftHouse onshore liaison (BW) communicated mostly in a collocated setting in Cologne, without interference of others. In the same cell, one can group local collaborative relationship for CarCo US and Germany, and SoftHouse.

Since most local communications are direct, cell B does not contain a relationship.

Cell C refers to remote communications between two or more persons without liaisons involved. This applied to the US team that communicated sometimes directly with BW, depicted with (1). It also includes interactions between the German and American CarCo groups, in particular between JF, HH, and HN. A final relationship in this cell concerns the onshore liaison and offshore SoftHouse personnel.

Cell D encompasses liaised contacts across sites. This applies to the CarCo US team when they did not work directly with BW but through HH or HN in Cologne, see (2). CarCo US and Germany connected to the SoftHouse offshore teams through a liaison.

Table 44 - Organizing for distributed collaboration: changes & alternatives (2/ 2)

	Direct contact	Liaised contact
Face-to-face, collocated collaboration	A. Initial setup: ▪ CarCo Germany - SoftHouse onshore liaison Germany ▪ CarCo Germany local team ▪ CarCo US local team ▪ SoftHouse India local team	B. (N.A.)
	A. Changes & alternatives: 1. Reinforced on-shore liaising in Germany: connect to local team 2. SoftHouse liaison in US: connect to local team 3. Triple site direct synchronous contact: collocated 4. CarCo & SoftHouse direct homogeneous contacts across sites: collocated 5. CarCo representatives to Indian site: connect to local team	B. (N.A.)
Remote, electronically mediated collaboration	C. Initial setup: ▪ CarCo US - SoftHouse onshore liaison Germany (1) ▪ CarCo Germany - CarCo US ▪ Onshore liaison Germany - SoftHouse offshore India	D. Initial setup: ▪ CarCo US - onshore liaison Germany (2) ▪ CarCo US and Germany - offshore India
	C. Changes & alternatives: 1. Reinforced on-shore liaising in Germany: connect to offshore team 2. SoftHouse liaison in US: connect to offshore team 3. Triple site direct synchronous contact: remote 4. CarCo & SoftHouse direct homogeneous contacts across sites: remote 5. CarCo representatives to Indian site: connect to onshore groups	D. Changes & alternatives: 1. Reinforced on-shore liaising in Germany: CarCo US and Germany - offshore India 2. SoftHouse liaison in US: CarCo US - offshore India 5. CarCo representatives to Indian site: offshore India - CarCo US and Germany

The gray cells contain the changes and alternatives. The first strategy indicates strengthening of the onshore liaison role in Cologne. This leads to stronger onshore collaboration with the German CarCo team (cell A). It promotes interaction between the onshore liaisons and the offshore teams (cell B). And it helps coordination between the offshore team and the American and German CarCo teams (cell D).
The second strategy is a suggestion to station an onshore liaison in Detroit too. This person would connect directly to the local US group (cell A) and the offshore team (cell C). Indirectly, he would facilitate collaboration between the US and the offshore team (cell D).
Strategies 3 and 4 promote direct contact in the form of local meetings (cell A), and remote exchanges (cell C).
The fifth strategy posts a CarCo liaison in India, working locally with the offshore team (cell A). This person would tie back directly to CarCo personnel in Germany and the US

(cell C), and accomplish integration between the offshore team and CarCo US and Germany (cell D).

On a meta level, two main strategy patterns can be distinguished. First, the extensive (proposed) use of liaisons. Strategies 1 and 2 suggest a stronger role for SoftHouse in Germany and the US. The fifth strategy also relies on liaising, but this time with a central role for CarCo to assist SoftHouse offshore personnel. The use of liaisons represents a complex organization form. It means that the liaison works locally with a group (cell A), and remotely with his base team (cell C). This way, he connects the two units indirectly (cell D).

A second strategy pattern concerns direct contact, both locally and remote (strategies 3 and 4). It meant an extension of the original communications setup, especially in the sense of inter-organizational contact. Formerly, direct contact was reserved for the local teams at the various sites, and only in Germany between the client and vendor. Direct contact seems much simpler than the liaison approach in that at least one party less is involved. This limited complexity can be traced in Table 44. Strategies 3 and 4 impact only one cell (A or B) if the local or remote versions are considered separately.

Overall, liaised contact modes remained a preferred approach in the Goldd project, deserving reinforcement (strategy 1), extension to the US (strategy 2), and a possible role for CarCo vis-à-vis the offshore team (strategy 5). On top of that, direct contact introduced a new approach as far as the interface between the two companies is involved (strategies 3 and 4). Drivers behind this adaptation include time pressure, dependencies between CarCo and SoftHouse teams, and the complexity of issues relevant to these teams. Underestimation of the latter two factors may have contributed to the delayed introduction of direct contact modes between CarCo and SoftHouse.

§ 10.3.5 Development Methodology

For the Goldd project, CarCo adopted a prototyping or Rapid Application Development (RAD) methodology. This approach utilizes multiple meetings between users and IT development staff to gradually understand, build and improve a new system (Beynon-Davies et al., 1999). In the RAD development process, visualizing and development tools play a central role (Karsten et al., 1999). Compared to the traditional waterfall methodology, less emphasis is placed on documented specifications. Coordination processes between users and IT, and amongst IT development rely more on interpersonal exchanges than documentation (Van de Ven et al., 1976).

In the case of Goldd, interviewees mentioned various reasons for choosing a RAD instead of waterfall methodology. HH explains that users could not imagine what Goldd would look like if they had only written specifications. Consequently, they would not put their signature under such a document. This necessitated in a sense the use of a prototyping approach:

> "The problem starts with our users. They would not, and I found that many times, read a specification and put their signature under it. Because they wouldn't understand it.

They have not the grasp that requires them to imagine something that's on paper and how it would work. So you're almost bound to have a prototype, and then collect the comments, and go ahead with that." - HH, CarCo-A-3

HN was one of the key persons from CarCo working on the first prototype of Goldd in Spring 1996. In his view, prototyping has become a tradition at CarCo mostly to facilitate interaction with users. With RAD tools, IT development staff can visualize and demonstrate the system-in-the-making. Users can interact with the quasi-system and assess whether it matches their needs. Capturing that process in written specifications seems far more cumbersome:

"We use RAD because it is more or less a tradition at [CarCo]. With writing specifications, inquiries are made and then programmed, but the specifications will not be in line with what has been programmed. RAD implies avoiding the mess of specifications. I think it is a more effective development approach. (...) The prototyping exercise was correct. Specification writing would not have been the right approach. Draft screens and such are easier for communication with the user." - HN, CarCo-B-1

RAD methodologies make the interaction process between users and IT smoother. This applies not only during the initial stage that is aimed at getting a first draft of the system. RAD tools facilitate also subsequent modifications to the prototype, almost real-time during feedback sessions:

"The question is whether you can do it by specifications. I don't think you can do it by specifications, it would be very hard. If you try to setup a specification, try to agree and communicate that specification to everyone, that's almost impossible. I mean you need to do that onsite (during RAD sessions - author), explain it, put some pictures, explain it. The disadvantage of specifications is that you do it on a paper base. When you do it in a prototype approach you can be sure that it is directly somehow implemented, you see the result much more quicker." - HN, CarCo-B-3

For Goldd, the development process was punctuated by three feedback sessions: Model Office 1, 2, and 3. The prototype for the first session was developed by a CarCo in-house IT team and presented in Detroit in Spring 1996. At that time, CarCo and SoftHouse were working on a contract to outsource programming and some development work. From the vendor, people were not operationally involved in the requirements analysis process that culminated in the first prototype. Nor did they participate in Model Office 1. Once the contract was settled, the offshore team received the prototype and data model. It was expected that these resources help them understand CarCo business requirements. The offshore team would have to develop the real Goldd system by the end of 1996 for Model Office 2. Feedback from that session would be incorporated over the first months of 1997, so that the next version of the system would be presented during the final Model Office 3. From there the system would be readied for launch in North America in summer 1997. HN explains this setup:

"It was a prototype approach and the assumption was that doing these Model Offices would be sufficient for the Indians to do the knowledge transfer from the user side, from the business requirements to the programmers in India. That was the assumption. Based on that we did a prototype on a PC (...) that was presented to the users. First of all just as a demo version, then later on we went ahead to watch their feedback and reaction to that. That was the kind of development approach which was chosen to do it. In that sense it was planned that we have two Model Office sessions, we do the first prototype on the PC, then we go ahead with two Model Office sessions and then we receive the final product and test it and evaluate it and improve it and launch it." - HN, CarCo-B-3

In MB's mind, the Model Office sessions offered the opportunity to connect the various stakeholders in Goldd: users, and development and programming staff. During the meetings, the system would be presented, commented, and possibly modified to please users.

"We would always have a Model Office because you never have users, system coordinator and development at the same site. You need a mechanic like MO to log comments, and to present the prototype. It is important to get feedback from the users about the requirements. And in this case we had a second and third approach." - MB, CarCo-C-3

§ 10.3.5.1 Model Office 1

The first Model Office session with the PC-based prototype was successful from a user point of view. They liked the GUI and could try out the system as if it were a real system. Compared to the 1970s systems they had been using so far, the mock-up meant a major leap forward:

"The first Model Office with the prototype was a major change for the business partners because they had a very different system before. Before the Model Office they had a hard time visualizing" - JF, CarCo-D-1

From an IT point of view, the prototype was little more than a minimal demo version. It did not have any processing behind the screens. Nor was it the product of solid requirements analysis. Its key role was to show users a concept that they could comment on. At some later point, detailed requirements studies would be needed to structure the system itself.

"I mean that was never a real prototype what we did. It was more or less a presentation where people are allowed to comment, but it was not a systematic approach to build the functionality of the system. They (users - author) viewed some screens and said: "OK can we have a button there that does this and that?" And: "Can we have a field there which that should look this way?" But there was never a real analysis of the business processes behind that and how these processes were interlinked." - HN, CarCo-B-3.

Looking back, the project leader made another observation on Model Office 1. He realized that offshore representatives did not participate in the preceding development process or the session itself. This would have built their understanding of CarCo expectations, and reduce the need for ex post transfer of knowledge from onshore to offshore.

"We went to the US for two and a half weeks to review the prototype (Model Office 1 in Spring 1996 - author). At that time it would have been very very helpful to have the Indians to be with us here (Germany - author) and in the US." - HH, CarCo-A-3

Indians themselves agree with this point. In a reflection on her interview with SPB, AC comments that "SPB agrees that it is very late to see the users, it would have been better if he had been there at the first Model Office" (CarCo-E-1). If he had a chance to redo the project, HH would have changed this aspect of the Model Office 1 phase. He would have liked senior members from the vendor's offshore operations to join in the analysis phase and feedback meeting.

> "I would want to have a different balance of people right from the very beginning, more senior Indian people who would participate in the prototyping and the functional analysis." - HH, CarCo-A-3

These people could have functioned as the ears and eyes of the offshore team, and update them upon returning. This would have reduced the pressure on the onshore liaison, BW.

§ 10.3.5.2 Remote Knowledge Transfer and Collaboration

> "Due to RAD there is no formal documentation." - SPB, CarCo-E-2

After Model Office 1, the weight of the Goldd project shifted from CarCo to SoftHouse. The offshore team received the prototype and data model and were responsible for completing Goldd before December 1996. In between, CarCo expected them to make regular deliveries. The offshore team was linked to the customer through an onshore and (for a brief time) an offshore liaison, BW and NK. They needed that link to gain more understanding of the CarCo context than the abovementioned resources could offer. Also, intermediate change requests could be relayed to the team. As work started in Bangalore, the liaison link did not work as intended. With NK leaving the project, BW's role became even more pivotal than it had been. He had to collaborate closely with the offshore team to meet their information needs, yet he hardly knew these people. A related problem was that information flows from CarCo users or IT to the offshore team went over many links. This caused delays and increased the risk of misunderstanding. Afterwards, SPB recognized this problem:

> "When the information goes from the users to JF, to HN, to BW, to us, it can get distorted or diluted. When one person in the link has not understood what the user meant, it will show in the product. Errors in understanding will be passed down the link." - SPB, CarCo-E-1

In fact, the offshore team had to work mainly from the prototype and data model as submitted by CarCo. The importance of these resources is stressed by MD and SPB:

> "The prototype a standard between India and CarCo. It was a standard we followed, and everything else was built according to the prototype." - MD, CarCo-F-1

> "The data model helped us understand quite a lot about the business, as it was also logical. With the data model we understood a lot, about 70 - 75%." - SPB, CarCo-E-1

The value attached to the prototype did not match its quality and depth. As HN mentioned, it was only intended as a minimal visual demo system for users during Model Office 1.

The ‘system’ lacked a solid foundation in business process analysis and modeling. What happened was that the technically competent offshore team lacked business insight. All they could do was trying to develop a reasonable system based on the resources available to them. The first results - delivered in September 1996 - did not please CarCo. It was late and merely an enhancement of the PC-based demo as HN reports:

> “They (offshore team - author) made an approach which was quite on the software of the system. I mean it was more a presentation prototype than a functional prototype. The emphasis was always: “Do we have all the screens, do they look nice and do we see information on it?” But that is not a system. So the real back-end of it, the functions and the business rules which are run behind the surface were not evaluated or analyzed in detail enough in order to make the system launchable in the production.” - HN, CarCo-B-3

In fact, the offshore team was not in the position to gain a solid grasp of requirements. The preparatory phase - Spring 1996 - did not help them enough. On the one hand, efforts of BW and NK during that period did not materialize as NK had left the project. HN’s own work as delivered through the prototype was not intended to fully equip the vendor team. The offshore group also did not receive strong support from BW during the Summer and Fall 1996. What they needed was an area-based, detailed analysis of CarCo requirements. This would fill in their gaps of business knowledge, and it would complement the work accomplished so far. Such specialized analysis did not happen. The offshore group worked in parallel on various aspects of the Goldd system. Their approach was somewhat unstructured and mainly based on local oral processes (see later section on cross-cultural topics). All this complicated coordination with the onshore liaison and the customer. Upon reflection, HN would have preferred a different setup. He emphasized the need for experts on both sides, carefully elaborating pieces of the Goldd system.

> “[Something] which I would change is that you do the prototyping more on an area basis. You need to have some experts on every side (German and Indian site - author), also in India specialized in certain business areas. You can’t expect that everyone is the expert in every piece of the system. You have to break that somehow down into functional areas and assign people to these areas. So he is the expert for Sales and P&A code, he is the expert for database design, he is the expert for Marketing & Advertising, he is the expert for Workflow & Security, and so on. That did not happen. It was full scale, full functionality, everyone doing a little bit everywhere. No clear focus. There was not enough time to focus in each of these areas. So you connect on a very general broad basis some requirements, but you don’t have the time to really specify, or come to the details, analyze in detail what is needed.” - HN, CarCo-B-3

Adding to these operational concerns were more fundamental factors that made successful development hardly possible. From the side of CarCo, the complexity of the system was underestimated (CarCo-B-3). This led to unrealistic expectations of key project variables like scope, processes, and inputs. Management pushed for quick results that appeared unfeasible to attain.

> “At the end the argument was always we want to quickly launch something. Quality is second priority. But at the end you see how long it takes. You end up with a lot of embarrassment, and conflicts which don't help. You must start doing it well from the very beginning, to say: “OK this is what it takes”. You must have a realistic evaluation of the complexity.” - HN, CarCo-B-3

Outsourcing in such a situation affects the vendor too. In their eagerness to win the Goldd contract, SoftHouse agreed with fixed budget and timing while the development work was incompletely specified. Along the way, this fueled discussions on parties' intentions, expectations and interpretations:

> "The fixed price and given time without specifying functionality caused aggravation throughout the team. If any idea was raised the answer would be: "This was not in the bid document, this was not included in the price". I am not opposed to fixed price as such, but fixed price in phases. I.e. fixed price for the prototype, fixed price for the reviewing the prototype, etc.... Fixed price over the whole project gives no room for prototyping. There was endless fighting about what was in the bid, sometimes based on either misunderstandings (you can interpret a document in 100 ways) or wordings. With the prototype approach, there were endless discussions. Fixed price and prototyping is a contradiction in itself. The bid document was unrealistic with the whole process" - HN, CarCo-B-1

§ 10.3.5.3 Model Office 2: Co-presence of Key Stakeholders

The second Model Office in Detroit, December 1996 presented the system developed over the preceding Fall. Despite considerable difficulties, users could try out a version that had made considerable progress since the PC-based prototype as HN explains:

> "Second Model Office was more orientated on Sales and P&A code. I didn't attend it. It was more in depth. During the first Model Office they (users - author) have seen the prototype on the PC. That was just really a prototype, just an idea, a conceptual approach. Then they have seen the first product in December (...). We focused on the core functionality: how do you setup a location, how do you set up a dealer, how do you assign Sales and P&A codes. This core system was presented in December." - HN, CarCo-B-3

One disadvantage of the session was that the IT group could not implement changes real-time. This would have compressed subsequent feedback loops. Absence of this capability meant that the change requests had to be passed on the offshore team for incorporation in the next version of the system: "During the Model Office a real prototyping tool would have worked better if we could have made changes immediately and showed them" (JF, CarCo-D-1).

For the offshore vendor team, Model Office 2 made all the difference. Even though it was rather late, they had for the first time access to users in the US and CarCo personnel contributing to the Goldd project. SPB joined the session as representative. For the first time, he was not depended on the remote liaison link with BW. The opportunity deepened his insights in user expectations:

> "After the Model Office I know what the users want. (...) The Model Office helped a lot. Now we know WHY they want things in a certain way. I will share this information with the team and it will make us much more confident about what we are doing. The Model Office has helped me see the concept behind the screens, the business. What the users want is a usable product, it has to be user-friendly. It is much easier to know what somebody wants when communicating person to person." - SPB, CarCo-E-1

§ 10.3.5.4 Final Stage and Reflections

"What I'm saying is that the match of prototype and offshore - I'm doubting that from where I am now." - HH, CarCo-A-3

Over Spring 1997, it became clear that the development process would be further delayed. Design of the Sales and P&A code functionality needed more elaborate requirements analysis. In addition, the American and Indian teams had failed to coordinate standards for the database design. This postponed data loading and conversion in the US that was required for the launch there.

Reflecting on the project, one can observe that the Goldd teams used RAD in a different way than commonly proposed. We use Figure 65 to explore these differences, and some of the issues that emerged. The light gray areas have been modified from the figure in the theory section to highlight specifics pertaining to the Goldd case.

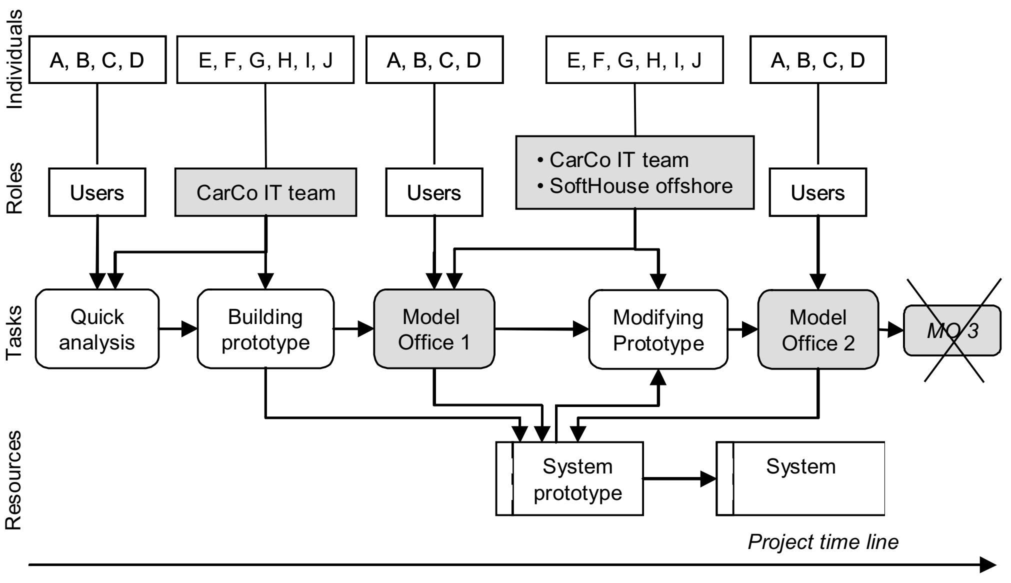

Figure 65 - RAD in the Goldd project

A first distinction is that the team involved in the prototype for Model Office 1 was not the programming team. The former group included CarCo IT staff members like HH and HN. The latter was an offshore vendor team. The task of elaborating the initial design and programming Goldd was outsourced to that team.

Second, the assignment of this task to another team implied a division of work that created interdependencies. The original agency relationship between CarCo users and their own M&SS group became more complicated. In fact, the latter group initiated an additional agency relationship with SoftHouse (Figure 66). As a result, the offshore group became very dependent upon the initial CarCo team - and of course the users as main principal - for requirements know-how.

Figure 66 - Double agency relationship in the Goldd project

Third, Goldd's organizational setup did not reflect these information processing needs. Parties underestimated or ignored the fact that BW as onshore liaison could not cater on his own for the needs of the Bangalore team.

Fourth, RAD trajectories rely on a number of cross-functional meetings like the Model Office sessions. In the case of Goldd, only two sessions were held. Model Office 3 (abbreviated as MO 3) was skipped. HN did not consider that enough for a prototyping approach. He argues that more cycles were needed, and more direct communications between CarCo users/ IT and the offshore team. This did not happen, in part because of budgetary reasons. In his mind, contact between the onshore and offshore groups must be more frequent, direct and specialized. People on both sides would have to focus on a specific areas and tie back to their remote counterparts.

> "I would want prototyping, more cycles. It was wrong to have two cycles that's far too less. More prototyping on specific areas, not on the broad scale. Prototyping on a distance could work. But it implies that you do some more prototyping cycles, more than we did, not just three. And it needs some more traveling, more direct communication. You need traveling, and you need budget for that and that was not given." - HN, CarCo-B-3

HN would have also preferred more extensive contact between the offshore team and users in an early stage. As things turned out, the SoftHouse team was involved in the Goldd project after the first Model Office. They met users in December 1996.

> "I would have liked more prototyping cycles, and more focus on in time (timing - author). The key issue that they (SoftHouse - author) missed was timing. We need more cycles and more work with the users before launch, now we will have to face issues in the production environment." - HN, CarCo-B-2

What HN suggests is an organization setup that matches information needs from the second agent, the offshore team. The actual collaboration patterns were shaped according to agency relationships (in part formalized like the contract between CarCo M&SS and SoftHouse). One can compare Figure 66 and Figure 52 to this end. This made sense from a governance point of view. Perhaps working with liaisons seemed convenient too. It avoided remote contact for the CarCo teams with a different partner. Only in a later stage did people realize the ineffectiveness of a setup that served none of the parties involved very well. The moved to a more direct contact mode that catered for parties knowledge needs and work flows (Table 39).

When looking back, HH and HN remained convinced that the initial setup could have worked. The chained contact between the onshore and offshore team could have relied on BW and NK if they had had a good working relationship and more experience.

> “The theory is OK, from the theory you need to have these two guys, the onshore and offshore project manager. But they need to be experienced, they need to know each other, to have to have experience let’s say several years of experience working with each other so that they really know each other and they should have experience in the sense that they to have done it several times. Then it works out. I mean if these guys really communicate with each other I don’t see any problems.” - HN, CarCo-B-3

> “I think basically the idea is very good. (…) I think it would have been if we had had a different start. I think the start went wrong. We got off on the wrong foot. I think basically the two people who were supposed to transfer the knowledge to the Indians did not function for whatever reason.” - HH, CarCo-A-3

At the same time, HH expresses concern on the combination of prototyping with offshore outsourcing. He recognized the fact that prototyping relies on close interaction between users and the IT development team. With a double agency relationship, the offshore vendor team must connect at least closely to the customer’s onshore IT group. However, distance and indirect contact between these two groups reduced their collaborative effectiveness (see Table 44). It also added to the work pressure on HH himself:

> “I question the value of matching an offshore development with a prototype approach. I think we'd have a better result if we can have the people sitting here or very close, and we could have a more interactive way of communicating. With a prototyping approach you need a project team to be onsite. Whenever there is a problem you can sit with them and solve it. (…) I mean the way it works now with basically one project manager (i.e., interviewee - author) who is also the technical front end, plus all the questions - it’s an overload.” - HH, CarCo-A-3

§ 10.3.6 Face-to-face versus Remote, Electronically Mediated Collaboration

> “Face-to-face communication is always better” - SPB, CarCo-E-2

Global projects like Goldd rely mostly on remote, electronically mediated communications. It would be too expensive to collocate representatives from different sites. Still, face-to-face meetings play an important role. This section explores situations and conditions that advocate co-presence interactions.

The Goldd project worked with a tight budget. Perhaps CarCo executives could not allocate more money to the project. Or they underestimated the complexity and cross-site needs for interaction. In any case, HN explained that budget constraints constituted one of the key reasons for the limited number of Model Office sessions and few face-to-face meetings:

> “I would want prototyping, more cycles. It was wrong to have two cycles that's far too less. More prototyping on specific areas, not on the broad scale. Prototyping on a distance could work. But it implies that you do some more prototyping cycles, more than we did, not just three. And it needs some more traveling, more direct

communication. You need traveling, and you need budget for that and that was not given." - HN, CarCo-B-3

Budgetary factors played an important role in the decision to go ahead with Model Office 2, in December 1996. HH would fly to Detroit to meet users and local M&SS people. The session was almost postponed because of late deliveries from the offshore team. This would complicate HH's position. Corporate regulations stipulated very stringent conditions for traveling in December. Since HH had already obtained approval for his ticket to the US, he would have to cancel that flight and re-apply (AC log November 25 - 29, 1996).
An overview of cross-site visits is provided in Table 45. The left hand column lists face-to-face meetings over the period 1995 - Spring 1997. The other four columns show people involved in these meetings from Germany, UK (liaisons), US, and India (light gray cells). The columns also clarify where the meeting took place with a diamond symbol (◆). The first meetings involved BW and NK from SoftHouse. They started working with CarCo representatives in Germany and US to prepare the bid and project. Early 1996, JF and BM from Detroit visited Germany for the data model and screen layouts. Next, HH and HN went to Detroit for Model Office 1 in the Spring of that year. Over Fall 1996, BW met the offshore team in Bangalore. The second Model Office meeting in December 1996 was the first one involving representatives from all sites: HH, BW and SPB from India went to Detroit for meetings with JF, local M&SS personnel, and users. Afterwards, SPB visited Cologne on his way back to India. He returned early 1997 to Cologne as temporary onshore liaison, a role MD took over in March. In Spring 1997, a taskforce meeting was arranged in Detroit with HN (Germany), MD, SM and VA.

Table 45 - Face-to-face meetings in the Goldd project

Event	Germany	UK onshore liaisons	US	India
BW, NK visit CarCo sites Winter 1995, early 1996	◆ Meeting location Germany team	BW, NK	US team, users	
US delegation visit Cologne, early 1996	◆ Meeting location Germany team		JF, BM	
Model Office 1, Detroit, Spring 1996	HH, HN		◆ Meeting location US team, users	
BW visits offshore team Fall 1996		BW		◆ Meeting location Offshore team
Model Office 2, Detroit, Winter 1996	HH	BW	◆ Meeting location US team, users	SPB
SPB visits Cologne, Winter 1996	◆ Meeting location Germany team			SPB
BW and BJ visit offshore team early 1997		BW, BJ		◆ Meeting location Offshore team
SPB, MD onshore liaisons Cologne, early 1997	◆ Meeting location Germany team			SPB, MD
Ad hoc taskforce visit Detroit, Spring 1997	HN		◆ Meeting location US team	SM, VA, MD
Totals:	7 times involved 4 meetings	4 times involved	5 times involved 3 meetings	6 times involved 2 meetings

The bottom row of Table 45 depicts how many times people were involved, and where the meetings took place. As coordinating site, Germany participated in the largest number of meetings and hosted also its majority. Representatives from the offshore team joined rather late in the meetings. Their first visit outside Bangalore was the second Model Office in December 1996, the first and only meeting that included representatives from all sites. Overall, the impression exists the number of visits was rather low as HN points out:

> "We rarely had site visits. I visited the US twice for Model Office sessions. SPB visited the US once for the Model Office. JF and BM came to Germany for the database and the screen layouts." - HN, CarCo-B-2

We explore for the different sites why people wanted to meet face-to-face, and how these meetings are related to remote, electronically mediated exchanges.

§ 10.3.6.1 CarCo Germany Perspective

In HH's experience as overall project leader, distance had a profound impact on his management relationship with the team in Detroit. He explained that the distance to the US sites makes it impossible to manage people there like he would to with local subordinates. In fact, he depends very much on their autonomy, motivation and capabilities (Perin, 1991). Only a self reliant team can work effectively on its own, without needing too much remote communications, visits and management involvement.

> "[With distance] It is even more important that you have good people, mature people, motivated people in the other country 5000 miles and six time zones away. It is even more important. I don't have to talk to JF on a day-to-day basis. She knows the plan, it has been reconciled with her and she makes sure that it's executed. But if she wasn't as strong as she is, I'd have one hell of a problem. If she'd be here I could kick her around every day. Not that I would, but it is the right kind of people, who do the right kind of jobs, you can always do these things - they almost run automatically. It cannot fail. But if you get the wrong kind of people, then no matter how good you plan it you gonna fail." - HH, CarCo-A-3

Distance to his subordinates in Detroit implies that he does not control their work extensively. He relies on their own insight and drive to accomplish local task responsibilities. Trusting the team there to control their own work results from the good rapport and global management structure earlier described.

> "For the US the level of control is less. So there is more trust for them to self-control. I do not want to micromanage a team at 5000 miles distance." - HH, CarCo-A-2

HH 'meets' US representatives often electronically. On top of phone and email, they enjoy priority access to advanced videoconferencing equipment at both CarCo sites. Still, HH perceives limitations of electronic media, even something as rich and interactive as videoconferencing. In his mind, it is necessary to punctuate the remote contact pattern with site visits:

> "Videoconference we have it almost every day now. That's a good substitute but it only goes so far. I mean at the end of the day you need to be there every once in a while." - HH, CarCo-A-3

With regards to the offshore team, HH had preferred collaboration on-site. The current setup reduces the directness and interactivity of communications, and it lengthens problem solving cycles.

> "I question the value of matching an offshore development with a prototype approach. I think we'd have a better result if we can have the people sitting here or very close, and we could have a more interactive way of communicating. With a prototyping approach you need a project team to be onsite. Whenever there is a problem you can sit with them and solve it." - HH, CarCo-A-3

MB from the German team also asserts that distance to the offshore team makes communications more indirect. When BW was routing communications, he had never direct contact with offshore team leaders or team members like SPB. This changed when SPB came onsite:

> "I worked more and more with SPB when he was here. And also through audio conference we have direct contact with the coordinators of the team in India. The first

approach was that we had an onshore and an offshore manager, NK and BW. The advice was then: all official things through managers." - MB, CarCo-C-1

Global distributedness seems to reduce direct, verbal communications. People use email exchanges rather than contacting their counterparts ad hoc on the phone or videoconference.

"If everybody were here at [CarCo] Germany, all with the same culture, language etc, we would have no videoconferencing and less email. More RAD and more verbal communication." - MB, CarCo-C-2

Somehow, distance increases the risk of confusion. It leads to a more asynchronous way of working, and requires more effort. Electronic media offer a limited range of communication capability. They may allow for textual, audio or visual exchanges but not as rich and interactive as to face-to-face meetings:

"There is so much controlling because the only medium is telephone and profs. With telephone you cannot see words and profs is only one way. When discussing face-to-face, with a PC or pen and pencil and you can draw a diagram and make them see what you mean, or you can use the tool immediately instead of waiting for reports from the tool. That would work easier." - MB, CarCo-C-3.

Electronic media encourage asynchronous exchange patterns as compared to collocated meetings. In addition, people may have different ways of using them, like frequency and formatting. All this increases the risk of misunderstanding and confusion. It demands a formal and possibly more indirect approach to communication patterns. Problems of remote exchanges also intensify control processes and the need for feedback loops.

"There would definitely be less control if the US team were here, the same applies for India as well. We use Word documents with questions, and everybody answers in different kinds (even colors) of font. It goes back and forth; at the end it gets very confusing. Or we would have that somebody would sent answers back without reference number. When working face-to-face you can have the answers and the questions in the same conversation." - MB, CarCo-C-3

In a face-to-face meeting, feedback are self-evident. People use verbal and nonverbal cues to indicate their understanding of a sender's point. With remote contact, this is not the case, especially not with asynchronous media like vmail or email. People must pay more deliberate attention to feedback loops, e.g., by confirming receipt of a message (Meadows, 1996b). In the case of Goldd, team members had to use the profs email system instead of ftp do exchange files. Unfortunately, profs did not offer suitable functionality to support feedback messaging. This complicated remote file exchange:

"With remote communication in general it is very important to get a note back from the receiver with: "I have understood," or with "I have received". This did not work very well with profs and we would sent files several times. With ftp you would not have this problem." - MB, CarCo-C-3

MB indicates that he prefers face-to-face to remote interactions. He cites the visit of US representatives to Cologne, early 1996. During these meetings, people could bring up and discuss issues immediately, without having to revert to the asynchronous back-and-forth process common to remote exchanges.

> "The two sessions when the Americans where here were very efficient, changes were made and documented immediately." - MB, CarCo-C-1

In one interview, MB ranked his preferences for interpersonal communications. Interestingly, this came quite close to the media richness scale of Daft and Macintosh (1981). In the first place, he prefers direct contact with someone, without having to use electronic media or liaisons. Next, he like to use direct phone calls. With India this appeared cumbersome because of technical hurdles and the organizational setup in Bangalore. Most exchanges relied on email, a medium that is in fact at the bottom of MB's list in terms of preferences.

> "First of all I would prefer direct communication, person-to-person (i.e., face-to-face - author). If that is not possible I like to call a person. (This because we do not have personal videoconferencing, this of course would be better.) But this is difficult to India because of the lines (we have to call the satellite first, etc.), then the connection to the person you want in India, they will pass you through several departments etc. So the need for direct communication is done via Profs, but the problem is that it is only one channel." - MB, CarCo-C-3

HN, MB's peer in Cologne, noticed that remoteness cuts out many informal aspects of interpersonal collaboration. Compared to collocated office settings, people do not share information as often and as easily. They adapt to distributed work environments with more formal processes and meetings. Electronic media can sustain remote contact, but they require effort and conscious preparation:

> "Without the distance we would have more informal contacts, more informal information, there would be less focus on the formal meetings. Communication on paper is more difficult. For audio or video conferencing you need to be prepared so that everybody is at the same level." - HN, CarCo-B-2

Distance makes communications more challenging and time consuming. People are more likely to experience misunderstandings or hiatus. HN explains for his contacts with US counterparts:

> "It's not a major issue that they are in the US. It's delaying. And we need some time to understand. Sometimes there are misunderstandings or communications breakdowns." - HN, CarCo-B-1

Under some conditions, these effects of distance make it necessary to meet face-to-face. This was the case when early 1997 it appeared that the design of Sales and P&A code functionality was not sound (see bottom event in Table 45). Lack of contact between the US and offshore teams resulted in different viewpoints and standards. The situation surfaced when the US team started preparing their data conversion:

> "During the testing we identified that the core Sales and P&A functionality is not properly designed into the system. They (CarCo US and SoftHouse India) didn't talk to each other. They do a conversion in the States, you have a database and a database design. And they do a conversion from the old system in the new database. So they

> load data in, then they expected that the Indian rules on that data work the same as they thought it should work when they did the conversion. But they never talked to each other and that didn't work, especially not in that area. So when you load these conversion data it was right in their understanding, but the Indians had a completely different understanding." - HN, CarCo-B-3

Effort was made to solve the issue remotely. HN in Cologne took on a role as coordinator. He worked extensively with users and peers to understand the issue. In the end, however, the topic appeared too complex for this approach:

> "We prepared the document here (in Germany - author), tried to come to a conclusion and agreement with the users. So we had about two weeks regular almost daily meetings. First we started with documents, I started trying to understand what they needed, what is Sales and P&A code at all, what do they require, what is their current business practice. And then I tried to specify that, document it, and communicate it. I had a lot of questions, and I tried to get answers to these questions by reading. But that didn't work out, it was always: "But we have this and this case, and this and this exception to the rule"." - HN, CarCo-B-3

Complexity basically forced the people involved to switch to a more intensified form of organization. They formed a taskforce and decided to meet face-to-face in Detroit. This enabled direct, interactive discussions including stakeholders from the US, Europe, and India. Onsite presence also provided HN with a closer look at the current North American system in Detroit.

> "And then we decided we have to make a separate task force on that issue. So I prepared my understanding of it as much as I could, went over there (Detroit - author), and discussed it with users. I looked into the current system run, how it works, discussed it with the Indians, which was when we agreed on the final concept, which has been implemented just now. (...) So they have to redo the conversion, do some rework on the conversion. And the Indians have to do something as well. Both have to adjust to a common concept which is now in place for that area. (...) We expect next week the first delivery based on that discussion. The meeting in Detroit was in May (1997 - author). The Indians came also to Detroit, 2 of them: SM came and VA (Team leader - author). SM is the offshore project manager and VA is responsible for some core functionality of the system, he is developer. I stayed there 10 days. MD went" - HN, CarCo-B-3

§ 10.3.6.2 CarCo US Perspective

From Detroit, JF pointed at the beneficial effects of on-site visits. Early 1996, she visited the Cologne team together with BM. Her immersion in that context generated a multitude of cues not available with remote contact. Understanding more of the German team's background helped her frame exchanges when working on a distance (Meadows, 1996b). Simultaneously, she built good rapport with local personnel. This led to more relaxed, open communication lines between Detroit and Cologne (Gabarro, 1990).

> "I visited [CarCo] Germany 3 weeks before and 2 weeks after Carnival. And it helped me a lot! The things that were not a part of the job, like the office environment, how people commute to their work, the area they live in. Knowing the background of people helps me understand how they think about the business. And besides that going to Cologne was also good for the work we did together. (...) Later they were

> more relaxing, they were more open after I had been there. I kick on it when HN sends me a joke. We really had to grow into it." - JF, CarCo-D-2

JF explained that presence at a site fosters awareness of that context (Tyre & von Hippel, 1997). Just as she had to go visit Cologne to learn about the context there, she pointed at the fact that SoftHouse would not understand CarCo's ways of working learning unless they were onsite. Only later in the project did SoftHouse realize that onsite presence of offshore team members was necessary to build cross-site know-how. They would not accomplish this as long as they relied on independent liaisons (BW) and/ or remote contact (offshore vis-à-vis US).

> "I think the biggest thing is learning the [CarCo] style of working. It is easier and you can work faster if you know how to get things done. I do not want to call it politics though. And [SoftHouse] will never learn the [CarCo] way, because you have to be there to learn it." - JF, CarCo-D-2

The way Goldd was setup led to limited direct exchange between offshore and Detroit. AS JF mentioned: "Contact to India is not in my round of responsibility (…) I do not know so much about them because I had almost no contact with them" (CarCo-D-2). The two groups never connected their local understandings or a built common basis for collaboration as the Sales and P&A code issues revealed (Grant, 1996b). Consequently, coordination between the groups became very challenging, resulting in de-differentiation of work. In other words, tasks that would have been delegated to the offshore team came back because of coordination hurdles:

> "Some things that would be done offshore came back because of the difficulty to give information and explain. It would be as difficult to explain as it was doing it ourselves." - JF, CarCo-D-1

With Germany, JF noticed that distance has its pros and cons. On the one hand, it advances people's skills to handle remote information exchange, like using ftp. The other side is that distance makes interactive discussions more cumbersome. With collocated meetings, people can bring in all the relevant documents and look at them. This practice is not possible when they work from different sites. In that case, they need local copies of the same resource. But even then, pointing to sections in the documents or changing them appears challenging:

> "Distance has good and bad effects. The good thing is that everybody learned how to transfer files, before this project we did not bother to do that. The bad thing is that it is much easier when a person is next door. If you are trying to explain something on the phone the difference is that you have no documents. You can set up a phone call and send the documents in advance, but always something will pop up that is not in the documents, and then you cannot draw it up." - JF, CarCo-D-2

Counteracting these issues requires formalization. JF emphasizes the need for setting a priori standards to coordinate expectations at different sites. Ownership of particular documents and processes must be clearly assigned to individuals so that everybody knows whom to refer to.

> "It is very important to define standard procedures. You cannot just do things between two continents. Somehow all the documents you send get lost somewhere in the middle, in the ocean. In every area you need somebody to control the documents. One person has to have total knowledge about one area. Otherwise, things get lost and therefore the work does not get completed." - JF, CarCo-D-2

Contact between Detroit and Cologne became not only more formalized. It became also more channeled. Initially, the two teams held videoconferences with multiple staff members at both sites. This contributed to local awareness of progress on either side. A disadvantage was, however, that the meetings covered to many topics. JF urged to reduce the number of people participating in order to achieve more focus (AC report January 6 - 17, 1997). According to AC, channeling exchanges leads to less involvement of team members not joining in the meetings. This requires additional communications at local sites after a teleconference.

§ 10.3.6.3 SoftHouse India Perspective

In their role as agents in Goldd, the offshore team they needed considerable knowledge on the principal's (i.e., CarCo) expectations. They suffered from not having been involved in the first Model Office session. Subsequently, over Fall 1996, the team did not receive much help from the onshore liaison, BW. They had to rely mainly on documentation and the prototype itself. This proved not sufficient as MD explained in March 1997:

> "(...) It took us several months to find out what they wanted. The documented work specifications give only an overview, but no details. BW did not give proper information. It is much better now that I am here, somebody needs to be on-site." - CarCo-F-1

SPB makes a similar complaint. He points out that over Fall 1996, the offshore team lacked information on the customer's requirements:

> "In the beginning it did happen that we had days without work, because there was no information to work with. (...) At the beginning we did not know what the user wanted, and it is better to talk directly to the user to know what is better for them." - SPB, CarCo-E-1

Goldd's organizational setup with liaisons constrained communications between CarCo and the offshore team. It led not only to insufficient and delayed communications, but also distortions. People add their own perspective to information they are passing on. Eventually, the offshore team receives information that does not match the original intention of the first sender, like in a telephone game (see discussion of this metaphor in the theory section).

> "When the information goes from the users to JF, to HN, to BW, to us, it can get distorted or diluted. When one person in the link has not understood what the user meant, it will show in the product. Errors in understanding will be passed down the link." - SPB, CarCo-E-1

Indirect communications through BW complicated the offshore team's work. They depended on multiple nodes before information reached them from the customer.

Communication backwards was even more burdensome. Interestingly, when BW visited the unit in Bangalore, he communicated more directly with leaders and members of the team. Somehow, his onsite presence encouraged more ramified networking then when he worked in Cologne. AC reports in her debrief of an interview with SPB:

> "All communication to India goes through BW. BW talks to SM (Offshore Project Manager, see Table 32 - author) who is more on the Oracle side of the team. On very rare occasions does BW communicate directly with SPB. This would happen if there are very specific issues with screen design and such. This would happen on the phone. When BW was in India, SPB also had the opportunity to talk to him. (...)
> All other communication is done through SM, via profs (e-mail), fax and phone. Before information reaches the team it goes through SM and through the team leader. I asked him what he thought about the communication lines as they exist: all communication through BW. SPM seemed a little indignant, he got immediately exited about the issue. It was clear that he thought it was troublesome and difficult to communicate in such a way." - AC, CarCo-E-1

The initial Goldd setup confined back and forth communications between CarCo users and the offshore team. It quasi simplified their relationship to a one-way flow of explicit, documented information that would reveal user expectations. In reality, the relationship was more reciprocal and should have been organized accordingly. Users and programmers have unique knowledge domains that must be fused for an effective final product. Users bring in their current practices and business knowledge, while programmers contribute technical expertise and experience from other projects. They can suggest novel ways of setting up the application (see flows 1a and 1b in Table 39). In other words, the flows between these two groups was more reciprocal than sequential (Van de Ven et al., 1976). It was also more uncertain in the literal sense that multiple alternatives existed for the Goldd functionality. Unfortunately, the people setting up the project were not aware of this situation. They held a simplified view of the project, which complicated the offshore team's job.

> "Users do things because they are used to do things, they have certain practices out of habit. The user does not know why he does certain things, he only knows that he has been doing it this way always. Programmers have a more global overview and they can ask users why they do things in a certain way. And often programmers can propose an easier way of doing things, the user would not think of the easier solution."
> - SPB, CarCo-E-1

SPB's participation in Model Office 2 obviated the offshore team's inability to reach users, albeit in a late phase of the project. His onsite presence facilitated direct, face-to-face discussions with key stakeholders: HH from Germany, North American users, and the US Goldd team. These interactions boosted his insight in the customer's 'thought worlds' (Dougherty, 1992) in a way earlier provided resources could not accomplish:

> "I understand a lot more after the Model Office, there is no comparison between what I knew then and what I know now. The data model helped us understand quite a lot about the business, as it was also logical. With the data model we understood a lot, about 70 - 75%. But the more important thing to know is what the user wants, and that is the most difficult and the most critical thing to understand. They do not ask so much: they just want a product that is like the former one, or much better. They only want it to be user-friendly as they have to work with it everyday. The user wants

something easy, he wants to be able to access certain screens in one step, at the most 2 steps. That is what we are going to try to develop now." - SPB, CarCo-E-1

Face-to-face discussions provided SPB with background knowledge, similar to the effect of JF's visit to Cologne early 1996. Transmitting this type and depth of know-how had not been possible on a distance, especially not with BW in between:

"After the Model Office I know what the users want. (...) The Model Office helped a lot. Now we know WHY they want things in a certain way. I will share this information with the team and it will make us much more confident about what we are doing. The Model Office has helped me see the concept behind the screens, the business. What the users want is a usable product, it has to be user-friendly. It is much easier to know what somebody wants when communicating person to person." - SPB, CarCo-E-1

After this onsite experience, SPB commented: "Face-to-face communication is always better" (CarCo-E-2). As a substitute for co-presence, he preferred direct, rich communications like videoconferencing can provide. "It would have been better if we had videoconferencing to Germany, because that works better. Audio conferencing is not really communication" (CarCo-E-2). SPB's comments are similar to what MB indicated earlier in this section. We can frame this perception with Table 44. Both team members emphasize direct contact between two or more persons across sites. Preferably, they communicate face-to-face with a remote counterpart (cell A). As an alternative, electronically mediated contact would work (cell C). This must be as interactive and rich as possible.

After her interview with SPB (CarCo-E-1), AC logged some reflections. She observed that face-to-face contact improved rapport between people from different sites. This fostered their understanding and willingness when collaborating remotely (Gabarro, 1990).

"I think it was a very, very wise decision to bring SPB to the US and to Germany. Before he came, I think both teams had a very vague notion about "some Indians, who are programming", knowing nothing about them. I think that this does not improve the communication between the teams, as you tend to have less respect for somebody if you do not know him. You probably do not want to go through all the effort of explaining somebody something if you do not know who he is. After SPB's visit, to me at least, things seemed a lot clearer. SPB was just a friendly guy, he had a lot of knowledge about the program and seemed very willing to work for the product. Knowing whom you are talking to makes you a lot friendlier, I think. SPB was also very happy to see the users and to hear things for the users first hand." - AC, CarCo-E-3

According to AC, face-to-face meetings have an important role at the beginning of a global project. People need some form of collocated introduction to know whom they will be working with. As MB mentioned earlier, such an event took place between the American and German team, but not with SoftHouse team members (CarCo-C-3). From AC's angle, it may not be feasible to have all members from all sites meet. But al least representatives should meet directly to build a minimal network across sites. Others could connect to their local representative in case they have questions on the way remote counterparts operate.

"It (...) seems to be important that the team members meet at least once, do some trivial things together, just to get to know each other. This would be more expensive of course, but it does improve communication a lot. The best would be for all teams to meet, but a representative of the different teams would also work. That if there is a question like, what do the Americans mean with this, somebody can explain. So it is important for the people who communicate (key representatives per site - author) to know each other and for every team that at least one person can understand why the other team thinks this way." - AC, CarCo-E-3

According to AC, representatives from sites A, B, and C know each other from collocated kick-off meetings. They sustain cross-site connections and assist local personnel when working remotely. With reference to Table 44, this implies that direct, face-to-face contact provides a foundation for communications in distributed projects (cell A). Afterwards, people can either sustain direct remote contact, e.g., between the representatives (cell C). Or representatives can leverage on their social capital and function as liaisons between local personnel and remote counterparts (cell D).

§ 10.3.7 Experiencing Technology

Information Technology played a vital role in the Goldd project. People used IT for local processes and to connect across sites. They relied on IT resources to develop the Goldd system. This section points at special issues people experienced in the Goldd project. It looks at remote connectivity and development resources. As an aside, the case refers to a project in the period 1996 - 1997. In the mean time, technical advances may have altered many of the issues described here.

§ 10.3.7.1 Remote Connectivity

The German and American sites benefited from CarCo's global IT infrastructure. They had access to shared servers, and used for instance a calendar system that allowed each site to see exactly people's appointments at the other site (CarCo-H-2). Goldd team members had priority access to videoconferencing facilities in Detroit and Cologne. They could place conference calls from people's desk phones with high quality connections. Both sites had access to ftp and PROFS for email.

A technical connectivity issue between US and Germany concerned remote server access speed. From Cologne team members had to access a server in Detroit to get data for testing. This took considerable time (AC log February 3 - 28, 1997). Also, the German team did not have access to the old CDDB and CIS systems in the US. When HN had to elaborate issues surrounding the Sales and P&A functionality, he had to fly over to Detroit to take a look at the systems (HN, CarCo-B-3).

Between CarCo and SoftHouse, technical infrastructure did not work as smoothly. Setting up basic things like a phone connection from Germany to India required considerable patience. As MB describes, they had to call first a satellite and take a number of subsequent steps:

"First of all I would prefer direct communication, person-to-person. If that is not possible I like to call a person. (This because we do not have personal videoconferencing, this of course would be better) But this is difficult to India, because of the lines: we have to call the satellite first, etc." - MB, CarCo-C-3

Once a line was setup, people suffered from noisiness and interruptions. This caused irritation for the caller in Germany, as well as for people in adjacent cubicles who could overhear literally people screaming on the phone (AC log January 20-24, 1997). People used mainly email for exchanges with India. It took quite some effort to get the SoftHouse offshore team on PROFS. For some reason, they could not use ftp, so large files were sent back and forth with PROFS. Unfortunately, facilities in India were not prepared for these volumes as MB explained:

> "With remote communication in general it is very important to get a note back from the receiver with: "I have understood," or with "I have received". This did not work very well with profs and we would sent files several times. With ftp you would not have this problem. (...) I heard today that ftp is not possible to [SoftHouse]. I don't know if it is because of [SoftHouse] policy or [CarCo] policy. We have zip files of many megabytes, and Profs doesn't work very well with these big volumes. And the disk space of the profs accounts in India are insufficient." - MB, CarCo-C-3

§ 10.3.7.2 Development Resources

Apart from remote connectivity, people used a variety of development resources. These included office applications, and applications for change management, design and database management. HN comments on some of these resources that were used at the different sites:

> "The CASE tool for changes to the data model is a standard. And in general Office Applications like Excel and Access are standards. You will not notice that until somebody uses a different standard." - HN, (CarCo-B-3)

Installing a common infrastructure appeared challenging at times, in particular for SoftHouse. This applied to data modeling tools (IEF and ER-WIN), and basic things like operating and email systems:

> "[CarCo] has a variety of tools (IEF/ ER-Win) that India does not have. For example, India had to get ER-Win to overcome problems. They have no mainframe, no Windows 95, there were difficulties with getting PROFS." - HN, CarCo-B-2

Solving these issues took a long time. In February 1997, MB still complained about incompatible infrastructures:

> "Between offshore and onshore we still suffer from compatibility with software (Microsoft Access). And sending files with profs; we have ftp transfer, they don't" - MB, CarCo-C-1

On top of this, the offshore team had its own share of problems with development software. They struggled with bugs in Oracle and Designer 2000 (CarCo-K-1).

§ 10.3.8 Time Zone Differences and Asynchronous Availability

Time zone differences a-synchronize working hours in multi-site projects. In the Goldd project, three sites were involved, each in a different zone (see Table 33 or Table 46).

CarCo joined the project with one site in Cologne, Germany in UTC +1, and one in Detroit, USA, UTC -5. SoftHouse's main site was in Bangalore India, UTC +5½. Asynchronicity can also be attributed to different local patterns of holidays and days off. We elaborate here on some project members' experience with time differences and asynchronous availability. The section is grouped around three interfaces: US - Germany, Germany - India, and US - India.

§ 10.3.8.1 US - Germany

Between Detroit (UTC -5) and Cologne (UTC +1) people experience a 6 hours difference (Table 33 or Table 46). The overlap occurs during afternoons in Cologne and mornings in Detroit. With an extended working day from 8:00 until 19:00 at both sites, people have a 6 hours window. More conservative days from say 9:00 until 17:00 reduce the window to 2 hours.

In an interview with HN, he emphasized two effects of the 6 hours time difference. First, it extends working days. If people worked at the same site, they would have a single slot of about 8 hours per day. Now, they experience a stretched period of time. Second, HN mentions that synchronous contact must be planned around the window with Detroit, i.e., afternoon in Germany:

> "Time zone are positive because we have a 16 hours working day. It means that we always have to plan after lunch for contact." - HN, CarCo-B-2

Conversely, JF from Detroit keeps her mornings open for exchanges with Cologne and accommodates her local responsibilities accordingly:

> "I always have to keep the mornings open for communications with Europe, and schedule my other meetings in the afternoon." - JF, CarCo-D-1

While she must adapt her schedule, JF appreciates the fact that outside the window German colleagues will not contact her (i.e., during her afternoon when Germans have gone home).

> "The good thing is that you do not get bothered by the other team on times that they are not working. It gives a break. Time difference between US and Germany is not a big problem. " - JF, CarCo-D-2

Apart from time differences, at least one instance occurred when synchronous contact was desirable but not possible. This happened when the German team took a Christmas break, but the Americans and Indians continued work on the Goldd project. In the US, data conversion and loading had to be prepared for testing and implementation. For this job they had to collaborate with the German team that had a central coordinating role (AC log December 16 - 27, 1996). As this event shows, opportunities for synchronous contact depend not only on time differences, but also on local holidays, customs and priorities.

§ 10.3.8.2 Germany - India

Interfacing between Germany and India was mainly the vendor's responsibility. With an extended working day from 8:00 until 19:00 in Germany and India, people have a window of 8 hours. More limited working days from 9:00 until 17:00 leave a window of 4 hours. SoftHouse's onshore liaison had to work frequently with offshore leaders and team members. Input from Germany and the US was often needed for work processes in India. The offshore team had to check on CarCo expectations before they could proceed. Time differences combined with the organizational setup sometimes frustrated these processes. This depended on the moment German and/ or American input was needed. SPB reports on issues arising in India late at night that were relayed to Germany and needed input from Detroit:

> "When we send problems to Germany late at night (Bangalore time, i.e., afternoon in Germany) and they have to consult with the Americans, it goes around for a day. The team members do not really realize that, they get annoyed when they don't get an answer quickly." - SPB, CarCo-E-2

The workflow delay can be analyzed with Table 46.[67] Suppose it is Day 1 (shown instead of 8:00) in Bangalore. Late in the evening, people contact Germany (also Day 1) for assistance or information. BW or BJ as onshore liaison are asked to talk with local CarCo team members or directly with JF in the US (Day 1). When these people start working on the issue, it is probably getting too late in India to continue the job. They must leave the office in Bangalore and wait until the morning of Day 2. This process interruption causes delays for the offshore team in India.

[67] Although the site in India is UTC +5.5, we use UTC +5 for practical reasons. CC stands for CarCo, SH for SoftHouse.

Table 46 - Triple site time zones, workflows and delays

UTC -5	UTC -4	UTC -3	UTC -2	UTC -1	UTC 0	UTC +1	UTC +2	UTC +3	UTC +4	UTC +5
CC USA					SH UK	CC Germany				SH India
22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	Day 1
23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00
0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00
1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
2:00	3:00	4:00	5:00	6:00	7:00	Day 1	9:00	10:00	11:00	12:00
3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00
4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00
5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00
6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00
7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00
Day 1	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00
10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00
16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00
17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00
18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00
19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00
21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00
22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	Day 2
23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00
0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00
1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00

Drivers of these delays include, first of all, dependencies and task uncertainty. That is, local task accomplishment is embedded in cross-site work- and information flows. Second, time differences reduce opportunities for real-time contact. For instance, at some point it is too late for the Indian team to continue work even when they receive the requested inputs from Germany within a reasonable time. Third, liaised organizing contributes to delays. Each node may add time to task processing. In the case described in SPB's quote, direct contact between India and the US could have accelerated problem solving cycles. Now, with Germany's role as an exclusive gateway between US and India, people depended on an additional node with its own capacity and priorities.

MD mentions positive aspects of the limited time overlap between India and Germany. In her position as onshore liaison, she explains that working days are stretched. During her afternoon and evening in Germany, she can elaborate on questions from Bangalore (e.g., Day 1 in Table 46). On Day 2 in India, the offshore team picks up outputs from her job and continues while she is off.

> "The positive thing about time difference is that it saves work time, it is like working in two shifts. I find out things while they are sleeping and they will work when I am sleeping" - MD, CarCo-F-1

A precondition for this advantageous use of time zone difference is that people depend only for inputs and outputs on other sites, not for the process. If there are urgent process dependencies during for instance MD's afternoon, she must interrupt that job (like the situation SPB explained in the preceding quote).

§ 10.3.8.3 US - India

Interactive collaboration between Detroit and Bangalore appeared problematic in the Goldd project. Between Detroit in UTC -5, and Bangalore in UTC +5½ a time gap exists of 10½ hours (Daylight Saving Time not applied). With DST, Detroit changes to UTC -4 so that the gap is 9½ hours. Extended working day from 8:00 until 19:00 at both sites, allow for just a 2 hours window. More conservative days from 9:00 until 17:00 eliminate real-time exchange opportunities. In example of that situation occurred when BW was in India late September. When he needed to contact US counterparts from there, he simply was unable to do so because of the time gap. As a consequence, people have to rely on asynchronous media like vmail and email (AC log September 30 - October 4, 1996).
The problem is echoed by JF from Detroit. For real time contact, Indians would have to stay in the office rather late, or Americans would have to come in early in the morning (see Table 46). The minimal overlap causes delays when quick resource input is needed from the US to India. During for instance Day 1 in Bangalore (Table 46), Indians must wait until Americans start their Day 1. This implies a long delay when remote resource needs arise in India in the morning. But even when they surface during the afternoon in Bangalore, it is getting too late there to wait on inputs from the US. Most likely, communications will be asynchronous. That is, the offshore team submits a request, and must wait until their Day 2 (Table 46) to continue work with inputs prepared during Day 1 in the US. It can only be hoped that tasks are sufficiently structured that no additional clarification loops are needed. This would stretch problem solving cycles of even simple tasks to days.

"Time difference between US and India is too big. They have to stay until very late to be able to talk on the phone. And sometimes they cannot get things from me until their following day." - JF, CarCo-D-2

§ 10.3.9 Diverse Cultures and Ways of Working[68]

The Goldd project brought together people from different corners of the world with different backgrounds. On the CarCo side, IT professionals and users with North American and European outlooks collaborated for the first time. SoftHouse joined the project with UK management and consultants (BW, NK, and BJ), and staff in India. We describe and analyze here how people experienced interactions in this diverse environment. Diversity presented itself in multiple ways: education, experience, language usage, ways of working, and expectations. It relates to different categorization levels (Krauss & Fussell, 1990): individual backgrounds, corporate culture, and geographical areas (nations or regions). The section is based on the viewpoints of people from sites involved in the Goldd project. Starting with CarCo Germany and US personnel, we move on to SoftHouse liaisons and Indian team members. The section concludes with a brief reflection.

§ 10.3.9.1 CarCo Germany Perspective

The Goldd project leader in Germany has built a lifetime career in the European CarCo organization. His strong identification with the firm is reflected in a statement he made in one of the discussion for this research. When he was talking about the organization, and differences in national culture, he mentioned that he felt a CarCo man first, and German second (CarCo-A-5). In other words, his being part of a national culture was subordinated to his role as a CarCo employee. Identification with his employer resulted from working for many years at European CarCo sites. This way, he got to know the CarCo organization and became committed to its success:

"I have worked with many [CarCo] people elsewhere, in England, I have visited most of the major national sales organization in all the European countries. I've been to all of them. The working relationship with these people although they may be culturally diverse has always been good. I feel at home anywhere I go and there is [CarCo]. I mean there is a certain [CarCo] style of working." - HH, CarCo-A-3

Familiarity with CarCo facilitated first time collaboration with US counterparts from M&SS. HH's role is part of a CarCo management network that spans the globe. Within that formal structure, he helped establish positive working relationships between his German team and the one in Detroit:

[68] This section reflects interviewees' perspective on cultural diversity in the Goldd project. It may contain very subjective views that generalize and stereotype categories, groups or individuals. These are described here for research purposes only, and are not endorsed by the author in any way. It should be noted that the author is Dutch and brings a North-Western European perspective to this research.

"What I'm fairly proud of is that over the duration of the project, and it started in 1995, the [CarCo] team has kept an excellent working relationship with each other - HN, MB, JF, CS, DM and a couple of people on the sidelines like BM, SK both in the US, and their bosses, we have very very good working relationships." - HH, CarCo-A-3

To HH's surprise, this good rapport did not extend to SoftHouse. In his opinion, SoftHouse has a corporate culture that differs from CarCo. He would have liked interpersonal connections with them, but for some reason that was never materialized. As a wild idea, he observes that collaboration with a CarCo unit in India would have had a better chance of success.

"I mean this (the good working relationships with US counterparts, see previous quote - author) is not even near the kind of issues we have with SoftHouse. And that's the kind of thing I would have liked to see with SoftHouse. It just doesn't happen. (...) They are different, they have a different corporate culture. (...) If we had a [CarCo] team in India (instead of SoftHouse - author) I think it would work quite well." - HH, CarCo-A-3

One of the reasons the contact with SoftHouse 'just didn't happen' could have been the organizational setup. CarCo did not deal with SoftHouse India directly but via liaisons onshore in Cologne. They never had the opportunity to develop relationships until much later in the project when MD or SPB came onshore. In turn, this channeled interaction pattern was rooted to some extent in cultural differences. Early on in the bidding process, HH met representatives from SoftHouse India in the UK office. Connecting to these people did not work quite well, because of cultural differences and possibly their culture shock. Consequently, HH preferred to do business with the UK office and have them handle contact with operations in Bangalore. UK liaisons would act as a buffer between the US and German CarCo people, and the SoftHouse staff in India (Figure 67).

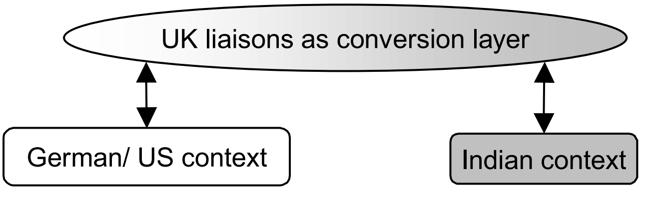

Figure 67 - Liaisons as cultural bridges

Looking back, he regretted this decision and would have preferred direct collaboration with the Indian office. Even with cultural differences to deal with, direct contact would have been a better options because of dependencies between the CarCo and SoftHouse teams.

"[SoftHouse] has an outlet here in England. The problem was that in the beginning we had a meeting with a couple of people from [SoftHouse] India and they didn't come across very well. In hindsight they were probably under culture shock. We should have had them anyway, we would probably have made a better choice. But such is life." - HH, CarCo-A-3

With the group in the US, good working relationships were built from early visits onwards. Still, cultural differences remained, like the way people address each other:

"In Germany the hierarchical distance means more than in the US. You would notice it in the way we address each other. If we talk English it would be 'M' (first name of MB - author) and 'you'. In German it would be 'Sie' (polite form of addressing - author) and 'Herr B' (means in English: 'Sir B', where B refers to MB's surname - author). That does not mean that they have more respect: JF (from US - author) respects me the same way HN (from Germany - author) does." - HH, CarCo-A-2

As HH notes, German practices differ from American ones. While people may have the same intentions and meanings, they use different protocols to connect. This demands adaptation in the form of multiple interaction modes. Within the German site, people retain German ways of interpersonal collaboration. Once they connect to the American site, they adapt to a more international or American mode. Apparently, given the good working relationships, the German team was aware of their own unique protocols compared with American expectations. They had learnt to switching protocols depending on the people and contexts they communicated with.

HN, senior team member in Cologne, observed several dimensions along which people participating in Goldd differed:

"We all speak different languages, although we all speak English, it is very different. Besides, we have different educations and different experiences. (...) We do have a [CarCo] culture. (...) We don't have the same training. (...) We have the same products and the same knowledge, but not for this product, probably the learning on the job is the same. There is a big gap between [CarCo] US and [CarCo] Germany and India, also in skills." - HN, CarCo-B-2

On a corporate level, he differentiated between CarCo and SoftHouse. From his angle, CarCo has a strong organizational culture across its international sites, something SoftHouse did not seem to have (CarCo-B-2). When asked whether people in the Goldd project act and think in a similar manner, he made a distinction between Germany and US on the one hand, and India on the other hand: "In the US and Germany, people do think the same, in India not (at all!)" (CarCo-B-2). In HN's experience, working modes differed between Germany and India. Gradually, the German CarCo team started to work directly with Indians (Figure 54). SPB came in December 1996 to Germany, and returned for a period in February 1997. In March 1997, MD took on his role as technical liaison. During this phase, Germans and Indians experienced more directly each other's culture. Before that, BW had bridged the diverse contexts (Figure 67).

One of the differences between the way Germans and Indians work is that the former prefer sequential, linear processes. For instance, first planning and then execution. Or someone needs input from another person for his task, he should wait until he receives an answer. To Indians, these steps were considered more intermingled. This caused friction with the German team.

> "The Indians make no differentiation between planning and executing. Maybe it is a culture thing, maybe it is training. This week we had something like this again. The test results were send to India and we got some questions back. When we sent the answers back we found out that they already had started programming and that they couldn't change it because they already had programmed it. Maybe it's a management/ organizational issue. The team now consists of 18 people. 18 people need strong management. They don't have a leader. [SM is the project leader] Before SM we had RG. RG was sent away because the data model did not come. Now we have SM and the software doesn't come." - HN, CarCo-B-1

Upon reflection, HN was not sure whether collaborative tensions should be attributed to cultural differences or the way SoftHouse India operated as an organization. He explained that leadership in the Indian team seemed wanting. Not only because they worked with a group of around 18 people. But also because many team members were just graduates from technical studies and working on their first job. They missed experience with planning, standards and interpersonal collaboration. This gap impacted local performance and the way they interacted with onshore personnel.

> "I think it is not a cultural problem, it is more or less an experience problem. They (SoftHouse India employees - author) are simply hired from the university. It is maybe their first or second job, when you do not have much experience, working in larger projects, maybe also not in working in a group, as a group. So they are individuals, have good knowledge in technical skills, as individuals, but I think the gap is the organization, the procedures, the standards, the working together, how do we approach a project. They do not have experience in that area and that's causing major problems." - HN, CarCo-B-3

MB was responsible for data modeling in the German team. As far as the kick-off phase of Goldd is concerned, he was surprised that the Indian partner was hardly introduced. The setup with liaisons meant that the onshore - offshore contact was always mediated, so that no relationships were built like with the US team.

> "In the project we have not been given time to get information about India. We only have time for the project. From the company there is no intention, like: "We have a new strategy "outsourcing", your partner is in India and we will give an introduction. We did have something with the American colleagues when they were in Cologne, a social event, dinner together. It could be helpful to do the same with partner." - MB, CarCo-C-3

Like HN, he had observed differences between German and Indian codes of conduct. Indians, he asserted, are used to less direct interpersonal exchanges. When they cannot or do not want to do something, they will hesitate to mention that. Instead of telling someone directly, they may ask additional questions. This is probably perceived from their side as politeness. Germans, on the other hand, appreciate discussions that reflect someone's interests and capabilities in a more straightforward manner. This implies a stronger connection between what people communicate and what they really think or expect. To them, the Indian approach was not perceived as politeness but rather as lacking transparency. They perceived it as less effective and efficient, which in turn caused friction.

> "The difference I think is in the national culture. We don't act the same due to [CarCo] culture, but to "Western" culture. Until three years ago, we didn't know [CarCo] US.

> Global was European. The main difference is the national culture. Like BJ said, Indians never say “No”. They will never tell you that they can't do something. Like I have never seen SPB disagree with HN. I would like to see him disagree. I would like to see them tell that. For us it is different: SPB came with all the knowledge about workflow and security and we would say: “No”, in an arrogant way. The Indians will come back with questions, because they cannot do it or because they do not like it.” - MB, CarCo-C-1

MB observed this difference with Indians, not Americans. Based on his experience, he suggests that Western (including Europe and US) and Eastern (e.g., India) cultures differ. This applies in particular to the linkage between what people think and what they communicate. He relates these differences to national cultures, and not CarCo or SoftHouse organizational cultures:

> “[CarCo] culture is not a common thing, at least not very important. For my experience it is more the national culture. We do not know what they are thinking in the Eastern countries because they all say "Yes”. Like the example with SPB. But it is dangerous to make common statements about them. You should be working in the Indian team like BJ to know.” - MB, CarCo-C-3

Another aspect of diversity is language. Although people use English as common language, they have their own version. Some may experience difficulty when English is not their mother tongue: “You must consider that we have British English and American English between [CarCo] and [SoftHouse]. We are not on the same language level as German is our native language” (CarCo-C-3). Upon reflection on his Goldd experience, MB says he would prefer working with people from Western cultures (CarCo-C-1). This would ensure commonality of people’s outlook and behaviors and smoothen (remote) collaboration (Grant, 1996b; Krauss & Fussell, 1990).

§ 10.3.9.2 CarCo US Perspective

From the US team, JF talked about her perspective on diversity in the Goldd project. It was her first opportunity to work with CarCo colleagues from Germany. After she joined the project, she worked for some time remotely with HH and HN. This appeared cumbersome as JF explains:

> “At the beginning there was a very big difference. I even thought it was scary, it did not know how long we could last working together. They are very rigid, very controlled.” - JF, CarCo-D-2

Early 1996, face-to-face meetings in Cologne worked as ice breakers. As people from both sides got to know each other, they developed a more open collaborative style. For interactions with American team members, the Germans adapted in a sense their behavioral protocols. This was probably easier than the other way around:

> “Later they were more relaxing, they were more open after I had been there. I kick on it when HN sends me a joke. We really had to grow into it. Here in the US we do not have so much contact with other cultures. Over there (in Europe - author), it is easier to get into contact with other cultures. So we are not really used to other cultures. Maybe it is harder for everybody to work with us. But the US is more open, jovial. Joking on the side helps us to get the work done.” - JF, CarCo-D-2

On a corporate level, JF claims that CarCo has distinct culture: “There is a definitely a [CarCo] culture. As for [SoftHouse], I haven't had any contact, I would not know what their culture would be” (CarCo-D-2). CarCo sites across the world display some form of similar mode of conduct. This provides a common background that facilitates international collaboration. According to JF, the corporate culture is strongly tied to CarCo locations. For people from outside - like SoftHouse - it is hardly possible to understand and learn the ‘CarCo style of working’. A consequence of CarCo’s unicity is that collaboration with external partners is less efficient (Williamson, 1975). Still, outsourcing may be necessary because CarCo needs external knowledge or considers partnering financially attractive.

> “The [CarCo] culture is the same worldwide. This depends a little bit on recruitment, but not much. A lot of people who work here are agency people, and they work here 1 or two years and are gone again. (...) I think the biggest thing is learning the [CarCo] style of working. It is easier and you can work faster if you know how to get things done. I do not want to call it politics though. And [SoftHouse] will never learn the [CarCo] way, because you have to be there to learn it.” - JF, CarCo-D-2

§ 10.3.9.3 SoftHouse Liaison Perspective

The SoftHouse liaisons were independent IT consultants with experience in international projects. They were hired by SoftHouse UK and had a British background. In the case of BW, this led to conflicts with the Indian team members in Bangalore. As earlier described, BW did not fully realize his role as consultant - not boss - to the Indian SoftHouse organization. He did not handle team members there respectfully, as SPB and MD reported to HH and HN.[69]

> “BW and NK were hired by [SoftHouse] UK, they had never seen [SoftHouse] India, they had probably never been in India. The British - Indian culture: they were fighting each other. The Indian team would say that they are independent, they won't listen. They are annoyed by someone there telling them what to do. (...) Indians are very proud, they don't want outside advice.” - HN, CarCo-B-1

BJ operated with more respect and cross-cultural awareness. He mentioned that people from the various Goldd sites operate in a different manner: “All three have a different mind-set. The US is more laid back, the Germans want to do everything according to the book or the plan, the English are more parochial (because of empire)” (CarCo-H-1). According to him, SoftHouse did not really have a corporate culture. The organization is rather built up from independent local or regional units.

On a practical level, BJ had to deal with remote telephone conversations with the offshore leaders in Bangalore. This appeared challenging at times, but only in part because of the technology: “The problems we encounter with the telephone, that is a cultural thing” (CarCo-H-1). In her logs, AC describes two events that illustrated these differences. The

[69] This quote is from a German CarCo team member. It is used in this section on the liaison’s perspective since data from BW does not cover the point made here for obvious reasons.

first one took place late January 1997 after BJ had just arrived in Cologne (AC log January 20-24, 1997). It took BJ a long time to reach his contact person in India. Related to that, BJ and people in India seemed to hold different views on what constitutes a normal telephone conversation. This returns in the description of the second event, the triple site audio conference in March 1997 (AC logs March 1997).Confusion on both sides seems the result of different norms and expectations. People try to connect but operate according to dissimilar protocols. These concern for instance speed and timing of talking, and planning and preparation of synchronous communication moments. BJ explained that working with Indians is difficult for people from Europe and the US if they do not know about the particularities of that culture (CarCo-H-2). Even with his extensive experience, this remained challenging.

§ 10.3.9.4 SoftHouse India Perspective

The Indian perspective is represented through interviews with SPB and MD while they were in Cologne. When talking with SPB, he seemed aware of cultural differences with the German and American teams. He did not attribute these to people's national cultures, and not their organization: "Corporate culture is not a key factor. We work in the same way but differences are caused by national culture" (CarCo-E-2).

SPB elaborates on the way his site in India operations. He explains that oral instructions and interactions have an important role in Indian office culture, at least as important as documentation:

> "In India oral instructions are used much more. Oral instructions are as important as written ones. We do not need a prove that we have told somebody something. If we accept an oral instruction, it is logical that we are committed to it. I do not have to prove that I am committed in writing. The good thing about oral communication is that you have a good product fast. The bad thing is that you do not have a global overview. For example Sales and P&A codes. Only some people really work with that. With oral instruction you only do justice to the one who says what, not to the others who do not say something." - SPB, CarCo-E-1

As long as BW operated as linking pin in Germany, Indians could maintain their way of working. Their team was in a sense shielded from the Germans. This changed after BW left.[70] BJ replaced him early 1997 and needed assistance for liaising on technical areas. When he received help from SPB and MD, it was for the first time that German and Indian team members connected directly. They started to notice that people were used to vastly different ways of collaborating. As SPB's quote suggests, Indians were used to oral instructions. They did not attach much value to ex ante planning and formalizing work commitments. Once SPB worked directly with Germans in Cologne, he could compare this mode with the way Germans worked, and comment on pros and cons of each style:

> "If you have it on paper you can see why other people may also have importance in the subject. With documents it is more clear, you have more overview. You can put all

[70] Probably, bridging cultural diversity added to the stressfulness of BW's role.

> the papers on your desk and have an overview and analyze. But with documents you can delay the work. When you get an oral instruction you can carry it out immediately, without thinking about other aspects. This can be 'dangerous' as you do not see the overview. And you tend to forget part of it, when you have an oral instruction." - SPB, CarCo-E-1

Formalization and documentation of work processes has advantages, like providing an overview. But it can also slow down work flows compared to the Indian way. Differences surfaced also in the way meetings are organized and conducted. In the Indian SoftHouse team, organization of meetings is ad hoc. People do not stick too strictly to starting times. This was in stark contrast with the way things worked in Germany. From SPB's Indian perspective, Germans consider scheduled meetings almost sacred. They must take place even if there is little reason for doing so, and people must be there sharply on time.

> "For example, in Germany they will hold a meeting at three and everybody is there sharp at three, although there is nothing to talk about and no agenda. If you come one minute late that is not good. We are not as timely as the Germans, 15:00 = 15:00." - SPB, CarCo-E-2

According to SPB, Germans value a procedural, systematic mode of working. Expectations are laid down in documents, like workflow schemes, plannings and worksheets. These documents take on a pivotal role in collaborative and managerial processes. Indian customs are almost diametrically opposed to this. They prefer less ex ante structuring of processes and rely on oral instructions.

> "In Germany it is not the results that matters but the procedures. Germans want everything systematic according to the book, no matter how long it may take. India works quicker but less systematic. (...) We do have results, but maybe because of the less systematic way we work there is no appreciation. (...) For example we don't see the need to give everybody a worksheet with what they have to do, we just tell them what to do and most of the time they do it." - SPB, CarCo-E-2

Based on his experience, SPB considers Germans extremely structured and methodical, more than Americans: "The Germans are more methodical than the Americans, the Indians are less methodical than the Americans" (CarCo-E-2). Given the contrasts depicted here, an intriguing question is how people deal with them when they must connect without a liaison. According to SPB, the German and Indian must somehow adopt a middle course: "We have to meet in the middle of the German and the Indian team" (CarCo-E-2). In practice, the Indian teams adapted to some extent to the more formal, structured German way. Internally, they continued utilizing oral instructions. But for instance audio conferencing meetings with Germany are planned instead of held spontaneously. Similarly, task commitments are documented as far as Germans or Americans are concerned.

> "In India, formerly we held spontaneous meetings, now we work more with agenda's like for example for the audio conference with Germany." - SPB, CarCo-E-2

> "In the team they still do not work with written commitments, only the team leader does the written part, for the Westerners. If somebody does not understand a certain task, somebody else will do that work. The team leader gives everybody the work he can handle. It seemed that programmers can even have a say in that, however this is somewhat restricted as some programmers prefer to do only the easy work and others prefer to do only the challenging work. Most of the work was separated into business

> parts and 1 person would do one specific core-area. Like dealer, search screen, individual, owner, etc ...” - SPB, CarCo-E-1

Within their own team, Indians sustained their own customs. On top of that, they developed a sort of adaptive layer when dealing directly with Germans, either remotely or face-to-face in Germany. This is illustrated in Figure 68. The German and Indian contexts are no longer bridged by a separate liaison, like earlier with BW (Figure 67). As a substitute for that, Indians partially modify local operations to facilitate connectivity to the German or American contexts.

Figure 68 - Direct cross-cultural contact with unilateral adaptation

Reasons for unilateral instead of bilateral adaptation are not clear. It could be that SoftHouse as vendor has to adapt to their customer’s expectations. More generally speaking, researchers have claimed that remote collaboration demands a more formal interaction mode (Meadows, 1996b; Millar, 1999). It would probably work better to adopt formalizing practices in India than to expect CarCo sites to get used to informal, oral processes.

Like the Germans, SPB noticed some impact of linguistic diversity in the Goldd project. This relates to people’s idiosyncratic use of the English language. Slight nuance differences trigger additional information loops for clarification:

> “Occasionally we have problems with the language, but this is not a major factor. Once for example to SM (Offshore Project Manager - author) wrote that he had doubts about the program. BW noticed that he did not mean doubts, but that he meant some small questions. Usually language misunderstandings are solved easily.” - SPB, CarCo-E-1

Like SPB, MD elaborates on the way people collaborate in SoftHouse’s Goldd team in Bangalore, India. She explains that people work extended working days and appreciate a relaxed, fun-filled atmosphere.

> “We do a lot of overtime work, but this is only for the software branch, only at [SoftHouse]. Indians are hard workers, they work on Saturdays and also on Sundays. But that is not really a problem because most of us are young and unmarried, and they do not have anything to do on Sundays. (…) We have a lot more fun (probably compared to the German site where MD works at the time of the interview - author). Each person of the team brings something to eat and we fight about it, we sing, we listen to the radio and we get the work done. And teasing is a big thing too, they are teasing all the time.” - MD, CarCo-F-1

She point out that hierarchical ties and role definitions are not defined in a very strict manner. Control processes rely on team work rather than pre-defined managerial reporting.

> “Nobody controls me … VA? (team leader) (…) Yes maybe to VA. No, I report to SM. The hierarchy is not very fixed, it is all very informal.” - MD, CarCo-F-1

MD notices that this style contrasts with CarCo Germany and to some extent the American team. Germans expect people to adhere to rules and agreements. For instance, SoftHouse deliveries should contain a header and arrive sharply on time. To Indians, this required adaptation:

> "If we are in an emergency, we would sent a document without a header, but the Germans will not even look at that. Like we have a delivery at 9 AM, and BW is still trying to download at 9 AM that is not good. Everything has to be sharp, 9:05 AM is not good. We never made a delivery to the Americans, but I think they are not as strict as the Germans." - MD, CarCo-F-1

§ 10.3.9.5 Reflection

From the kick-off phase of Goldd onward, CarCo teams in the US and Germany collaborated directly. They experienced each others' differences and learnt to deal with these. Collocated meetings supported this process. Between the German and Indian teams, the initial setup with liaisons covered cultural differences. This changed when a transition took place towards more direct contact. Striking differences surfaced, centered around the role of formalization, documentation, and planning. Table 47 attempts to give an overview of the three teams' way of working based on available data. The rows shows - as far as possible - people's perception of other sites. From an American and Indian point of view, Germans operate very methodical. Germans on the other hand are confused and sometimes irritated by Indians' hesitance to "tell things like they are", especially when something is unfeasible.

Table 47 - Cultural diversity and perceptions in the Goldd project

German perspective	Normal	N.A.	Confusing, lacking transparency, disconnected with reality, ineffective/ -efficient
American perspective	Rigid, controlled	Normal	N.A.
Indian perspective	Strict, linear	Less formal than Germans	Normal
	German way of collaborating:	*American way of collaborating:*	*Indian way of collaborating:*
	Linear processes, "tell it like it is", strong management, planning, formalization and documentation, methodical	Jovial, relaxed, less formal and compared to Germans	Oral instructions, ad hoc processes, politeness, hesitant to "tell it like it is"

Bridging cultural diversity seemed to proceed quite well between the American and German teams. People developed good working relationships. This was possibly helped by their membership of the same organization, and the limited differences between American and German culture (both are considered examples of Western, North Atlantic culture). It seems that Germans adopted a more relaxed style when dealing with Americans.
With India, things were more difficult. People started to connect directly rather late in the project. More fundamental differences seemed to exist along various dimensions. This induced Indians to adapt a more German or perhaps Western oriented style when dealing with CarCo. The local teams in Bangalore did not change internal modes of interaction.

The CarCo case is concluded and cross-analyzed with the DiskCo case in Chapter 11 .

PART 4 INTEGRATIVE ANALYSIS & IMPLICATIONS

In this part, we bring together results from our empirical and theoretical work. We concluded the latter with a framed analysis of current literature. Our empirical studies were analyzed from an interpretive point of view. We intend to bring these results one step further in a positivist sense (Lee, 1991). To this end, the next chapters connects the case studies to our initial conceptual lens. This answers our research questions and points at areas where we complement current research. The chapter starts with an extended conceptual lens that reflects these areas. It offers a more complete and relevant mode for analyzing the impact of global distributedness on coordination and control processes. The part concludes with a chapter that condenses insights from the preceding chapter, and translates these into a practitioner-oriented format.

Chapter 11 Integrative Framing of Case Studies

In the first part of this thesis we related the empirical section to the following research questions:

3a. What is the impact of global distributedness on the way people coordinate and control their work in global software projects?

and

3b. How does global distributedness impact the way people coordinate and control their work in global software projects?

The first sub question refers to ways in which global distributedness impacts coordination and control processes. The second one focuses more on the process by which this impact materializes. In this chapter, we bring together theory and empirical research. We use the outcome of the theory section to frame results from our two case studies. This answers not only the two sub questions. It also shows where and how we can extend current literature. Our qualitative case study design was intended to include an exploratory element, i.e., seeking for new ways to look at the impact of global distributedness on collective action. This extension recurs throughout this chapter, that is structured as follows.

First, we discuss three themes that exceeded the five gaps from our conceptual lens: perception and concepts versus realism; ex ante coordination and control mechanisms; and task urgency and criticality. The themes point at factors that made our explanation more complete, and helped us to better answer the research questions. They also extend literature - to our knowledge, current research had not paid explicit attention to them.
Second, we pick up out discussion of the gaps - Geographical distance, time zone differences, cultural diversity, governance differences and infrastructural differences. Starting from the outcome of our literature study, we explore the empirical data in an integrative manner. Governance differences are discussed in the context of geographical

distance and cultural diversity. The latter section is broader than just differences or national or organizational culture. It includes lingual issues and operational diversity.

Based on the integrative analysis, we extended our conceptual lens as depicted in Figure 69 (compare with the original version in Figure 37). The dotted boxes show two of the themes that we have included - perception and concepts versus realism; and ex ante coordination and control mechanisms. The former impacts task contingencies. For instance, people may underestimate task dependence and uncertainty (CarCo case). It also changes coordination and control mechanisms. People's understanding of a project influences their portfolio choice. The second theme also relates to task contingencies and portfolios. Prior collaboration reduces task uncertainty (DiskCo case). It also impacts how people coordinate and control. For instance, working relationship foster goal congruence and reduce the necessity of control (Gabarro, 1990). Finally, the conceptual lens includes a new task contingency: task urgency and criticality. We found that these factors impacted communication modes in the DiskCo and CarCo case.

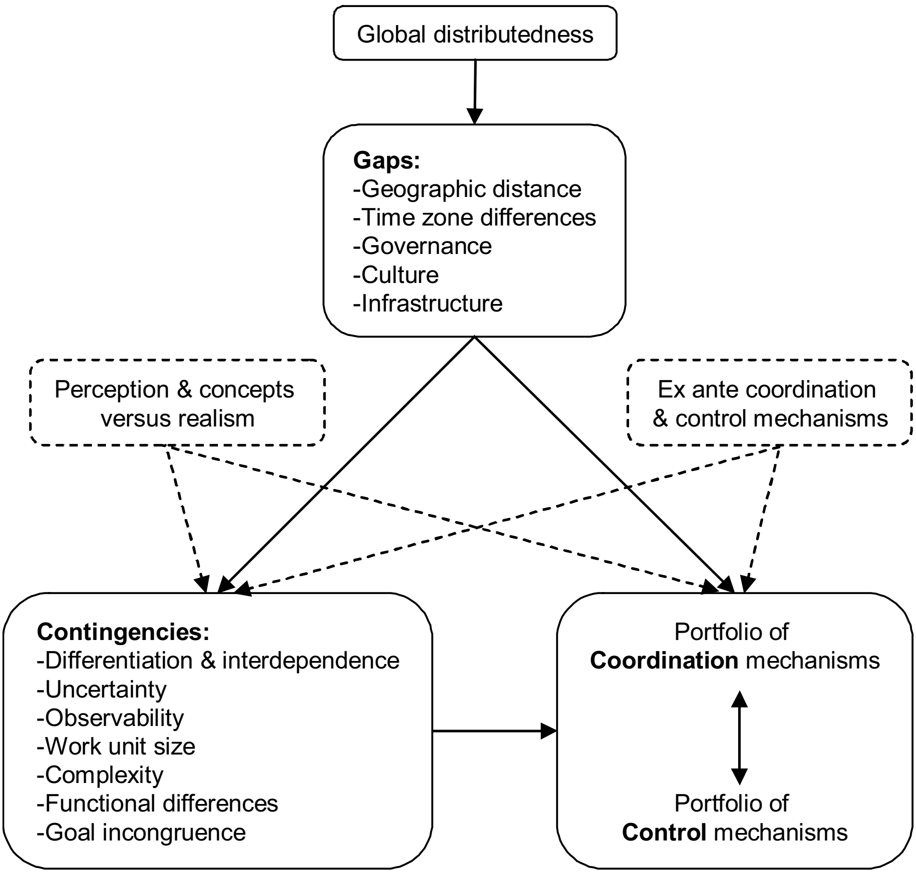

Figure 69 - Conceptual lens (an extension of Figure 37)

§ 11.1 Themes

In this section we present three themes that complement the gaps. They seemed indispensable for understanding coordination and control processes in the two case studies. A first theme concerns discrepancy between people's perception or concept of a project, i.e., their ex ante approach. And on the other hand, what we refer to as realism - people's day-to-day experience once the project has started. Discrepancy between these two imply for instance that a project plan underestimates learning curves (DiskCo). Or communications structure do not match information processing needs (CarCo case). We assess consequences of discrepancies and adaptation modes, to our knowledge one of the first times in literature. A second theme pays attention to ex ante coordination and control mechanisms. People leveraged on various forms of collaborative experience, organizational practices, and other advantages. Especially for the DiskCo case, this compensated to a large extent for the challenges of remote collaboration during the project. The final theme - task urgency and criticality - constitutes an additional task contingency that explain communication patterns and media usage in a dispersed project.

§ 11.1.1 Perception and Concepts versus Realism[71]

Information Systems projects are known for their complexity. They often involve advanced technologies that demand novel approaches to coordination and project management (Brooks, 1997; Kraut & Streeter, 1995). For this reason, it is estimated that the majority of IS projects is late, and exceeds budgets. Task uncertainty obviates a realistic assessment of resources, activities and timing (Nidumolu, 1995). It necessitates interpersonal coordination mechanisms that consume time and other resources in unknown quantities. we observed this phenomenon in our case studies. They confronted us with discrepancy between on the one hand people's assumptions and estimates, and on the other hand 'what it really took'. Inexeperiencedness of project participants may have contributed to a rosy picture of activities (somehow, not an overestimation). Anticipation of a project was often drive by short time horizons and tight budgets. This led to commitments that could not be met. Once people were en route, a more realistic perspective began to dawn that required adjustment of key project parameters. We assess the role and impact of this phenomenon in the context of the two dispersed projects (see also Figure 69).

DiskCo

In the late 1990s, DiskCo was confronted like many firms with the Y2K problem. Before mid 1999, they had to modify or replace their existing MANMAN infrastructure. Company executives decided to roll out Oracle across their dispersed sites. A common source code underlined their transition towards globally standardized processes. The case study shows

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[71] 'Realism' is used in this section as inter-subjective understanding. That is, the reseacher's interpretation of empirical data from multiple interviewees. 'Perception' and 'concepts' refer to the mindset of individuals and groups. We focus here in particular on situations where realism and perception/ concepts seem to deviate.

that the project's deadline of mid 1999 confronted people with an aggressive schedule in the Far East. Some conversions were almost organized in parallel. Executives in the US and Singapore underestimated the fact that Far East operations differed from earlier US conversions. The large volume required modification of know-how build around smaller R&D facilities in the US. This lengthened learning curves for the first Far East implementations. People also underestimated the unique requirements of some sites in China and Malaysia. Government regulations impacted local applications that required special interfaces to Oracle. The VP IT from Singapore site A maintained regular contact with people involved in local implementations. This way, he picked up their concerns and contacted his boss to request changes to the original plan. It appeared that the investment of somewhat more time on Singapore's first implementation accelerated subsequent projects. This was not realized in advance, but resulted from monitoring actual projects and adjusting initial perceptions.

CarCo

More serious discrepancies emerged in the CarCo case. Interviewees repeatedly stressed that management underestimated the project and lacked realism. Like with DiskCo, the Goldd project started with an aggressive schedule. Its low budget left little room for cross site visits and connecting technologies, even though people faced several 'firsts', like first time offshore outsourcing, first time US - Germany collaboration, first time to work with client/ server technology, and so forth. Goldd's organizational setup relied on liaisons to handle all contacts between offshore and onshore. It was assumed that knowledge could be transferred as a temporary one-way flow from onshore to offshore through these persons and with the help of minimal documentation. This underestimated the fact that offshore personnel was not familiar with customer requirements, and could offer suggestions to CarCo users. To make things worse, SoftHouse had agreed on a contract with fixed budget and planning. This contrasted with their lack of insight in what it would take to design and deliver the Goldd system. Likewise, the CarCo project manager perceived the relationship with SoftHouse in a simplistic manner. He rushed into the project without carefully considering the vendor and establishing inter-organizational ties. Assuming little dependence and uncertainty, the manager basically ignored the offshore team. He did not put control mechanisms in place since he trusted the vendor's ISO certification and track records.

As things turned out, Goldd was not a simple system, consisting of some functionality around a database. The project manager found his job too much for a single person to handle. The onshore - offshore chain lacked the capacity to support reciprocal knowledge exchange. This dried up resources for the Indian team and made their job hardly feasible. Especially since they were not involved in the analysis phase. When their deliveries were late and below par, the companies struggled with the almost classical contract that did not match the nature of the project work. The unrealistic setup increased tensions, both within the two organizations and between them.

Makeshift measures were taken, like increasing pressure on the liaison and SoftHouse UK management. The CarCo project manager implemented daily output controls. This compensated for his blindly trusting the onshore liaison and ignoring the offshore group. Gradually, the communication structure was changed. An Indian offshore team member joined in the second prototyping feedback session. Later, he reinforced the onshore liaison. This promoted more extensive and direct contact. It altered the interface funneling between CarCo and SoftHouse.

Looking back, people proposed several modifications to the original setup. They had wanted more formalization, controls and face-to-face contact (i.e., traveling). Interviewees aired concern on the low budget and rapid kick off phase. They realized the complexity of the system. This would justify common planning and extensive communications needs between the offshore team and CarCo staff. The liaison role in Germany seemed not realistic. And offshore staff should have been involved much earlier and more directly in the analysis phase. All this showed the inappropriateness of initial perceptions of the projects, and the concept for organizing (remote) collaboration. It lacked realism.

§ 11.1.2 Ex Ante Coordination and Control Mechanisms

While working on the DiskCo and CarCo case, it became apparent that ex ante coordination and control mechanisms played an important role during the project. With 'ex ante' we mean the period preceding the project, even before any planning or business analysis. It is an example of a temporal - or perhaps process - perspective on coordination and control mechanisms that is starting to receive more attention (Bardram, 2000).
In our initial conceptual lens, we did not yet realize and include these mechanisms. Like most researchers, we adopted a variance theory perspective that does not consider the impact of time on coordination and control processes (Mohr, 1982). The case studies convinced us to modify that stance. In fact, looking back, however, we did find a few hints in Meadows' 1996) work. Her interviewees (Indian vendor personnel) stressed the importance of having been in the US on prior occasions. They indicated that past opportunities of immersion enhanced people's ability to interact with US counterparts. Interviewees did not refer to working relationships per se, but a generic know-how pertaining to the US context (Meadows, 1996b: 87, 109).

DiskCo

In the case of DiskCo, we found that ex ante coordination and control mechanisms defined collaborative processes during the Oracle project. We went back to the work of some scholars with an eye for this temporal dimension. This informed our subsequent analysis of the DiskCo and CarCo case.
Several forms of ex ante mechanisms can be distinguished. We framed these using the integrative perspective on coordination mechanisms that was proposed in the theory section. First, work-based coordination mechanisms include ex ante standards and norms (NASA, 1999), and experience with a collaborative task (Carlson & Zmud, 1999). Second, we related coordination by organization design to Williamson's (1981) organizational advantage. Before starting on a project, people may have collaborated for some time in the same organizational context. They have become familiar with idiosyncratic customs like norms, protocols, and control approaches (Moran & Ghoshal, 1996; Williamson, 1981). Third, in the area of technology-based coordination, Carlson and Zmud (1999) mentioned that people's ex ante proficiency with an electronic communication medium determines the richness of their experience at a later point of time. Fourth, inter-personal coordination mechanisms refer to common knowledge bases (Grant, 1996b; Krauss & Fussell, 1990)

and working relationships (Gabarro, 1990). Common knowledge in areas like language and specialized task domains "enhance the efficiency and intensity of communication" (Grant, 1996b). Working relationships result from collaborative experiences. They lead to mutual orientation and communication efficiency (Bryman et al., 1987; Gabarro, 1990).
In sum, ex ante mechanisms of various forms substitute for coordination and control efforts during accomplishment of a project. They economize collaborative processes in the sense that less effort is needed for achieving coherent collective action.

With the Oracle project, DiskCo took on a very novel task that had to completed in a short time frame. Without ex ante mechanisms, this would have demanded excessive information processing. It may even have been impossible. Yet DiskCo had several advantages as an international firm. They had already a sophisticated infrastructure in place, with remote server access, Lotus Notes groupware, and a corporate intranet. People were used to a network of lease lines that supported remote communications. They had worked together locally and across sites on earlier IT projects. This had established a common application and hardware infrastructure (even though applications were locally customized). Turnover in the Far East was low; many people worked for years at DiskCo and established bonds with peers moving up the career ladder. They knew who does what at which site, and were familiar with common norms and expectations. The VP IT reinforced this advantage by selecting only seasoned DiskCo staff for the Oracle project teams. All this made (remote) collaboration very easy. Even though the project itself posed a major challenge, people did not have to pay much attention to the (dispersed) collaborative process itself.

CarCo
People involved in the Goldd project were not in the same position. We discuss the internal CarCo and SoftHouse organization, and after that interfacing between the companies. Within the CarCo organization, transnational collaboration existed on a managerial level. A sort of buddy network had emerged similar to DiskCo. But to staff it was the first time that they collaborated across the Atlantic. They had to establish rapport for the first time, though some form of corporate culture facilitated this process. Technically speaking, an international IT infrastructure existed but without DiskCo's sophistication and commonality (e.g., no groupware).

SoftHouse India consisted mainly of recent technical graduates with little collaborative experience. The company itself did not enforce extensive standardization and quality control processes, although they were somehow ISO certified. The vendor could not rely on earlier developed off-the-shelves modules, and had limited technical resources at its disposal - IT development tools, mainframe, telecommunications connections to Europe and US.

To CarCo's Goldd teams, offshore outsourcing was a first-time event. They did not have experience with remote partners and inter-organizational collaboration. Relationships between the companies did not exist, nor did they have advanced tele-collaboration technology in place. CarCo relied heavily on SoftHouse's expertise in different areas - organization, communications, and technology. Many of Goldd's technology were completely new to them. As things turned out, CarCo and SoftHouse rushed into the project without realizing their lack of ex ante mechanisms. Instead of investing in mutual understanding and resources, they relied on a liaison as exclusive interface.

Summarizing, we state that ex ante coordination and control mechanisms help us to understand the Oracle and Goldd project in a more complete manner. They reduce task uncertainty and novelty. People can rely on existing relationships, routines, and technology. This brings a self explanatory coherence to a project that frees up resources to focus on unknown facets. Ex ante mechanisms may also foster realism. Confronted with a novel task, people may assess more precisely what it takes, and adapt accordingly. Figure 69 captures these impacts with three arrows that start from the box with ex ante coordination and control mechanisms.

§ 11.1.3 Task Urgency and Criticality

One of the new findings in our case studies is the impact of task urgency and criticality. Under these conditions, people modified their contact and communication patterns. This related to geographical distance and time zone differences. We included the constructs as another form of task contingencies, see Figure 69. In this section we explore their role in the DiskCo and CarCo case.

DiskCo

DiskCo's Oracle conversions were temporarily constrained by the Y2K problem. Mid 1999 Oracle had to be up and running since the existing systems would no longer operate normally. This increased pressure. It increased the challenge of implementing the system that was completely new to the DiskCo organization. On top of that, Oracle expertise was in the US since the first implementations had taken place there. Pulling that know-how to the Far East required dealing with geographical distance and considerable time zone differences.

Management in the Far East responded by getting closely involved in the implementation process. They closely monitored resource availability, learning processes and work progress. Regular, frequent communications ensured their up-to-date awareness. Managers - in particular the VP IT - visited site during critical phases. These included normally project kick off and the period around the go-live date. On-site presence facilitated rapid response and intervention. During the first implementations in the Far East, US experts stayed stand-by in their private time.

The urgency of conversions encouraged proactive communications across sites. People updated others with new insights. They kept peers and management informed on their absence and provided private, mobile or other alternative contact information. Urgency and criticality promoted transition towards richer, more synchronous media like telephone or face-to-face contact. Under such conditions, people also tended to communicate more directly. For instance IT talking to users at another site without going through local IT counterparts. With US sites, time zone differences necessitated adaptation of working hours on either site to setup a call or attend to burning emails. People there were expected to synchronize their priorities with Far East sites, i.e., stay available. Interdependence and task urgency do not tolerate goal incongruence.

CarCo

At first sight, CarCo's outsourcing strategy placed most time pressure on the vendor. They were expected to complete the system in subsequent deliverables over Fall 1996. When the offshore teams could not meet deadlines, it set off a chain reaction. Model Office 2 was almost postponed, the third one was skipped altogether. This affected CarCo IT and users. For the US team it affected their schedule since their sites were slated for the first implementations.

Task urgency impacted media choice. When MD worked onshore, she would call SPB instead of using email (Table 42). Time zone differences exacerbated the impact of task criticality. Indian teams would send over requests to Germany. From there problem solving could take days if the US team had to be consulted. For urgent cases, direct contact between US and Indian was unfeasible. This delayed problem solving (AC, CarCo-K-1).

§ 11.2 Gaps

Our conceptual lens distinguishes five gaps: geographical distance, time zone differences, cultural diversity, governance differences and infrastructural differences. Our theory review offers a starting point for exploring their impact on coordination and control processes. From there, we integrate our findings from the DiskCo and CarCo case. This shows where our empirical findings overlap with current literature, and where they offer new insights. In order to avoid redundancy, governance differences are discussed together with the first gap, geographical distance, and to some extent the cultural diversity gap.

§ 11.2.1 Geographical Distance and Governance Differences

In this section we discuss the impact of distance on coordination and control processes. We combine findings from the theory section with empirical case study data. Geographical distance is first of all related to the choice between face-to-face versus remote communications, and the use of electronic media. Second, we look at the organization of distributed collaboration. This topic is closely intertwined with governance differences, especially for the CarCo case. The gap refers to diversity between organizations or organizational units that operate in different countries. It is incorporated in this section on geographical distance to avoid overlap. Governance differences surface also in other sub sections here, and the one on cultural diversity. Third, we assess learning in a dispersed environment, and the role of documentation and technology as knowledge transfer mechanisms. The fourth and fifth sections explore how people plan, manage, and control geographically distributed projects. In particular for the CarCo case we explore how governance differences are dealt with. The final section assesses the adoption and use of development methodologies in a dispersed work environment.

§ 11.2.1.1 Face-to-face versus Remote, Electronically Mediated Collaboration

Geographical dispersion constitutes a special form of polycontextuality. It means that people work not only in different activity settings, but that these are physically separated such that frequent face-to-face meetings are unfeasible. In the theory section, we

investigated the impact of geographical dispersion on coordination and control patterns. We found that according to expectations distance reduces the frequency and richness of interpersonal contact. Inclusion in another context comes less naturally. Consequently, people are less aware of what is going on in another context. Transferring knowledge from one context to another one appears burdensome. Compared to a collocated office, people need to spend more time and effort to understand and accomplish tasks. All this would not matter if people worked independently. Yet global projects bring together participants from dispersed settings who are expected to coordinate their contributions as if they were worked collocated.
Bringing coherence in this situation requires deliberate attention to cross-site connectivity. Mechanisms include electronically mediated contact, liaisons, on-site visits, and boundary objects (e.g., shared documentation). For many of these, people depend on technology. It offers on the one hand remote contact opportunities, and novel communication modes like cc-ing and broadcasting. On the other hand, electronic communications lack the multi-modality, richness and sometimes interactivity of face-to-face contact. People share less freely and are not likely to build meaningful working relationships solely based on remote contact. At the same time, they require effort in terms of planning and preparing synchronous exchanges, or translating meaning into textual format. Researchers found that people need special skills and behaviors for effectively using electronic media. They must be capable of working on their own, and tend to work more formally. Remote contact has its limitations. Establishing the contours of a novel project benefits from collocated meetings, as do some tasks that demand complex interpersonal exchanges. This suggests a mix and match pattern of visits and remoteness. We continue this section with assessing the impact of dispersion in the DiskCo and CarCo case.

DiskCo

DiskCo's Oracle project involved sites in the US and Far East region. Within the DiskCo organization, Singapore site A and Malaysia site A worked with US counterparts to learn from them and receive assistance. They passed on their expertise to sites in China, Malaysia and Japan. Singapore site A staff also worked temporarily with SysCo staff in India. We discuss here for these relationships how geographical distributedness impacted collaboration processes, and how people experienced technology for remote exchanges.

- *Singapore site A/ Malaysia site A and US sites*

Singapore site A (core team) and Malaysia site A (data conversion team) were the main point of contact for US experts. IT staff and key users from these Far East sites connected to their American counterpart to benefit from their experience. Because of the distance, people communicated mostly electronically. At the same time, face-to-face contact was considered vital. IT executives from around the world flew in to DiskCo's HQ on a regular basis to discuss mutual concerns and policies. On a staff level, people appreciated face-to-face visits for various reasons. Without having met their US colleague counterpart, people sometimes felt ignored. Apparently, remote exchanges (mostly email) made less of an impression. Face-to-face meetings on the other hand fostered informal conversations on a broader range of topics. When being on-site in the US, people were meeting a wide network of people. They appreciated collocated meetings because of their comprehensiveness and interactivity. Documents could be shown and discussed on the spot instead of exchanging multiple emails with attachments. This saved effort, in particular for novel tasks or situations where people faced differences between local ways of working. Afterwards, meetings paid off: they smoothened and enriched remote conversations (Carlson & Zmud, 1999).

- *Singapore site A and Far East sites*

For communications within the Far East region, people from Singapore site A echoed the advantages of collocated communications. They could perceive more cues and therefore communicate more precisely. It was also easier to explain and clarify topics. People engaged in interlocked exchange loops that accelerated problem solving. Co-presence facilitated understanding of someone's background. Subsequently, this made it easier for people to support their counterpart remotely, e.g., Singapore site A supporting someone in China. They could imagine and anticipate the context of their peer's issues. Somehow, electronic media did not allow for a complete rendering of a local context. They required more effort in terms of interpretation and representation. In order to compensate for these properties, people had to communicate frequently, and learn to present their point in a clear manner. Remote collaboration thus consumed more time and effort, especially when people were using asynchronous media. People developed a more systematic, compressed way of collaborating. This reduced uncertainty and communications volume.

Ideally, people had established rapport before the start of a project (see ex ante mechanisms in Figure 69). Such relationships increased the usefulness of electronic media, and thus decreased dependence on them. Visits played only a role in case of demanding collaborative situations, i.e., tasks characterized by complexity, novelty, or diversity. Or large groups of people that needed training. Without ex ante rapport, people preferred visits to establish a minimal level of mutual awareness.

- *Malaysia site A and Far East sites*

DiskCo staff from Malaysia site A was responsible not only for local implementations, but also for supporting data conversions at Far East sites. They experienced a difference between remote and collocated collaboration. On a distance, exchanges did not happen as naturally as they would at their own site. The risk was that people were less aware of what was going on at other sites while their activities were closely connected. They had to work in a tight schedule with often shared resources. To avoid unknown issues, people needed to invest more deliberately in updating their remote counterparts and receiving updates. At some point, people considered cross-site visits important to talk more extensively with colleagues and have a look at the local IT environment. This could be at the beginning of a project to understand a unique local situation, or during critical phases like around the go-live date. Remote contact would not cater for the multitude of cues needed at that moment. People also preferred co-presence for larger meetings and those that included participants with different functional backgrounds. The same applies for support. Core team members indicated several advantages of having support personnel on-site instead of connecting to Singapore site A. Remote problem solving tends to take longer and demand more effort. People must launch more formally a request for assistance, instead of walking into a local office. Compared with Singapore site A, on-site staff was more naturally included in operations at Malaysia site A. It was easier for them to identify with a local problem situation. Besides, local support was their only job while Singapore site A was juggling priorities to support multiple sites.

- *Singapore site A and SysCo India*

The core team in Singapore site A hired SysCo from India for assistance on development work early in the Oracle project. At the beginning of such an outsourcing relationships, DiskCo wanted vendor staff to come on-site. This facilitated them getting acquainted with the relevant DiskCo context - the local staff, company standards, requirements and IT infrastructure. Temporary on-site immersion established knowledge bases or socio-cognitive capital. This reduced novelty and uncertainty, and thus dependence on interactions with Singapore site A staff. From then onwards, it seemed feasible to make the transition towards remote support. Still, support from India was not without problems. Even with remote network access, DiskCo staff experienced electronic media as constraining. They missed the multi-modality of face-to-face interaction, where they could provide a comprehensive explanation with diagrams and other resources. On a distance, they had to spend more time and effort to convey their problem. This correlated with the experiencedness of their programmer counterpart in India.

- *Using electronic media*

Electronic media convey representations. People entrust their message to technical devices for subsequent processing and dissemination. Some media allow them to talk (phone, audio- an videoconferencing). Others demand less natural input, i.e., translation into textual or graphical format (email, documentation). By definition, electronic representations substitute imperfectly for face-to-face interpersonal exchanges. Yet often technology comprise the only feasible means for sustaining remote connectivity. It may even offer novel modes of communicating like broadcasting and cc-ing[72] (Markus, 1994). We assess here how people experienced and used various forms of electronic media.

- **Phone calls and e-mail** - Email provides anytime, anyplace exchange capabilities in document format. It does not disturb people on the receiving end, nor demand their real-time availability. Email supports replication of a message at little effort. DiskCo staff used email lists for connecting people with similar interests or professional involvement. They broadcasted and put people on cc to ensure information symmetry. The medium has its limitations too. Email is ‘lean’ in that it captures and transmits limited cues. This lack of communication quality boosts the volume of exchanges when complex or novel topics are discussed. For critical tasks, people suffer from their dependence on delayed feedback loops. They would prefer instantaneous contact, but this is sometimes not possible because of time zone differences. DiskCo staff developed an adapted communication mode by blending properties of email and phone calls (DeSanctis & Poole, 1994). They submitted documents electronically to fuel and economize subsequent tele-conversations.

- **Audio- and videoconferencing** - Audio conferencing connected simultaneously multiple parties, independent of their location. This fostered exchange between

[72] Email applications offer the option to send a copy of an email message to someone else. This is referred to as ‘copy conform’ or ‘cc-ing’.

dispersed experts and problem owners. Lack of visual contact limited the number of people to avoid identification and coordination problems.

Videoconferencing was not available at all DiskCo locations, nor was it very popular. The infrastructure lacked speed and synchronization of audio and visual signals. It could not capture and represent large numbers of actors. People missed document exchange and drawing capabilities as part of simulated face-to-face encounters. They had to reserve rooms in advance and spend considerable time preparing the meeting. Somehow, videoconferencing does not contribute much to establishing first-time rapport (Abel, 1990). For prolonged meetings, it appeared too tiresome. Taken together, people preferred alternative media like teleconference calls.

- **Multi-media: multi-faceted representation** - Interviewees explained that they liked the multi-modality and richness of co-presence exchanges. In a limited time span, they could talk, look at each other, draw, show documents, simulate applications, and so forth. Most electronic media support only certain facets of such complex exchanges. Their lack of richness and/ or interactivity constrains the completeness of remote representations. People quoted the combination of NetMeeting and teleconferencing as an example of multi-modal communications for a limited number of people. They could interactively talk and work on the same application.

- **Factors contributing to the use of electronic media** - DiskCo staff learned to cope with the properties and constraints of electronic media. First, they emphasized the important of working relationships. Knowing remote counterparts made it easier to determine whom to connect to. It lowered the threshold to electronic communications, and made these in fact less necessary. Relationships eliminated to a great extent meta-communications (Watzlawick et al., 1967). They made it easier to digest a partner's mediated communicative behaviors (Carlson & Zmud, 1999; Gabarro, 1990).

  Second, electronic contact benefited from common knowledge. That is, when both partners had a solid background in the area of their collective activity. This enabled them to focus on novel aspects instead of clarifying basics (Grant, 1996b).

  Third, remote exchanges demanded careful preparation, and explicitness. A remote counterpart may not be aware of someone's issue and concerns. Or have difficulty understanding them because of their unique nature. He needs comprehensive information to imagine the context and urgency of an issue. People drafted comprehensive emails and structured their requests extensively to ensure completeness of their counterpart's response.

  Fourth, DiskCo management stressed the importance of regular communications. They had frequent tele-meetings with subordinates, e.g., the VP IT and his directors in China and Malaysia. In addition, subordinates were expected to push information on local project progress. This way, management remained aware of progress at the various sites (Kurland & Egan, 1999). On a management and staff level, people held regular meetings to exchange experiences. This applied in particular to the kick off phase of a project, and subsequent critical phases, like around the go-live date. Regularity compensated for the loss of frequent, low-threshold contact that seemed easier to achieve within a single context (DiskCorp-D-1).

  Fifth, with asynchronous media, people missed the instantaneous feedback loops that characterize face-to-face and phone conversations. They depended on the receiver's willingness and ability to reply within reasonable time. Occasionally, the receiver had other priorities and left a message unanswered for some period of time. This increased tension when people worked under time pressure. They preferred a brief note that indicated at least when the receiver could help out.

Finally, proactive communication attitudes were considered important. Dispersion lowers the frequency and extensiveness of exchanges. People are less aware of what is going on at remote site compared with their local setting. They may not know what expertise is available at different locations. On top of that, contexts change with people getting different roles, new projects coming out, and changes to standard practices. Handling such uncertainty in a dispersed environment called for proactive attitudes in two ways. People pushed information on changes in their work environment to others affected by this. Often this concerned dispersed communities of people with similar roles at different sites. They used distribution lists and the corporate intranet. At the same time, people with an issues were expected to connect to peers and pull relevant expertise.

CarCo

In the Goldd case, budgets for traveling were very tight, especially on the side of CarCo. US delegates visited Germany once. Conversely, German CarCo staff flew to Detroit for two prototyping feedback sessions (instead of the originally intended 3). And one team member crossed the Atlantic for discussing a complex issue with Americans and staff from SoftHouse India. Onshore liaisons flew on a couple of occasions to India. We investigate here for CarCo and SoftHouse respectively how people experienced and handled distance as compared to collocation.

- *CarCo perspective*

Interviewees from CarCo mentioned the loss of informal, frequent contact when working remotely. Remoteness constrained interpersonal contact. It made micro management from Germany to the US impossible. The team in Detroit worked on their own while updating the project manager in Germany. People tended to communicate more task oriented and in a structured manner than locally. Between the US and Germany, explicit agreements were made for document exchange and ownership. Like DiskCo interviewees explained, on a distance people cannot achieve the comprehensive modality of face-to-face meetings. CarCo staff indicated that remote conversations required more preparation and protocol. Remote communications lacked interactivity. Endless back and forth emails replace real-time conversations. Cross-site interactions usually involved only a few people. It was not as ramified as in a local situation with large meetings. Those maintaining remote contact were responsible for updating local peers to avoid asymmetrical distribution of information. Occasional face-to-face contact was deemed vital for sustaining rapport.

Indirect organizing played an even larger role between onshore and offshore. The Goldd project suffered initially from the impact of both distance and indirectness. Fear for confusion led to an exclusive channeling of interactions through the SoftHouse liaison in Germany. Direct contact between CarCo staff and offshore team members was assumed to make it difficult to assess the status of processes and documents. Remote communications were not only indirect but suffered from a limited range of available media too. People

used mainly fax and email. SoftHouse India did not have videoconferencing facilities, and (satellite) phone lines were noisy.
As things turned out, funneling of communications led to insufficient contact. People were not aware of some meta-site dependencies and design standards. Later in the project, Indian team members came alternatingly onshore to strengthen the liaison role. This made the communication pattern more direct. The new liaison would work closer with CarCo personnel onshore and facilitate direct contact with his peers back in India. Looking back, the project manager had preferred onshore presence of the Indian team, or at least earlier onsite liaisons from that group. The prototyping approach called for strong interactions between the three IT groups (US, Germany and India), as well as more feedback sessions with users in Europe and US.

- *SoftHouse perspective*

From the angle of SoftHouse India personnel, distance impeded knowledge flows between sites. They could not talk face-to-face to CarCo users and IT, nor have a look at their current infrastructure. CarCo requirements were to some extent reflected in the data mode and PC-based prototype. But distance was not the only problem. Added to this was the indirect communications setup in the Goldd project. Taken together, CarCo and offshore vendor personnel did not establish relationships (Meadows, 1996b). They could not leverage on the relationship advantages like mutual commitment and knowledge, and communication efficiency (Carlson & Zmud, 1999; Gabarro, 1990). Quite late in the project did some vendor staff meet with CarCo staff. Their status as representatives included the responsibility for updating peers in Bangalore. Before that time, offshore team members depended on local team leaders and the onshore liaison to relay requests and pass on knowledge. This multi-node chain lacked speed, capacity and richness. To make things worse, the onshore - offshore link relied mostly on textual communications and some documentation. It could not convey CarCo expectations in a comprehensive manner and lacked interactivity. People assumed that know-how would flow only one-way to India, yet offshore experts could have made suggestions to CarCo users. They did so when meeting for the Model Office 2 in Detroit but that was late in the project.

§ 11.2.1.2 Organizing for Distributed Collaboration

Most studies on dispersed collaboration focus on student experiments (Jarvenpaa & Leidner, 1998), relationships between managers and teleworkers (Kurland & Egan, 1999), and offshore outsourcing relationships (Meadows, 1996b; Millar, 1999). They focus on communications issues and remote interactions between a limited number of actors. Our studies seek to complement these findings. We explore not only how people communicate, but also why they communicate and how interactions are organized in a dispersed environment. In other words, we investigate interdependencies and communications structures in the DiskCo and CarCo case.

DiskCo

Interdependence has been a central notion in organization studies since some of the earliest scientists like Smith (Smith, 1793), Gulick (Gulick, 1937), and Barnard (Barnard, 1938). They pointed at the advantages of dividing work and assigning it to specialists, instead of single actors performing a complete process. Work division promoted efficiency and large scale organizing. It had also made actors interdependent - they needed coordination to maintain overall coherence. Relying on systems theory, Thompson (1967) was among the first to point at several forms of dependence: pooled, sequential, and reciprocal. Van de Ven (1976) later added reciprocal interdependence. A group around Malone and Crowston expanded this work to some extent (Crowston, 1997; Malone et al., 1999). They suggested various forms and combinations of dependencies between actors, resources, and activities. In our study on DiskCo's Oracle work, we found dependencies recognized in literature and a few others that often related to geographical dispersion. We briefly elaborate on these with an emphasis on information and knowledge flows. Next, we discuss how DiskCo handled them.

First, interdependence existed between users and IT. This cross-functional relationship was reciprocal. The new system created uncertainty for users. They had to switch from MANMAN to Oracle without any knowledge to start from. This triggered knowledge flows from IT (and key users) to users. Conversely, IT had to model business processes. They pulled information from users and possibly suggested efficiency improvements to existing practices. Second, rolling out a single new resources like Oracle created dependencies among the different plants. We refer to this as standardization or commonality interdependence. People had similar issues and depended on the first site that solved these. Third, deploying a single source code leaded to a situation where any modification affected all other sites. This adaptation processes - or resource modification interdependence - needed coordination on a meta site level. Fourth, the sequentially arranged conversion scheme endowed sites asymmetrically with experience. Plants later in the pipeline depended on know-how from earlier projects. This would suggest a unilateral flows from experts to novices. Yet it was a reciprocal form of dependence: experts (in the US, later Singapore site A) could not automatically anticipate the novices' situation (in China, Malaysia) because it usually differed from theirs. Finally, Singapore site A and Malaysia site A took on a central role in the Far East region. They supported other sites as a central resource. This resulted not only in assistance dependence, but also resource sharing dependence. Several sites pulled from the same central resources with scarce capacity.

DiskCo developed several modes for handling the various forms of dependencies. We discuss these for different relationships partly here and partly in following sections.
First, asymmetric knowledge existed between early implementors in the US and those in the Far East. This was resolved by local Oracle training and consultancy, thus reducing cross-site dependencies. Far East representatives were sent to the US to experience conversions first hand. Americans came over to the Far East to train their local counterparts. A recurrent principle is that people transfer knowledge as homogeneously as possible, especially on a distance. Singaporean key users in Finance would connect to American key users in Finance, and so forth. Commonality of functional background made it easier to learn something new (Grant, 1996b). Similarly, less familiarity of an expert with a student's background hampered the knowledge transfer process. (For instance generic Oracle training on HR modules for key users in Finance.) Far East staff also received documentation on US implementations. This represented process recommendations and known issues.

Second, people from Singapore site A and the data conversion team in Malaysia site A assisted other Far East sites with their Oracle conversions. These two sites were considered expertise centers after having pulled in know-how from the US. Relationships between the two sites and other implementation plants were reciprocal: local sites depended on the know-how and resources from these two sites, while they had to provide information on local processes and infrastructure. Because of the distance, it was important that local sites could work as autonomously as possible. It would be challenging to have them rely completely on the central sites for resource inputs, problem solving and control processes. The extent of remote dependence correlated with local availability of resources and strength of the IT group. Local Malaysian groups (other than the data conversion team) could attend generic training there, but this was not available in China. The Chinese group was also less experienced than the Malaysians. Together, this made them very dependent on the central sites. Since obtaining a visa was difficult for the Chinese, people had to fly in for training and support. In all cases, documentation played an important role to convey standard procedures and known problems. Through Lotus Notes people had access to up-to-date information from any location. This reduced dependence on remote interpersonal contact across sites.
Third and finally, the Oracle project increased mutual dependence between user and IT groups at each plant. Users needed assistance with the new system, while IT had to elicit requirements for customization. Contact between IT and the various departments was funneled through key users. Managers assigned one seasoned staff member of their department to that role. That person received extensive Oracle training and worked closely with IT. Their strength was bilateral inclusion, standing with one leg in their own department, and the other one in the cross-functional core team. Key users participated in an internationally dispersed community of DiskCo colleagues with similar roles at other sites. Their homogeneous background and interests facilitated remote knowledge sharing (Goodman & Darr, 1998). Locally, key users absorbed Oracle know-how from IT and external training. They translated this into customized training for users from their department. To IT, they were representatives who passed on requirements and feedback. Key users assisted IT throughout the conversion trajectory.

We now expand on the setup of cross-functional dependencies in a dispersed organization. DiskCo's approach avoided remote communications across functional boundaries. They reserved that grosso modo for people working in the same area - Finance, Distribution, IT and so forth. When Finance key user from Singapore talked to a Finance key user in the US or China, they were 'on the same wave length' (SKL, DiskCo-L-1). Using homogeneous for remote contact made it easier to deal with the constraints of distant communications and possibly time zone differences. Specialists from dispersed locations were connected to create multiple homogeneous contact networks. Locally they would connect across departments. Taken together, this eliminated the need for remote cross-functional communications. When key users in say China were confronted with a local problem, they would either connect to their counterparts in Singapore, or discuss it locally with IT. If need be, that IT group could liaise with Singapore IT and from there to the US. Conversely, Singapore IT would connect to local key users as representatives of user communities. Alternatively, they would talk to local IT groups who could connect to their user departments. Either route had its advantages and avoided crossing functional and geographical boundaries at the same time. On the one hand, Singapore key users were considered central experts for the Far East region. They connected on a daily basis to their remote counterparts. On top of these dispersed homogeneous communities, there was the local advantage. Local IT were very familiar with their onsite user departments (CPW, DiskCo-A-3).

CarCo

In the Goldd project, CarCo outsourced development of the new dealer database system to vendor SoftHouse UK. That company subcontracted the project via a holding structure to SoftHouse offshore presence in India. Contractually, the offshore team worked for SoftHouse UK, that company worked for CarCo as represented by the Goldd project leader HH. Ultimately, the system was destined for CarCo users in the US, Europe, and later elsewhere. Initially, the operational setup reflected this governance model. CarCo's M&SS units in Detroit and Cologne connected to North American and European users for requirements analysis. The German M&SS unit represented CarCo to SoftHouse. It interfaced with the vendor through an onshore liaison installed by their UK office. That person in turn liaised with offshore operations. We elaborate on collaboration within the CarCo organization, between the Detroit and Cologne teams. After a similar approach to SoftHouse, we expand on interfacing between the customer and vendor firm.

- *CarCo IT in Detroit and Cologne*

The CarCo M&SS IT organization compares to some extent to DiskCo Far East. Both operated multi-site in an integrated transnational management structure. Local units in Detroit and Cologne units supported similar business operations although their IT infrastructure at the start of Goldd differed substantially. For remote contact, they used phone calls, email, ftp, and videoconferencing. People could share servers, and run shared calendar applications. They did not have more sophisticated tools like Lotus Notes. Like DiskCo, remote contacts coincided with content role specialization at both sides, e.g., data model experts from Detroit and Cologne would connect. For managerial and planning issues, JF and HH or HN maintained close contact as site representatives.
Many Goldd members in Detroit and Cologne had been with CarCo for a long time. Their being part of the same company promoted goal congruence and relationships. Though people had not collaborated across the Atlantic before Goldd, people built rapport after cross-site visits. They liked to collaborate remotely. Relationships fostered a positive working climate and efficient, responsive interactions.

- *SoftHouse*

The vendor company seemed a less coherent organization, with more turnover. The UK office acquired new contracts and employed people to interface between customers and offshore. For CarCo, they hired independent consultants who were not familiar with India or SoftHouse's presence there. On would work in Cologne, the other one offshore. Their relationship was supposed to facilitate remote contact. Locally, they were expected to make the connection to respectively CarCo and the vendor's offshore Goldd team. Things did not work out that way, as the offshore person left.

In India, the IT labor market was highly volatile just before the end of the millennium. People switched projects and companies as they gained experience. At SoftHouse they worked in an informal atmosphere and made long working days. The onshore liaison did not know anyone in India, nor was he familiar with their way of working. He was not part of the same corporate unit and did not have a formal position of authority vis-à-vis the offshore team leaders or members. He took on a somewhat authoritarian role when visiting India. This eliminated relational ties as a remaining option for effective remote collaboration.

- *CarCo - SoftHouse interface*

In the original setup, the onshore liaison funneled all communications between customer and vendor. This included all relevant areas in the project: business requirements, project management, and technical topics. Liaised contact was supposed to avoid confusion between onshore and offshore. At first sight, it smoothened outsourcing to a firm with a very different cultural and operational background. The British onshore liaison would in a sense shield off offshore operations. He constituted an additional layer between CarCo and the offshore teams. This seemed convenient for the customer, but it complicated the onshore - Indian connection. The offshore team had not been involved in earlier analysis activities. They knew CarCo users nor IT nor any requirements. There was a huge knowledge vacuum there. After the offshore liaison left, they leaned heavily on the onshore liaison to complement minimal resources like the PC-based prototype and data model. Meanwhile, CarCo fed the liaison with an ongoing stream of change requests and design standards. They also started to grill him when first deliverables were late and below par. Yet he had little tools to make things happen in India, neither through remote contact nor through local buddies. His exclusive liaison role left structural holes between CarCo and SoftHouse. They dependent exclusively on a person expected to handle the full variety and volume of customer - vendor communications. Ultimately, this was a risk for HH as project champion. He should have maintained redundant ties with offshore operations, like the VP IT from DiskCo.

Things improved when SoftHouse replaced the onshore person with a more seasoned consultant and a representative from the Indian team for technical areas. This expanded the interface and moved SoftHouse closer to CarCo. To the Indian liaison, remote contact was not really a challenge. He was well included in the offshore team and knew all ins and outs. As a senior expert, he was respected and accepted by the offshore team. At the same time, his onshore presence facilitated face-to-face contact with CarCo team members without having to go through layers. This boosted interactions and knowledge flows, also with CarCo US. Similarly to the DiskCo case, remote contact can flourish but it demands a basis. That is some form of inclusion and familiarity. In this case, HH preferred an Indian onshore manager who could - even on a distance - easily identify with the Indian offshore team. Similarity of background would facilitate remote connections.

§ 11.2.1.3 Learning, Documentation and Technology

In the theory section we discussed some studies on the use of groupware in distributed work environments (Ciborra & Patriotta, 1996; Majchrzak et al., 2000a). Scholars found that this technology structures workflows. It demands entry of data to represent collaborative processes in an explicit manner. The system played a less central role than originally envisaged. It could not function as an exclusive collaborative platform. Instead, groupware funneled only some aspects of work processes. It functioned as a sort of dynamic documentation system that captured and disseminated information for dispersed

actors (Goodman & Darr, 1998). People also limited the role of groupware to avoid excessive transparency of work progress to management (Ciborra & Patriotta, 1996).
In this section, we explore groupware in a broader context. We expand on the preceding section with a focus on learning modes and documentation. Technology is considered in the form of Lotus Notes and corporate intranet.

DiskCo

The Oracle project at DiskCo required extensive learning processes. The organization was not used to a common IT infrastructure or technology as sophisticated as Oracle ERP. In order to deal with this knowledge vacuum, DiskCo deployed a number of strategies that are discussed here. Their application was time pressed because of the Y2K problem.

First, the VP IT stressed the importance of training. He had reserved a considerable budget to prepare IT and key users for the implementation process, and to ready users for using the new system. People mentioned that training should be as close as possible to their situation. Instead of external training, they preferred customized help from DiskCo staff who had been included in the same organizational context and therefore spoke the same language. The VP IT stressed training that was direct and immersive. He did not want people to represent their department and pass on their interpretation of what they had learnt. At the same time, key users played a pivotal role as knowledge brokers for their department. He achieved immersiveness by letting people come over to a site where Oracle was up and running for on-the-job training. Distance learning was reserved for small scale instructions on basic functionality. Over time, knowledge transfer became more effective. Staff from Singapore site A distilled useful content and reframed that for people involved in subsequent conversions.

Second, DiskCo enforced SDLC as standard corporate development methodology. They made electronic prescriptions and document templates available. These were used for the Oracle implementation process and customization requests.

Third, a knowledge database made expertise worldwide accessible in an impersonal manner. Lotus Notes supported dispersed representation of known issues and problem solving steps. Categorization of entries supported multiple angles to look at information. Management expected subordinates to enter relevant insights into the system.

Fourth, experience with early implementations was captured in a sort of standard operating procedures. Documents, checklists and templates reflected best practices. Their use compressed learning curves, especially when local situations differed minimally from the default. Documentation reduced local uncertainty and thus dependence on central support sites - Singapore site A and the data conversion team from Malaysia site A. It formalized and economized interactions with these sites.

Finally, users and IT had a separate database for bringing up issues they encountered during the conversion trajectory. The issues database contained functionality for managing the problem solving process, and contributing from anywhere in the world. Problem owners usually looked first at the database before they contact peers. Even when they could not find relevant information, they preferred to circumvent the environment that was transparent to management (Ciborra & Patriotta, 1996).

To conclude, groupware - in this case Lotus Notes - enhanced the role of impersonal knowledge exchange mechanisms (Van de Ven et al., 1976). It made documented expertise accessible for dispersed use and contributions. The environment was limited to technical know-how that could be represented in brief descriptions. Its added value depended on people's willingness - with some hierarchical pressure - and capability to participate in this electronic documentation environment. They had to have a common interest and basis. That is, people needed ex ante knowledge to locate and fit in database information. Their contexts (local IT environment, business processes) should not differ too much from the ones underpinning the represented expertise in Lotus Notes (Goodman & Darr, 1998). If these basic conditions were not met, people reverted to on-site meetings. This facilitated interpersonal encounters to build the common knowledge bases described above. It also enabled people to look at resources available at another site - like a new Oracle setup or unique local systems - and interact with these.

CarCo

CarCo's outsourcing strategy resulted in reciprocal dependencies with the vendor company. With a focus on learning, a first interdependence concerned SoftHouse's technical expertise. The company was hired for expertise in areas like workflow processes and client/ server technology. Their staff would complement CarCo's inexperiencedness with advanced technology. In practice, little opportunity existed to materialize these goals (JF, CarCo-D-1). Somehow, the project manager was aware or capable to connect his organization to vendor staff and tap into their knowledge reservoir. This could be traced to the combination of distance (CarCo Cologne/ Detroit versus SoftHouse India), and the indirect organization structure. With all communications funneled through liaisons, a ramified network of multiple ties could not emerge. The same factors constrained the second learning process - from offshore staff. As recent technical graduates, SoftHouse personnel had little insight in business operations, let alone a company from the US and Europe. They received limited information from the onshore liaison. Consequently, offshore staff relied strongly on the data model and PC-based prototype. These resources, however, were intended nor capable of functioning as almost exclusive boundary objects. This undermined the offshore vendor's role as agent in an unstructured agency relationship. A third learning process concerned education of users alongside implementation of Goldd system. Our research did not cover that period. To conclude, one would expect strong connectivity between offshore vendor personnel and CarCo IT and users. These parties engaged in an unstructured collaborative activity with several reciprocal learning dependencies. The indirect mode of organizing constrained and lengthened these processes. Quite late in the project, things improved when an offshore representative attended the second Model Office and met with users and IT staff from CarCo. These interactions boosted his insight in CarCo requirements, and gave him the opportunity to share his expertise. Upon reflection, representatives from the offshore team should have been involved much earlier to cater for reciprocal onshore - offshore dependencies.

§ 11.2.1.4 Planning, Managing and Managerial Control

Earlier studies found that distance disconnects a manager from his subordinates. He communicates less frequently, hindering his awareness of work progress and constraints. Rapport between manager and subordinates seemed challenging to build (Kurland & Egan, 1999; Staples, 1997). In response, managers stressed the importance of selecting capable and trustworthy subordinates. They initiated a rhythm of formal contact moments, and relied on an explicit control process. With regular intervals, subordinates were expected hand over deliverables. Sometimes, a local representative of the manager complemented his role. These findings applied to teleworking situations (Perin, 1991; Sia et al., 1998). We extend them to dispersed temporary systems for the DiskCo and CarCo case.

DiskCo

At DiskCo, the VP IT in Singapore site A supervised the Far East Oracle conversions with the exception of Thailand. Compared to earlier IT projects, the Oracle implementation was larger, more cross-functional and time-pressed. This changed his role. Meta-site management became important to ensure adherence to the overall plan and coordinate cross-site resource dependencies. The VP IT took on a very engaged role to stay tuned with progress at the various sites. This awareness helped him identify and adjust for bottlenecks.

The Oracle conversion emphasized for the first time commonality and impacted mission-critical business processes. His approach to this challenge combined centralized control and support with decentralized responsibility. While the VP IT remained responsible for the overall region, local IT directors were fully in charge at their sites. Micromanaging local conversions from Singapore site A appeared unfeasible. It would multiply dependencies and communications between Singapore site A and the various sites in the region. At the same time, local autonomy was complemented with centralized control and resources. The VP IT expected and enforced his IT directors to report at a very regular and frequent pace. He talked with them remotely, and sometimes with a number of them through teleconferencing. He flew in during the kick off phase and at critical stages to meet with them and connect broadly to managers from user departments. This provided a multi-perspective view and solid awareness of local progress. Unlike the CarCo project manager, he did not make himself dependent on a single channel - his IT directors. Local IT directors were supported extensively with centralized resources, i.e., the core team in Singapore site A. They received training, advice, and templates to setup their own conversion project.

Rolling out a standardized application like Oracle is likely to meet with resistance. Users and IT had been used to their own version of the MANMAN system for years. All this had to change in a short period of time. Within the IT function, the VP IT could fall back on his relationships with the IT upper management echelon. The CIO at US HQ knew him from his time as expatriate VP in Singapore. With regards to his subordinates, the VP IT used his hierarchical position for centralized resource allocation across sites. It enabled him to convince subordinates in Singapore site A, and his directors elsewhere. Independent of the Oracle project he had been working with his IT directors for years, with standard practices like performance appraisal. As local representatives, these directors were supposed to sell the project internally to their staff. If need be, management referred to executives at US HQ who had formally kicked off the plan. Users were approached in various manners. The VP IT climbed the ranks at DiskCo together with many buddies in other functional departments. He leveraged that relational network to sell the project and receive commitment. From there, VP's and directors would convince subordinates within their function of Oracle's usefulness. Again, the VP IT could ultimately exert pressure by pointing at top management commitment - up to the CEO at US HQ. The VP IT also organized kick off meetings at every site to sell the project personally to IT and users. Goal congruence amongst executive and managerial ranks dripped down to staff levels. People knew the importance of the project to their bosses, and this increased their willingness to participate. This made it much easier for IT staff to work with users. Still, resistance emerged at times. The VP IT personally flew in around the go-live date to support IT staff. All in all, the VP IT leveraged on organizational advantages like hierarchy, existing control structures and relationships (Bradach, 1997; Williamson, 1981).

In the US, a global master plan had been developed that indicated for each site when generic steps were to be completed. Regional centers like Singapore site A were expected to fill in details together with local sites. This was not accomplished in a satisfactory manner. Interviewees indicated that a more fine-tuned plan should have removed uncertainty in an earlier stage. In a dispersed temporary system, this is important for reducing remote dependencies and communications. Such an environment called for formalized communication patterns to coordinate the large numbers of actors involved at various points. People needed more ex ante predictability, somewhat like a construction project (Bryman et al., 1987). This meant a departure from the past where people relied on more informal connections and worked less interdependently across sites.

CarCo

The situation in the CarCo Goldd project was more complicated, mostly because of offshore outsourcing. Approaching it from the top, the global project manager (HH) stressed his overall responsibility. Within the CarCo organization, a structure similar to DiskCo facilitated this role. Formal reporting relationships across sites was very common. Managers participated in a buddy network that enabled their responsibility for remote staff. For Goldd, the project leader knew someone with a similar role in Detroit. They had a common boss in the UK. The US team could fall back on that local person for issues like sick/ leave. They were not micromanaged from Cologne. That appeared unfeasible, just like DiskCo's VP IT refrained from operational responsibility at remote sites. Goldd's manager used simple GANTT charts to plan his German and American team in a integrated manner.

Offshore outsourcing complicated HH's job. Retaining overall responsibility, he engaged in a lateral relationship with SoftHouse UK. This company subcontracted to offshore operations. The contract with this company was incomplete and lacked realism according to CarCo subordinates and SoftHouse staff. With respect to offshore operations, HH initially took a completely hands-off approach. Onshore and offshore activities were minimally coordinated. Planning remained on a milestone level, lacking comprehensiveness and a log term scope. HH trusted the companies track record and ISO certification. Between onshore and offshore, liaison handled communications. He made himself dependent on SoftHouse's assumed professionalism in technical and organizational areas. Still, he was ultimately responsible for Goldd's success.

The first deliverables from India did not promise much good. The offshore team could not work well with the onshore liaison and lacked know-how on CarCo requirements. HH's minimal involvement and exclusive dependence on the onshore liaison left him unaware of delays and miscommunications between onshore and offshore (Burt, 1993). Only when SoftHouse fell short did he increase pressure on the onshore liaison and the UK office. His contract-based threats eventually led UK management to leverage upon their hierarchical influence on Indian management. Pressure on the offshore team to deliver increased as both UK and Indian management monitored their performance closely. HH setup daily ‘prayer’ meetings to monitor progress, mainly through output controls (Kurland & Egan, 1999). The onshore liaison was replaced by a person with more offshore experience and a representative from the Indian team. This improved connections between onshore and offshore and led to a more integrated planning approach.

§ 11.2.1.5 Control

In the theory section we discussed research on control in geographical dispersed work environments. Current research focuses in particular on teleworking. There, distance impacts the relationship between manager and subordinates who work at home or elsewhere (Perin, 1991; Wiesenfeld et al., 1998). Some scholars explored control in offshore outsourcing relationships (Meadows, 1996b). They found that distance deprives someone in a controller role of information on a controllee’s performance. To reduce this tension, controllees had to push information at a regular pace (Meadows, 1996b: 107, 104). Distance results in asymmetric insight in work progress. It makes it also harder for controller and controllee to build rapport, and ensure accomplishments through interpersonal contact. Researchers suggested that people structure work processes in a more explicit manner. They stressed input to reduce controllee dependence, and output control that consist of observable deliverables like a report. Instead of process control in the sense of behavioral observation, people monitor progress at regular intervals. We assess here control of dispersed actors in the case of DiskCo and CarCo. This extends what has been noted in the previous section on managerial control.

DiskCo

In the Far East region, DiskCo’s turnover rate was quite low. Many people built their careers for years in the organization. The stability of the firm’s workforce guaranteed socialization in corporate norms and rules. People knew organizational expectations and built rapport with peers. The VP IT reinforced this embedded control mode for the Oracle project by selecting only seasoned participants from the existing organization. The project increased his dependence on IT directors at remote sites whom he could not oversee in the traditional sense (Perin, 1991). In addition to this ex ante control mode, he visited each site at least during the kick phase, and around the turn live date. At that time, he would meet with his local IT director and people from user departments. He connected broadly to a plant’s organization to ensure intimate awareness of work progress. While working from Singapore, he frequently called his directors and expected them to leave him regularly a message. The VP IT did not micromanage regional site from Singapore site A. He tightly controlled his managers there, who in turn would ensure local performance. In a sense, controls between the VP IT and his IT directors can be characterized as a mixture of relational control, hierarchical structure, and self control. The VP IT trusted them, but because of the project’s criticality, he also kept a finger on the pulse.

The VP IT could not use hierarchical control for directors from user departments. In these cases, he leveraged upon his interpersonal relationship with these people. They had climbed the DiskCo career ladder in parallel and formed a sort of buddy network. Control on a managerial level promoted goal congruence throughout the organization. This facilitated on a staff level lateral control processes across functional areas. For instance, IT team members from the core team at Singapore site A met little resistance from users at

their own site or elsewhere. The VP IT had paved the way. Sometimes IT staff emphasized formal control through documentation to avoid situations where users denied earlier requests.
DiskCo ensured control in the sense of consistency through documentation, templates and methodology like SDLC. Lotus Notes supported this process by making standards documentation available to every site. The application also represented problem solving processes such that these became transparent across DiskCo's hierarchical layers (Ciborra & Patriotta, 1996). Finally, multi-site implementation of a single source code required change control procedures. Modifications were structured in several phases and controlled by means of an automated tool (CCC/ Harvest), and broadcasting communications.

CarCo
The Goldd project brought together people from two organizations, scattered over sites in the US, Germany, UK and India. A myriad of control structures ensured performance in this dispersed work environment. We discuss first control processes for CarCo and SoftHouse separately, and finish with the interface between the two companies.

- *CarCo US and Germany*

In Detroit, JF took on a coordinating role for the group of people involved in Goldd (Figure 51). She worked fairly autonomously from her boss. Within the Goldd team, people collaborated in a lateral mode without very fixed controller/ controllee roles. In Cologne, HH was formally the boss from the small Goldd group there. He relied mostly on self control (people's own motivation and professionalism), and sometimes output control. His subordinates alternated control roles for certain tasks like testing.
HH combined his local managerial role with responsibility for the overall Goldd project. As far as the CarCo Detroit was concerned, HH could not observe and interact with them like he would with his local team. Yet he had various control modes at his disposal. Basically, JF was a seasoned professional and needed little instructions or monitoring. Her being part of the same organization and M&SS group promoted goal congruence. In addition, HH became officially her boss some time into the project. Above that, CarCo's management structure relevant to Goldd was globally integrated. HH reported to the same boss as management at JF's site. Lateral relationships in the form of a sort buddy network across the Atlantic complemented this hierarchical setup. On a lateral staff level, interviewees stressed peer control between Cologne and Detroit. This compensated for the fact that distance constrained remote collaboration and thus increased the risk of misunderstanding.

- *SoftHouse UK and India*

SoftHouse offshore operations in India operated in an informal fashion, see also a later section on diversity. A group of mostly recent technical graduates collaborated in a lateral mode without much hierarchical direction or formal rules. People moved in and out of this team depending on work pressure and their external interests.
SoftHouse UK stationed liaisons onshore and (for a brief period of time) offshore. These independent professional consultants were minimally controlled. The onshore liaison did not have formal authority in India, although BW tried unsuccessfully to assume such a role. His official role was more of an advisor. On a managerial level, UK executives did

have an impact on offshore management. Pressed by CarCo, they exerted this influence when first deliveries from India were below par.

- *CarCo - SoftHouse interface*

The contract closed for Goldd between CarCo and SoftHouse was incomplete. It did not specify in details the output and delivery process. At the same time, it stipulated a fixed budget and time frame. As CarCo representative, HH was minimally involved with SoftHouse. He obviously did not have hierarchical controls in this lateral relationship, and trusted vendor's track record and ISO certification. Over Fall 1996, his lack of controls backfired. Deliveries did not meet expectations. Gradually, HH tightened controls on the vendor. Initially he pressed the onshore liaison, but when that did not work out, he reverted to the contractual relationship with SoftHouse UK. Executives there responded by increasing pressure on offshore management. This triggered their internal control structures and resulted in performance improvements. In addition, HH assumed more direct output control by means of daily 'prayer' meetings with the onshore liaison. This regular pacing resembled the approach of the VP IT from DiskCo, and findings from Kurland and Egan (1999). The onshore liaison role was reinforced with the arrival of a representative from the Indian team early 1997. That person could tie back to the offshore team, and leverage on his senior position there. Sometimes, HH and the onshore liaison (BW, BJ) felt the constraints of a lateral relationship when they their interests did not coincide. For instance, HH tried to discourage BW's holiday early 1997, and BJ did an attempt to assign administrative duties to AC. Overall, outsourcing made CarCo laterally dependent on a (remote) vendor firm, while HH retained final responsibility for the project. He did not have the advantage of control structures within a multinational firm (Edström & Galbraith, 1977; Williamson, 1981). His productive relationship with the Detroit team, and DiskCo's example seem to confirm this.

§ 11.2.1.6 Development Methodology

Few researchers have yet focused on software development methodologies in a geographically dispersed project. Interviewees from offshore vendors in India commented in Meadows' (1996) study on the usefulness of prototyping. It made the software visible in an early stage, and thus facilitated communications with remote end users and IT staff. Some of their concerns included the lack of participation of offshore vendor personnel in the requirements analysis phase. More generally speaking, they missed know-how on the customer's business and requirements. This made them very dependent on the customer's onshore organization for a continuous flow of information. Preferably, offshore staff should be involved directly in the early stages of the project to build up requirements knowledge.

DiskCo

Development methodology was not key to DiskCo's Oracle project. They did use methodologies for implementing the application and handling small customization requests. Initially, this was Oracle's Application Implementation Method (AIM). This was replaced by a modified version of Software Development Life Cycle (SDLC). On the corporate intranet, an internal Software Process Engineering Group (SPEG) posted descriptions and document templates. This helped local IT groups structure their projects according to corporate standards. DiskCo thus promoted consistency of its dispersed IT development efforts and facilitated cross-site exchanges.

CarCo

CarCo adopted a prototyping approach for the Goldd project. It was a tradition at the company, and seemed necessary since users refused to sign specifications that they could not understand. Another concern with a waterfall type of approach was that it would take too long. For some reason, there was a lot of time pressure on Goldd. Prototyping would encourage interaction with users. They could visualize the system and provide feedback to the development team during three Model Office sessions. In practice, the offshore developers were not included in the first session, and only two sessions were held in total before system launch. Distance was one of the drivers behind the low number of feedback meetings. The complexity of Goldd was underestimated. It was considered simply some functionality around a dealer information database.
Development of the system was outsourced to tap into low cost expertise form India. The contract with SoftHouse stipulated a fixed budget and time scale. The experience normally required for meeting these parameters was not available in the SoftHouse organization. Outsourcing led to a sort of dual agency relationship setup, where offshore teams worked for CarCo M&SS, and that unit worked for several user departments. The communications setup matched this governance model but not information processing needs. CarCo communications were funneled to an onshore liaison who was expected to connect to on offshore counterpart, and from there to SoftHouse India operations. The liaisons were temporarily immersed in the CarCo organization. SoftHouse expected them to pass on their know-how to the offshore teams, one stationed onshore and one offshore. This remote human-to-human chain did not work. The offshore liaison left, and the remaining onshore person could not establish rapport with offshore personnel because of distance and his lack of socio-cultural skills. To make things worse, people could not fall back on impersonal coordination mechanisms like formalization and documentation (Van de Ven et al., 1976). Both played a minor role in the project because of the prototyping methodology. The onshore liaison faced the impossible task of channeling communications on a variety of technical and nontechnical areas between the two companies. To CarCo, he was considered responsible for SoftHouse performance. Yet within the vendor organization he had only a lateral role with little formal influence on offshore operations. This put more pressure on him than he could handle - after a few months he dropped out. Things improved when he was replaced by someone with more offshore experience and a representative from the Indian team for technical topics. This enhanced the onshore liaison role in terms of variety and processing capacity. In addition, more direct contact between CarCo and offshore was promoted to alleviate the liaison role (Burt, 1992).

At the start of Goldd, CarCo IT staff completed a first minimal requirements analysis. It was intended to develop a PC-based prototype that provided users with a minimal concept of what the system could look like. Since SoftHouse offshore staff was not involved in that phase, the prototype became a central boundary object to them - a role it was never intended to play (Karsten et al., 1999; Star & Griesemer, 1989). They attempted to develop Goldd based on the prototype and the data model, but never analyzed CarCo requirements in detail. Later on, this necessitated formation of a task force with representatives from US, Germany and India to redo the design of Sales and P&A code functionality. Upon reflection, risks associated with the prototyping approach had materialized in the project: lack of systematic analysis, documentation and a structured development process (Beynon-Davies et al., 1999). It seemed that the offshore team did not assign specialists to zoom in on particular areas. They worked in an informal manner on various parts of the system. This complicated contact with the customer's IT group. From that side, people basically did not (want to) know who did what in the offshore team. Multiple specialist-to-specialist contacts were not established like in the DiskCo case. As far as users are concerned, the liaised onshore - offshore link did not leave room for Indian staff to learn form users and provide suggestions with their extensive IT expertise. Only in a later phase did an Indian team member participate in the second (and last) prototyping session. For the first time, he had direct access to users without liaison layers and distance in between. This boosted his learning process and added value to the users. It matched the underlying agency relationship between users as key principal, and the offshore team as main agent. Looking back, the project leader had preferred involvement of senior Indians much earlier in the project, and Indian team members onshore. This would promote interaction with IT staff there, and simplify contacts with IT and users in Detroit.

§ 11.2.2 Time Zone Differences

In the theory section, we found that time zone differences constrain synchronous exchanges between sites. To sustain connectivity, people use asynchronous media like email, voice mail and documentation. A property of these media is not only their asynchronicity, i.e., lack of interaction. Some of them are also 'lean', most notably email and documentation (Daft & Macintosh, 1981). These communication formats rely on translation of an intended message into a textual format. Asynchronicity and leanness hinder the accomplishment of certain collaborative tasks that demand interpersonal interaction. When people embark on novel tasks, or activities with uncertain facets, they may need rich (multiple cues) and interactive adjustment cycles to coordinate their work (Mintzberg, 1979).
From prior research, we found several ways in which people respond to the above situation. They put more effort into updating counterparts and scheduling synchronous meetings. Local planning and priorities may be adapted to meet other sites' demands. When working asynchronously, people draft comprehensive messages. They make their point explicit to avoid redundant feedback loops that delay problem solving.

DiskCo

In the case of DiskCo, time zones played a role between Far East and the US, and to some extent between Singapore and SysCo's site in India. It was also challenging to arrange for triple site meetings with participants from Far East, US and Europe. Between Far East and US sites, different zones constrained or eliminated real time windows when normal working hours were sustained. This led to almost exclusive use of email and document exchange. Yet actual communication needs demanded different communication patterns. Oracle posed a novel application environment to Far East staff, they had many questions for their US counterparts. At the same time, US staff was not familiar with Far East that differed in volume. On top of this, people worked under time pressure because of the Y2K problem.

With this novelty, unknown diversity, and pressure, scholars suggest direct face-to-face contact, or at least rich, interactive media (Daft & Macintosh, 1981; Galbraith, 1973). Unavailability of such opportunities delayed problem solving. On the one hand, time zone differences promoted use of a medium that could not support extensive information processing needs. Even when people would exchange messages almost real time (e.g., instant messaging or chatting), they would need substantial back and fort loops to build mutual understanding and solve issues. Now, time zones further stretched these cycles. Asynchronicity of working days postponed replies, that often concerned requests for further clarification. With critical deadlines to meet, this increased pressure on Far East staff.

People sketched two response patterns to deal with this situation, both in line with earlier research. First, they stretched asynchronous media. They included in their emails information on the background of their requests as well as examples. This reduced uncertainty for their counterpart, and hopefully would eliminate some clarification loops. Some people further facilitated their counterpart's job by formatting their requests bullet-wise, almost like a form. Exchanges thus became more comprehensive, channeled, and structured. Second, people adapted working hours and priorities to meet their remote partner's demands. They created artificial windows for phone calls and teleconferences by calling from home or stretching their working day at the beginning and/ or end. During critical phases around a conversion, people would stay stand-by like physicians or emergency workers. Tele-conversations required planning efforts and preparation to enhance their added value. Synchronous meetings across three continents (Far East, US, Europe) underlined the importance of preparation and adaptation. Their added value was that people could bring up and discuss issues with all parties involved, instead of organizing multiple smaller meetings. This compensated the inconvenience and effort associated with triple site audio conferences.

CarCo

The Goldd project at CarCo confronted participants with reasonable time differences between respectively US East Coast and Germany, and Germany and India. With normal working hours, people could not connect real time between US East Coast and India. People experienced another form of synchronicity during the Christmas holiday of 1996. While the US and Indian teams continued work, the German team took a break. This interrupted and thus delayed cross-site problem solving cycles in which American and German team members should have joined.

In the relationship between the American and German team, people found that time zone differences stretched their working day. They adapted their schedule to dedicate time during the window to their counterpart. Arranging for synchronous meetings cost deliberate attention and effort (Kraut & Galegher, 1990).

Between US and India, no synchronous communications were possible. This necessitates use of asynchronous media and postponed on some occasions the resolution of urgent issues. Besides, exchanges were supposed to flow through the German site and not directly. This implied that when Indians brought up an issue, it was processed in Germany and relayed to the US. Combined with time zone differences, any interruption in this chain caused major delays and annoyed the Indian team.

§ 11.2.3 Diversity: Differences in Culture, Operations, Function, and Language

In the theory section, we proposed cultural differences as one of the gaps to conceptualize the impact of global distributedness. Our view relied not so much on dimensions of cultural diversity (e.g. power distance, masculinity/ femininity, Hofstede, 1991), but rather on socio-cognitive and information processing approaches. This perspective has been applied in studies on communications (Krauss & Fussell, 1990), and cross-functional interdependencies (Dougherty, 1992). These scholars assert that inclusion in a certain context or community shapes people's behavioral and thought processes in a unique manner. This surfaces when they collaborate with others without that common knowledge base. In that case, some form of additional information processing is required to counteract nonoverlapping interpretation schemes. In a geographically dispersed setting, diversity is more likely. At the same time, mutual awareness becomes challenging because of the mediated (lean) nature of communications. Coping mechanisms include face-to-face visits and selection of staff with prior cross-cultural experience. From this angle, we assess the DiskCo and CarCo case.

DiskCo

The DiskCo case suggested a broader outlook on cultural diversity. People experienced not only differences related to their national culture, but also different operations, cross-functional dependencies, and lingual issues. We discuss these four dimensions in succession. First, in our study on the Oracle project, we encountered directly or indirectly people from China, Singapore, Malaysia, Japan and the US. Participants from the first three countries experienced little diversity. Most Singaporeans have Chinese ancestors and feel cultural and lingual (Mandarin) familiarity with peers from mainland China. Between Singapore/ Malaysia and the US, people noticed their diverse background, reflected in their ways of working and frame of reference. Some people from Singapore/ Malaysia had already built insight in US culture before the Oracle project. They had visited US counterparts, or worked for an American expatriate manager (Edström & Galbraith, 1977). Even then, cultural diversity increased information processing needs, in conjunction with the novelty of the Oracle project. People engaged in extensive discussions to explain their point of view, while trying to empathize with their counterpart's outlook. In another vein, the Singaporean team worked for the first time with Japanese IT staff and key users. From their angle, Japanese came across as very polite and formal. The VP IT in Singapore decided on a very gradual process of mutual collocated introductions to build reciprocal knowledge and rapport.

Second, collocated played also an important role in bridging functional diversity. In the Oracle project, key users from various departments worked closely with local IT staff to learn, adapt and implement the Oracle application. These interdepartmental communications were mostly handled on-site. Rich and interactive sessions were held to connect people from different contexts. Remote contact was reserved for intra-functional exchanges, like between IT staff in China and Singapore, or data conversion specialists in the US and Malaysia. The mediated nature of remote contact promoted homogeneous connections, i.e., between professionals specialized in the same area. This reduced information processing needs.

Third, operations in the US differed from those in the Far East. They were focused on R&D, whereas Far East plants manufactured high volumes. After the initial implementations in the US, professionals there were supposed to assist their Asian colleagues. They assumed that their experience could be applied directly to the Asian context. This was not the case because of the volume difference, and local government regulations in China and Malaysia. For staff from Singapore, it appeared challenging to convey the unique nature of their operations to US counterparts, and obtain their acceptance. People were heavily focused on commonality of business processes and minimizing customizations to the Oracle application. Extensive discussions were needed to clarify diverse perceptions and seeming goal incongruence. This was complicated by the limited time window between Singapore and US sites that necessitated predominantly email exchanges. Diversity of operations also played a role between Singapore and Malaysia because of unique local customizations. Experts in Singapore run the risk of giving advice that did not match the Malaysian situation, but was based on their assumed understanding of that context. Instead of remote contact, staff from Malaysia preferred to visit Singapore to explain in person their IT infrastructure, and to look on-site at the novel Oracle environment. On some occasions, plants operated in a very similar manner, e.g., drive plants in China and Malaysia. This homogeneity reduced uncertainty and information processing needs. Once a plant of a certain type was converted, others could benefit from that know-how (Goodman & Darr, 1998). They could apply an optimized process that incorporated lessons from the first conversion. In other cases (e.g., US - Singapore), diversity made local lessons less relevant. People had to go back to basic assumptions in order to identify, understand and somehow work around dissimilarities.

Fourth, language played a role on some occasions. Some Chinese and Japanese staff members were not comfortable with English, especially orally. Chinese staff had difficulty to understand during phone conversations a DiskCo staff member in Singapore with an Indian background and accent. Similar issues occurred when Singaporean staff contacted vendor staff in India. Bad quality phone lines combined with the Indian accent made remote collaboration more arduous.

People adopted various modes to handle lingual issues. Singaporean staff members with a Chinese background could switch to Mandarin as an alternative for English. In other cases, people switched from phone to written media (email). This delayed problem solving when issues were at stake that demanded a richer and more interactive connection. The VP IT emphasized personnel selection as a tool for ensuring English proficiency among staff in China (Jarvenpaa & Leidner, 1998).

CarCo

The Goldd project connected CarCo sites in the US and Germany with vendor presence in the UK and India. We apply here the four dimensions distinguished for DiskCo. First, we elaborate on national culture, as applied to CarCo, SoftHouse, and the interfacing between these companies. Within the CarCo organization, the teams from Detroit and Cologne observed the diversity of their cultural background. Especially American staff found Germans rigid, inflexible and formal in their approach. After a cumbersome remote start, the Americans' visit to Germany worked as an ice-breaker. Immersion in their context extended appreciation of the German team's background. Conversely, German staff

adopted a somewhat American or international style when dealing with their US colleagues.
Within the SoftHouse organization, units in the UK and India were involved in the Goldd project. The UK unit stationed an onshore liaison in Germany. That person - BW - was supposed to work with offshore Indian staff. His cultural insensitivity and disrespect for the local organizational setup in India led to a communications breakdown, and lack of coordination between onshore and offshore. Oral communications appeared challenging between the offshore team and BW's successor in Germany, BJ. This complicated onshore - offshore contact and led to what can be referred to as under-coordination: a lack of insight in and adaptation of dispersed, interdependent activities.
Initial contacts between CarCo and SoftHouse representatives from India suggested substantial diversity in the eyes of the German project manager. He preferred consultants from the UK office to liaise between his group and the offshore team in India. Their supposed familiarity with both Indian and continental European culture would smoothen onshore - offshore exchanges. This came at a price, though. It meant that staff from CarCo and SoftHouse were never introduced to each other. They did not meet face-to-face or electronically. Much later in the project, people started to realize that liaised organizing hampered the collaborative capacity between onshore and offshore. They experienced difficult months of misinterpretations, delays, and tensions that could be traced to the combination of indirect contact and challenging interdependent activities. Having people from a third culture 'in between' seemed to complicate the cultural transition process. Towards the end of the project, Indian team members were stationed onshore to assist the British liaison. This promoted mutual understanding and rapport between CarCo and SoftHouse India staff. Looking back, people had preferred direct contact, and possibly (temporary) collocation right from the start. This way, they could have dealt with cultural diversity upfront, and smoothened subsequent collaborative processes.

Second, Goldd was a dispersed IS development project that required many types or areas of activities. These ranged from very technical ones like designing data conversion rules, to areas that focused on business and organizational issues, e.g., requirements analysis. Each site in the project was somehow involved in these different areas. There was a difference, however, in the way people involved in certain topic areas connected across sites. The German and US site adopted an approach that resembled the DiskCo case. Locally, people would specialize in a certain task area, and connect with remote counterparts with a similar responsibility. Thus, multiple homogeneous communities emerged around for instance the data model, business requirements, and project planning. With India, communications on the various topics were funneled through the onshore liaison. This proved too much, both in quantity and requisite variety. For that reason, the onshore liaison was assisted by an Indian team member to handle technical issues between onshore and offshore.

A third dimension of diversity concerned ways of working. People at CarCo sites - though geographically dispersed - mentioned a common way of working that was part of their corporate culture. Apart from some initial differences, this paved remote collaboration processes. By contrast, SoftHouse India and CarCo worked in strikingly different manners. In India, people were used to an informal organizational setup and communication mode. They relied mostly on oral instructions instead of planning and documentation. Sequencing of tasks was considered in a less linear, step-wise mode than people were used to in Germany. Besides, many Indian staff members came straight from the university after earning a technical degree. They had little knowledge on business practices and collaboration in a project environment. Indians found Germans and to some extent Americans quite formal. They had a hard time accepting that delivery times and meeting schedules were strictly adhered to. All this led to negative attributions, misunderstanding and mutual reproaches. Later in the project, the Indian team modified their local mode of operating to some extent to the 'Westerners'. They created an adaptive layer of formalization and documentation to meet CarCo expectations, while retaining internally their traditional customs. Ideally, they would have liked to 'meet in the middle', i.e. adaptation on the side of 'Westerners' and 'Indian', but this never materialized.

Fourth, English was used as common language like in the DiskCo case. Proficiency played a role here too. Except for the Americans and British, English was not people's mother language. For this group, international communications cost them more effort and they could not express themselves as precisely as they would like to. This lack of nuance led sometimes to confusion or misunderstanding.

§ 11.2.4 Infrastructural Differences

Prior research identified infrastructural differences in client - vendor relationships. Both companies had their own IT environments that appeared challenging to connect. In order to decrease the costs (in a broad sense) of remote collaboration, firms invested in counteracting the impact of infrastructural incompatibility. Vendor staff was included in the customer's telephone system and network environment. Both firms standardized their infrastructures and set up common databases to facilitate information flows across their organizational boundaries.

DiskCo

In the case of DiskCo, people enjoyed an advanced infrastructure that spanned the company's global site. They had access to lease lines that eliminated variable costs of telecommunications in exchange for a fixed fee. This encouraged frequent and extensive phone contact amongst participants in a dispersed project like the Oracle implementation. (Sometimes, people even overused the phone according to one interviewee.) At times, however, lease line capacity fell short because of under capacity and time differences. Between Far East and the US, remote telecommunications traffic tended to peak during the limited window. This made it difficult to ensure availability of a telephone line. In response, people switched to emails (Far East - US). Or they arranged face-to-face meetings, especially for prolonged communications needs with multiple actors involved (Singapore - China).
Remote server access was slow at times. This put an emphasis on local availability of resources, like the testing environment for Oracle development tasks. Since DiskCo adopted a single source code, a multi-site server environment was setup with replication and change control mechanisms. Slow system access meant that for critical activities within the Far East region, people preferred to meet on-site for training and support.
At the beginning of the Oracle implementations in the Far East, DiskCo received support from SysCo in India. This vendor has been a long-term partner of DiskCo. For that reason,

DiskCo has setup hardware and network infrastructure at their site in India to facilitate remote involvement. When calling to India from Singapore, people experienced noisy telephone lines. This hampered remote contact, especially in combination with the accent of some Indian staff members.

CarCo

For the Goldd project, we distinguish between CarCo's US and Germany site, contact between Germany and India, and triple site connections. The US and Germany site had remote server access. They used ftp for file exchange, and basic applications like email and calendar sharing. The main Goldd server was located in Detroit. German project staff accessed this server to pull data for testing. Like in the case of DiskCo, access speed from Cologne to Detroit was slow, delaying testing activities. Another problem was that the old systems that were to be replaced in the US were only available there. For requirement analysis, German and Indian staff needed access to these systems. They had to pay a visit to Detroit to this end.

More serious infrastructural issues existed between Germany and India. Telephone connections were noisy and cumbersome to setup via satellite. On top of that, phone conversations were routed through multiple administrative layers in India. This further discouraged phone calls. In fact, remote contact relied mainly on email and fax. At SoftHouse India, people did not have ftp, so people were using email to transfer files. Unfortunately, accounts in India could not handle the considerable size of these. The vendor also did not have Windows 95 and mainframe systems. They had difficulty obtaining the data modeling tool that CarCo used.

Across the three sites (US, Germany, India), people used different development resources, like data modeling tools. Some of these were not available in India or hard to come by. Triple site audio conferencing was attempted a few times, but videoconferencing was unfeasible.

All in all, infrastructural differences include incompatibility of resources, absence of resources, and slow or low quality remote connections. These factors increase efforts associated with remote collaboration (Kraut & Galegher, 1990). People must invest resources in work-around solutions, and may need more frequent face-to-face meetings. Ideally, they would like better performance on dimensions like costs, speed, and quality of remote connectivity. This implies replication of resources (to reduce remote traffic), fast high-speed connections, and commonality of IT infrastructures.

Chapter 12 Implications for Practitioners

> "I travel for two reasons (from India to US - author). One is to be in touch with my teams over there, and second is to be in touch with customers. All my customers are in the US and there is a distance problem. 10,000 is a long way to be in touch with customers. So I travel there and use the opportunity to meet up with customers, existing customers as well as potential customers (...)" - Director of Aditi, a software company in India[73]

Practitioners constitute one of the important audiences of this study. This section distills lessons from our theoretical and empirical work. It is dedicated in the first place to managers of global software projects. The chapter describes issues people may encounter under conditions resembling those studied here. Pointing at issues, we ask questions and offer suggestions to avoid or handle problem situations. The chapter follows closely the setup of the research. It is prescriptive, but above all realistic to ensure its usefulness. Advice is offered in a condensed format; the preceding chapters provide background information if need be. We start with three themes and elaborate then on a number of gaps: geographical distance and governance differences; time zone differences; diversity in various forms; and infrastructural differences.

§ 12.1 Themes

We start off with three themes that capture basics of managing a globally dispersed software projects: perception and concepts versus realism; ex ante coordination and control mechanisms; and task urgency and criticality.

§ 12.1.1 Perception and Concepts versus Realism

Realism is a critical starting point for global projects but difficult to achieve. People have incomplete information and misconceptions because the project confronts them with many new factors - the team members, locations, technology, processes and resources. Underestimation is far more costly in this environments than in local projects. It can take many forms - planning that is too tight, budgets that are too low, participants who lack experience, and too simplistic a perspective on the complexity and interdependencies of a project. Underestimation leads to an unfeasible project setup. Sooner or later, people will realize that they cannot make it with the existing setup. These tensions are counterproductive. They can be avoided in several ways: use multiple sources to assess the difficulty of a project and the quality of resources; maintain close connections with a variety of people inside and outside the project; formalize regular meetings to receive automatic updates on what is really going on; do not rely exclusively on liaisons for connections to important stakeholders; visit sites to talk directly with people.

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[73] Quote from research by Dr. Millar et al, see for instance (Millar, 1998, 1999). Used by kind permission.

§ 12.1.2 Ex Ante Coordination and Control Mechanisms

It is important to know what 'capital' people bring as individuals and as a group. It can take many forms: Do people know each other? Do they speak a reasonable level of English? Are they used to international projects, other cultures? Do you know this vendor? What is their track record? How can you be sure of that? How is technology? Are infrastructures well connected and similar? Are people comfortable with teleconferences, videoconferences, groupware, intranet and application sharing?

Capital reduces communications needs and investments at the start of a project. It makes (remote) collaboration more efficient and fun. Once you know how 'rich' you are, compare that with your realistic perspective on the project itself. Can you leverage on the capital? Do you need more capital? Is there a mismatch?

You may want to select people and companies such that you have a maximum amount of capital. This applies in particular to challenging, time-pressed tasks - you can clearly do without worries about basic collaboration issues in these circumstances. If the capital is not available, make a realistic estimate of what it takes. Invest accordingly - the sooner, the better.

§ 12.1.3 Task Urgency and Criticality

[This section is only relevant for managers of high-pressure global projects, e.g., those that are mission critical to a company, time-pressed, and/ or very complex] Invest time upfront to achieve common understanding of the project situation. Pull and push information almost constantly so that everybody knows how things are progressing. Avoid remote contact - invest in face-to-face meetings, preferably at the start of a project. Arrange for direct communications (no liaisons) at least for key personnel at different sites. Assess the impact of time zones. Do people need to adapt working hours, remain on stand-by? Make sure people have contact information so that they know at any moment whom to contact and how.

§ 12.2 Gaps

Gaps refer to the differences and diversity that exist between sites involved in a global project. It can take several forms: geographical distance and governance differences; time zone differences; diversity; and differences of infrastructure. Subsequently we expand on these here.

§ 12.2.1 Geographical Distance and Governance Differences

Geographical distance of people involved in the same project challenges many assumptions underlying the traditional office environment. It cuts out informal conversations, and the easiness of meeting people face-to-face and sharing resources. Related to this is the fact that people work in different organizational units. Or in different firms if a project is (partially) outsourced. Contributors to a project may not fall under the same management structure and have their unique ways of working. Still, someone is responsible for a coherent end result. We assess several topics that help to accomplish this.

§ 12.2.1.1 Face-to-face versus Remote, Electronically Mediated Collaboration

When people work at different sites, they do not see each other. They may see each other during occasional visits, but contacts must rely on electronic media like phone, videoconferencing, email and groupware. This makes cross-site exchanges more rare and task-oriented. People tend to connect for a specific purpose. Electronic media offer limited richness and interactivity. They usually provide only a few modalities of communications (voice with phone or documents with email and groupware). Media require more effort than communicating with someone in the same room. People must convert their message into an email text, they must scan documents, submit these as separate attachments. And with audio/ videoconferencing they must work harder to imagine their counterpart.

One can deal with these issues in several ways. First, face-to-face meetings, perhaps as kick off, help people establish rapport. They can obviate the constraints of geographical dispersion. Second, expect people to update you and their remote counterparts on a regular, frequent basis. Force informal communications by arranging for regular remote conversations (phone or videoconferencing). Expect people to push relevant information to others. Make this as easy and comfortable as possible. Help them develop remote communication skills. They must get more done with less richness and interactivity, e.g., craft comprehensive emails, be as clear as possible. We expand on these skills and attitudes in the next section.

§ 12.2.1.2 Using Electronic Media

Phone and email are probably among the most common electronic media. They must be used with consideration. The phone is great if people know each other and master English. Email allows for broadcasting messages and comprehensive documentation, perhaps in preparation for real-time conversations. It makes it easy to cc people and work across time zones. At the same time, email is a lean medium and asynchronous. It does not convey much about a person’s mood, priorities and expectations. This delays the accomplishment of tasks that are complicated, urgent, or novel to those involved. People must invest effort in explaining a topic, and make explicit what they want another person to contribute.
Audio conferencing is very useful for connecting people at different sites whose input or involvement may be needed. Its effectiveness depends on people’s familiarity with other participants and the topic under consideration. Not too many people can join in one session, this makes it difficult to maintain overview. Videoconferencing infrastructure is not yet widely available with good quality (speed, synchronized signals, picture quality etc). It takes effort beforehand (preparing and sharing documentation), and during a meeting (who talks at what point, what protocol is used).
Ideally, people with tasks that are connected across sites have multi-modal communications. They must be able to talk, share resources, and perhaps see each other, all in one session in with great ease of use and quality. This would mimic the properties of face-to-face contact as closely as possible.

Effective use of electronic media relies on several factors. People rely less on media if they know their counterpart and the task they are working on. They must get used to a more formal communication mode that demands more effort, explicitness, clarity, comprehensiveness and empathy. Enforce regularity of interactions, stress quick response times to requests from remote sites. Expect people to feedback their understanding to avoid misunderstanding. They must communicate proactively - push information to remote peers, hunt for know-how they need to get their job done. Rely on electronic environments like groupware, intranet or web-based services to promote cross-site awareness. Communicate who is responsible for what, who knows what, and how people can be reached. Foster direct contact between people with interdependent tasks, i.e., do not have them go (only) through liaisons. Invest in cross-site visits for early and critical phases of a project, and also when people face a task that is particularly challenging. Do not underestimate dependencies across sites, and task complexity. Check regularly with local and remote staff to get a feel for feasibility.

§ 12.2.1.3 Organizing for Distributed Collaboration

Make an assessment of dependencies in the project as early as possible - they drive collaboration processes. Dependencies could concern knowledge (vendor staff must know requirements, people need to know what their peers do, they must be trained on a novel system or tool), activities (workflows across sites or locally), and resources (people need access to legacy systems, version control issues). Share insight in dependencies; brainstorm on ways to deal with them. Remote dependencies within the same area are usually not really a problem. People on both sides are for instance experts in Finance, so they know each other's background and have shared knowledge. Focus heavily on dependencies that cross not only sites but also expertise areas. It is very difficult for people to work remotely with a counterpart who lives in a different 'thought world' (Dougherty, 1992). They would have to exchange a lot of background information before zooming in on their common task. Invest in face-to-face contact, or route communications through local peers specialized in the same area as the remote counterpart. In other words: a user in Finance at site 1 connects to IT staff at site 2 in one of three ways: (1) face-to-face, (2) through IT at site 1, or (3) through a Finance expert at site 2. The key is that remote contact is as homogeneous as possible, i.e., involving people with the same background.

Be careful with liaisons who funnel communications between sites. It may seem comfortable and 'clean' in that it avoids multiple confusing links across sites. Yet you may become too dependent on their functioning and interpretations. Never use a liaison who is new to people at both sides. He should be part of at least one context. The task may overburden liaisons: it may exceed their capacity and encompass too many different areas of a project. Broaden the liaison role to 2 or more people, and complement it with direct contact. Especially for people with site crossing activities, foster reciprocal visits so that people build rapport instead of communicating always through other persons.

§ 12.2.1.4 Learning, Documentation and Technology: Managing by Representation

After you made an assessment of knowledge needs, develop a training plan. Rely on local resources and documentation. This economizes on visits and remote interpersonal communications. Encourage immersive, on-site training if people really need it. Check how comfortable they are with a new area/ tool/ task. Test them if they have to use a new system.

Reduce dependence on persons. This can be achieved through documentation. Reducing dependence on individuals is important in the case of turn over and in order to economize on cross-site communications. This reduces the impact of time zone differences. Promote explicitness of work processes, expectations and outputs. Implement a common methodology with extensive documentation to promote consistency across sites. Enforce a policy of making knowledge explicit and sharing it through groupware and documentation. Representation of work processes and resources makes it easier to manage and share across sites (Haeckel & Nolan, 1993). It reduces dependence on individuals and (remote) interpersonal exchanges. One important tip, however: do not try to use documentation for dealing with people's fundamental unfamiliarity with project activities. If they do not understand how their job fits in the project, they need rich connections and interpersonal communications. The same applies for cross-functional or cross-specialization dependencies (Electronic) documentation is inappropriate in these circumstances. It only works when people have a common background and firm grasp of the overall project activity context. Typically, start with human-to-human connections, and then move gradually to document enabled contact, i.e., human-to-documentation-to-human.

§ 12.2.1.5 Planning, Managing and Managerial Control

As a manager, keep connecting to people. It is challenging to remain aware of what is going on at different sites. Setup up regular meetings, connect to individuals, visit sites at a regular pace. The more challenging and mission-critical a project is, the closer you must get involved. Leverage on your hierarchical position, a firm's transnational management structure and your relationships. Network extensively to foster connections within the project and with your environment. The latter may include top management, management from other functions and locations, but also customers, and firms providing critical resources like telecommunications, packaged applications, and development tools. Monitor goal incongruence (in outsourcing relationships or across organizational units), and resistance to a new system (users). Handle this on a relational, contractual or hierarchical basis. Backup your local or remote staff to ensure their positive working climate.

People often do not know what to expect. Sell the project to them, plan it as extensively as possible and share that widely. Improve the plan, add details, and promote transparency of what is going on, where people are, and where they are heading.

Control extensively. Do not rely on common sense or single individuals. Instead, get a complete picture. Talk to vendor staff, to their customers, to users, to your boss, others' bosses. Never assume that things will be OK, that 'no news is good news'. Maintain a regular communication pattern within your project and with key stakeholders outside. Do not save on traveling since face-to-face contact and immersion in a local context provides the best information. Promote formal deliverables, standards and checks. Be as explicit as possible on what you expect and how people can accomplish their job. Assign responsibilities formally and check reality against that yardstick. Monitor constantly so that people can never blame you for not being clear or providing the resources they needed.

§ 12.2.1.6 Control

Set up a self-controlling environment. Select people with competence and a professional will to succeed on their own. Control more extensively and formally than in a collocated setting. There is a greater risk of misunderstanding, misalignment and incompatible priorities. Work as much as possible with people you trust and with firms you know. Avoid mismatches between people's experience and the demands of their job. Use a combination of interpersonal rapport, formal hierarchy, and contractual stipulations. Encourage peer control, and self control in local teams. In a collocated group people tend to work more informally. They meet often and know each other well; they are quite well aware of what is going on. Do not try to replicate that to remote contacts. It is usually unfeasible. People need more formal role assignments, more explicit process representations and expectations. Control processes tend to become more formal, based on documentation. Vary control tightness with task criticality, and people's competence and goal congruence. Pay attention to basics like resource ownership, and version control of documents or application builds.

§ 12.2.1.7 Development Methodology

Software development is embedded in a complex relationship between users and IT personnel. These groups have asymmetrical knowledge bases and become mutually dependent. Users know their business environment and to some extent their current system. IT staff brings in technical expertise. Fusing these knowledge domains underpins successful development. Commonly people prefer prototyping over requirements specification. It facilitates interaction with users through multiple feedback sessions. Geographical dispersion may hinder this process. With users at one site and IT somewhere else, people must cross distance and their functional diversity at the same time. This is unfeasible, especially not in early project phases. It is necessary to have IT representatives close to the users. These persons must be well included in their remote IT team to facilitate remote contact.

§ 12.2.2 Time Zone Differences

In a global project, people may work in different time zones. This reduces the period they can work synchronously. People must invest more effort into planning conference calls, especially when more than 2 sites are involved. Time zone differences lead to increased use of asynchronous media like email, fax and voicemail. These media lack richness and interactivity. They require effort in the sense that people must put their thoughts and questions into documented format. If they work on complicated or novel collaborative tasks, this leads to tensions and delays. One email may trigger more questions and a deluge of subsequent messages. Forced asynchronicity of communications is a problem with urgent tasks that demand instantaneous attention from someone at another site.

Handling the impact of time zone differences relies on several approaches. Build in buffers for delays. Usually time zones stretch (remote) problem solving. Reduce dependence on synchronous interpersonal contact. Invest in documentation technologies like groupware and intranet. Learn people to stretch the effectiveness of lean media like email. They must be able to craft comprehensive emails that leave little room for interpretation. Reduce the email snow-balling effect - arrange for a multi-site conference call for issues that need interactive discussions. Check people's willingness to adapt working hours. It enlarges their window with other sites and promotes use of real-time media. One may consider arranging workflows such that they follow the sun. Do not underestimate what it takes to achieve smooth hand-overs. Like with relay-racing, people must be ready for time-pressed transitions. They must understand their local tasks and what remote counterparts do. They must have all required resources available.

§ 12.2.3 Diversity: Differences in Culture, Operations, Function, and Language

Diversity is more likely in a global project and also harder to deal with than locally. It is only a problem when people are interdependent. Understanding dependencies across sites is a prerequisite for dealing with diversity in an effective manner. Diversity is to some extent a knowledge gap. It may take many forms: differences in national culture, organizational culture (practices), cross-functionality, and language. We give suggestions for these areas. A key rule is: make remote contacts as homogeneously as possible. This facilitates dealing with distance and electronic media.

Select and connect people with experience related to their remote counterparts. If someone in India has been to the US, involve him in maintaining contact with American counterparts. Task dependence may require connections between people with different cultural backgrounds. Make a trade-off between the pros and cons of direct communications (i.e., without interpreter in between). On the one hand, people must invest in cross-cultural awareness (without doubt through face-to-face encounters). But this pays off later on: once people have built rapport, they collaborate more effectively. Make these investments for people with prolonged remote contacts that concern mission-critical tasks. Plan for gradually building cross-cultural ties. Realize that connecting two or more sites with different cultures requires local adaptation. On top of their local way of working, people must develop additional skills and attitudes for site-crossing exchanges. Collocated kick off meetings seem indispensable as ice breakers. These should involve at least a few representatives from each site. Think about who adapts to whom. The best thing is that each side gets to know more about the other side. This avoids overtaxing on group.

Bridge cross-functional dependencies on-site. Do not expect people to work with remote counterparts who have different functional backgrounds. Either have them visit each other, or work through local people who speak the language of the remote person.

Operations in site 1 and 2 may differ, perhaps without people being aware of it. Identify these differences - i.e., knowledge gaps - as early as possible. In fact, this must be accomplished through cross-site visits. Diversity and distance bite.

Select and train people with site-crossing responsibilities in such a manner that they master a common language, usually English. Whenever English is a second language for people, they feel less comfortable. Their expression lacks precision and requires more effort. They may prefer written exchanges over oral communications.

§ 12.2.4 Infrastructural Differences

A common and well-connected IT infrastructure is crucial to a multi-site software project. Plan considerable time for identifying gaps. Some firms setup up permanent lease line connections. This eliminates variable costs of calls promotes communications. Check on bandwidth, speed, and quality of telecommunications service. Ensure capacity of lease lines, servers, local computers to handle (large) files, documentation and remote communications traffic. Identify peak hours for cross-site calls, especially with time zone differences. To what extent do people need access to a remote server, and inclusion in a company's telephone system? Sometimes one site must know more about resources at another location. Can they visit? Is simulation possible? Are development tools similar across sites? What purchases are necessary? Invest not only in commonality and compatibility of technology, but also skills. What is the current level of skills and competencies? Where are gaps? Who must be trained on what technology how extensively? Check people's resistance to use novel technology and invest as early as possible in their appreciation of advanced tools.

PART 5 DISCUSSION & CONCLUSION

"Everything should be made as simple as possible, but not simpler." - Albert Einstein

Scholars have found that global distributedness impacts coordination and control modes. In this study we intended to enhance insight in this process. The next chapters discusses our research journey in this light. We then revert to the demarcations of our study and discuss its limitations. The section concludes with suggestions for future research.

Chapter 13 Discussion

The geographical scope of collective human endeavors has expanded over the past centuries. Introduction of advanced traveling and telecommunications technologies have accelerated this process in recent years. Advanced economies rely on workflows, supply chains and projects that span multiple sites. From a business point of view, successful performance of these dispersed structures is a necessity. It defines firms' efficiency and abilities of innovation, and therefore their competitive edge. On an operational level, however, geographical dispersion creates novel challenges. Distance eliminates many of the dynamics of collocation. By creating geographical and time separation, distance creates impediments to communication. Furthermore, people cannot take for granted that their peers, customers or bosses understand their customs and protocols. Dispersion connects a more diverse network of actors. It enforces reconsideration of assumptions; this implies that communications become more elaborate and explicit to complement the limited nature of representations.

We have focused on these challenges in the context of global software projects. These have become one of the most prevalent types of distributed temporary systems. A number of reports have indicated what issues people experience when they make the transition from local towards globally distributed IS projects. ***The objective of this research is to understand the impact of global distributedness on software projects***. Specifically, our research conceives the consequences of global dispersion in terms of its impacts on coordination and control processes in these projects. These processes are considered pivotal to project management. Our initial research questions focus on coordination and control modes. Next, we assess the nature of global dispersion and the way it impacts coordination and control processes in software projects.

Research approach

The empirical problem and research questions drive the design of our inquiry. We combined theory development with empirical research. For both areas and their connection to the overall research questions we adopted methodologies to enhance transparency, traceability and overall coordination.

Theory development concerns the review and integration of current research. We adopted a structured approach that takes into account the current stage of theory development in our topic area and the research objectives.

As an initial step, we traced the history of coordination and control concepts all the way back to the earliest scholars in management to gain an understanding of the area. Results from this undertaking were theoretically integrated with recent lines of thought on coordination and control processes: distributed cognition (Hutchins, 1991), collective mind (Crowston & Kammerer, 1998), semi-structure (Brown & Eisenhardt, 1997) and High Reliability Organizations (Bigley & Roberts, 2001). The structure of this integration process followed a contingency theory thinking approach. It resulted in integrative frameworks for coordination and control modes. Next it linked the two concepts of coordination and control.
As the next step, we explored current research applicable to temporary systems that are polycontextual and geographically distributed. Relying on our knowledge base in coordination and control theory, we framed this review according to the objectives of our study. This second literature review encompassed areas like polycontextuality, electronic media use, groupware and teleworking. Probably for the first time, we analyzed these concepts on an integrative level. We came up with gaps that refine the concept of global distributedness. These include geographical distance, time zone differences, governance differences, cultural diversity and differences in IT infrastructures. We developed an initial version of a conceptual lens. Then, we revisited the literature to analyze the impact of gaps. This literature framing leveraged our first review on coordination and control. It resulted in an initial understanding that became a starting point for empirical work.

Empirical research complemented the theory development work. Using our conceptual lens, we conducted two qualitative case studies on real-life projects. The case studies generated data and insights that confirmed and expanded our initial understanding. We followed Lee's (1991) proposal for combining interpretive and positivist analysis as one of the few empirical studies to date. We devised a method for applying his principles to multiple case studies, thus extending Lee's (1991) approach and literature on cross-case analysis (Miles & Huberman, 1994; Yin, 1994). Our interpretive analysis was strongly driven by qualitative data, similar to our literature reviews and reinterpretation (Meadows, 1996b). At the same time, we kept the overall focus of our study as a guideline.

An integrative chapter connected results from the case studies with our theory development work. This revealed extensions to our initial understanding. We finally translated the results from our study into practitioner-oriented prescriptions, one of the target audiences of this work.

Findings

This research study delivered results that contribute to our objective. On the one hand, we found with our conceptual lens that gaps have multiple ways of impacting coordination and control processes. On the other hand, the study revealed new themes that extend our initial understanding as summarized in Figure 69. Both categories of findings are discussed here.

Impact of gaps

Our study assessed how the gaps (distance, time zone differences, cultural differences, governance gaps, and infrastructural differences) change collaboration patterns. First, we found that geographical distance separates people and cuts out informal exchanges. Connection and reciprocal awareness come less naturally. Electronic tools provide a linkage for transmitting representations of reality. But mediated communications require more effort and lack the richness, multi-modality and interaction of face-to-face meetings. These still remain important for building relationships and understanding of a collective task, especially when it is a novel task like requirements analysis. The success of remote contact depends on people's proactive attitude and regular contact patterns. Explicit (documented) communications on expectations and actions compensate for limited interpersonal exchanges. People's prior relationship and common knowledge base enrich electronic contact.

We connected the governance gap to distance since their impacts appeared closely related. Remote collaboration across organizational boundaries adds to the complexity of dispersed projects. Each organization brings its unique set of expectations and way of working. This requires additional bridging effort. The risk is that teams on both sides are minimally connected, and fail to bridge their diverse thought worlds. Under these conditions, trying to accomplish challenging collective activities reflects unawareness of underlying coordination problems, and appears a recipe for failure.

People prefer communications with remote counterparts to have a similar background, vocabulary, and training. This ameliorates problems associated with remote contact. As a consequence, cross-functional dependencies require similar functional variety at the dispersed sites. People connect within their relatively homogeneous dispersed functional community, while solving cross-functional issues locally. Sometimes, people try to connect a polycontextual project through liaisons. This increases project risk since it depends on the functioning of one or a few pivotal individuals. These linking pins often add little value to a project, and are likely to become bottlenecks.

Remoteness enhances the need for explicit awareness of knowledge and information dependence. This appears a novel area in coordination theory. These dependencies could be like agency relationships between the users and developers in IS development. Or, they could be a form of pooled dependence on standardized knowledge applicable to multiple cloned implementations of a standardized IS like ERP. Moreover, there could be sequential and incremental development and flow of these pooled standards between subsequent implementations. Knowledge transfer is achieved by a mixture of impersonal digital boundary objects (requirements documentation, implementation standards and procedures), and personal contact. It is beneficial for contacts across sites to be as direct and homogeneous as possible. Directness is especially vital for transferring novel insights, like at the start of a project. Homogeneity means leveraging on a common base of expertise, e.g., a key user in Finance at one site connects to someone with the same role in a different place. Turnover or late involvement of people undermines a shared cognitive infrastructure, despite impersonal boundary objects.

Distance changes managerial processes of communicating, planning and controlling. Managers maintain a regular pace of contact with remote subordinates, contributors and stakeholders. They avoid an 'out of sight, out of mind' situation where they lack insight in progress at remote sites. It appears unfeasible to micro-manage subordinates on a distance. Instead, managers build relationships through visits. They reduce uncertainty in their dispersed project by sustaining multiple contact linkages and outlining plans that are as comprehensive as possible. They use a multinational's hierarchy to exert local control. In the case of outsourcing, relationships between executives foster remote collaboration on an operational level.

Control processes in a distributed project rely strongly on an individual's local responsibility. Selection and pre-project socialization thus become essential. It appears challenging to monitor progress at a remote site since communications are less intense. A shift occurs towards a more formalized way of working where people share detailed activity outlines. This facilitates comparison with actual progress. IS support this control mode in the form of workflow systems and groupware. If need be, a multinational's hierarchical structure compensates for a manager's loss of cross-site controls. Control in remote outsourcing relationships requires more explicitness and formalization than collocated projects. Frequently, eager vendors sign incomplete contracts for complex IS projects. Their underestimation leads to situations that lack both task clarity and relationships across firms (Ouchi & Johnson, 1978). These projects are characterized by conflicts, delays, budget overruns and (expensive) ad hoc measures.

With respect to application development, distance complicates the use of prototyping. This approach centers on interaction between developers and users. In a dispersed project, these groups cannot meet frequently and they miss rich face-to-face discussions. Liaisons between the vendor team and users further constrain inter-group exchanges. Lack of knowledge transfer and mind melting have a negative impact on the quality and timeliness of system development. Consequently, development and implementation methodologies take on a pivotal role in dispersed projects. They provide structure in a setting that lacks communication opportunities available to collocated projects. Additionally, mediating technologies like intranet and groupware push the same information to scattered team members.

Second, time zone differences force a shift towards asynchronous communications media like email and vmail. This conflicts with situations that demand urgent attention or increased information processing (like novel tasks, diversity, and intense task dependencies). In the latter case, asynchronous media often lead to endless chains of messages with requests for clarification. This causes considerable delays and tensions. People respond by adapting their working hours, or communicating in a more formalized, comprehensive manner to avoid feedback questions.

Third, our empirical work suggests that the impact of diversity is not limited to cultural differences. Other forms include differences in operations (R&D versus mass volume manufacturing), function (IT versus various user departments), and language (English versus localized versions of English or other languages like Chinese and Japanese). We elaborate here on these forms of diversity.
People bridged cultural differences by adding an adaptive layer to their unique local way of working. This process benefited from international experience, and working locally with expatriate managers. First time connections across cultural gaps require collocated meetings as ice breakers. An alternative is to rely on liaisons to connect culturally diverse groups. This seems convenient but it limits inter-group relationship building and information processing capacity.

Operational differences cause misunderstanding on both sides, and make lessons learnt at one location less relevant for others. Extensive communications are required to clarify different viewpoints and enhance local heedfulness to operations at another site. People adapt their local way of working or develop a hybrid mode of operations. These efforts delay projects, especially when people face time zone differences and (have to) use asynchronous media.
Cross-functional communication appears challenging on a distance. Connecting different thought worlds requires elaborate explanations that would benefit from face-to-face discussions. In order to avoid remote contacts across functions, connections were established between people with similar roles (IT - IT, inventory - inventory). Requests that involve another function are either solved locally, or through homogeneous connections across sites. This leverages common knowledge bases on both sides and simplifies remote contact.

English seems to emerge as a world language, and individuals' proficiency in this area has become a selection criterion for global projects. For many, however, communicating in English remains challenging. They do not catch nuances and jokes, and are not comfortable with oral exchanges (especially with bad telephone connections). These people prefer documented exchanges (email) instead of phone calls. Such adaptations make remote contact less efficient and effective.

Fourth, global projects would be unfeasible without technologies that move people and physical resources, or information (air travel and IT). In terms of the last category, people suffered from incompatibility of IT resources (different development tools), absence of IT resources at some sites, and slow or low quality remote connections (server access, telephone lines to some countries). This constrained remote collaboration and delayed projects. Upfront investment in commonality and appropriate infrastructures is required. Technology should become a reliable resource that underpins seamless interactions and enables people to focus on the job at hand.

Additional findings
In addition to the impact of gaps, we found other themes that help us understand coordination and control of global software projects. First, the very nature of projects implies that tasks are novel and incompletely understood. People's perception of their collective task and the impact of gaps often does not map to the enfolding reality of a project. This gap between perception and 'realism' often takes the form of underestimation of task complexity, intricacy of technology, and challenges of interpersonal collaboration. Underestimation leads to a project setup that does not do justice to the complexity of distributed collaboration. People experience tensions of unfeasible work demands. Eventually, those responsible for the project must adjust their thinking to the reality of a project. This adaptation process includes ad hoc measures. It complicates and delays a project. Looking back, people prefer realism and comprehensive plans as early in the project as possible. This reduces distributed information processing and adaptation needs.

Second, just looking at a project does not reveal its problems in sufficient detail. People mentioned the importance of what we refer to as ex ante coordination and control mechanisms. They emphasized the importance of ex ante global IT infrastructures, knowledge of project-related topics, interpersonal contacts, and international experience from earlier projects. Lack of ex ante mechanisms occurs when teams within a multinational organization connect for the first time, or companies outsource to a novel partner. In these cases, the initial project phase requires extensive investments in coordination and control mechanisms before the 'real' project work can start. Failure to do so (possibly caused by underestimating the impact and severity of the gaps), spreads out these costs over subsequent project phases. This may cause mismatch of expectations, and result in tensions and delays.

A final new finding was the role of task urgency and criticality. Global IT projects play a vital role in today's business strategy.[74] This translates into strong pressure on the work floor level to deliver, and leads to several adaptation patterns in global projects to deal with tensions. Management monitors more closely daily or weekly progress. They cannot afford to delegate this involvement. Project members work more proactively. They keep each other informed on their activity schedules to economize collaboration processes. People use more interactive, richer media to solve problems in a short time span. They connect more directly to circumvent dependence on liaisons or hierarchical layers.

Contributions

These findings answer our research questions and bear relevance to practitioners and academics. We translated these findings into prescriptions for the first group. These provide them with a resource that extends existing resources. We assume that our study is more comprehensive, better structured, and more theory-informed than others' work so far. The quality of the underlying research work ensures insights that connect professionals' struggles with global software projects with state-of-the art academic thinking. Out of this symbiosis, we hope that insights and recommendations emerge with that offer sustainable usefulness.

Our contribution to the academic community takes several forms. First, we integrated coordination and control theory as separate fields of study, and moved on by integrating the two. We looked at contributions in organization sciences over the past century and identified four categories of coordination mechanisms: work-based coordination, coordination by organization design, inter-personal coordination, and technology-based coordination. A matrix was developed for identifying control mechanisms. Its first dimension is controllers, including hierarchical supervision, co-workers (clan), technology, self, contractual party, and third party. The second dimension concerns the object of control processes, i.e., input, transformation process, and outputs.

Coordination and control processes are closely intertwined. For instance, coordinating plans and procedures support control in the form of comparing actual accomplishments with those intended. Another link between the two constructs is the existence of contingencies that drive coordination and control modes. Our literature study identified the following ones: interdependence, uncertainty, observability, complexity, work unit size,

[74] A unique example was the Y2K problem.

and functional diversity. For each of these, we outlined their impact on coordination and control processes. Scholars working on coordination and control problems may benefit from this work.
Second, this contribution drove one of the most comprehensive literature studies to date on polycontextual, distributed collaboration. The second literature study maps this field for investigators and resulted in a summarizing conceptual lens. We propose gaps that exist between sites involved in a joint project, and affect collaborative processes. These are geographical distance, governance differences, time zone differences, cultural diversity, and infrastructural differences. Third, we conducted two in-depth qualitative case studies on global software projects. This is an important contribution to a field that has relied mostly on experiments, dispersed student projects, and research that is based on interviews with a few individuals in multiple companies.
Fourth, the case studies are one of the few that combine interpretive with positivist approaches, as proposed by Lee (1991).
Finally, our integrative analysis extends knowledge of coordination and control processes in dispersed software projects. We wanted to understand the impact of global distributedness on coordination and control processes.

Researchers in the area of global software projects and adjacent fields can use these results as a starting point for further inquiry.

Chapter 14 Limitations and Future Research

Like any research and human endeavor, our work has its limitations. These are discussed here and translated into opportunities for future research. The section is structured around the main dimensions of our study - its scope, theoretical basis, and empirical research methodology.

Scope

This research focused on temporary as main unit of analysis. It did not pay attention to more fine grained or larger scale phenomena. Future research could expand on individuals' experience in dispersed work environments, or interpersonal relationships and the functioning of dispersed groups. Other options include investigation of workflows, processes and supply chains without temporal constraints.

This research focuses on projects in the late 1990s. Anything before or after that time is not included and offers opportunities for inquiry. We looked at projects that were characterized by geographical dispersion and time zone differences. Others could exclude the time zone aspect by focusing on north-south dispersion (i.e., sites in North and South American in the same zone, or Africa and Europe).

We looked at real-life software projects in a business context. This excludes those in other business sectors and industries, and also projects in a military or nonprofit environment. Real-life means that we did not conduct experiments, or worked on simulations like distributed virtual environments.

Within our parameters we zoomed in on coordination and control processes. This perspective is multidisciplinary. It blends research from fields like economics, sociology, psychology, organization science, management of technology, and information systems research. An implication of this approach is that we cannot expand on a single discipline. The study leaves much work to be done for researchers within these areas. For instance, sociological research on dispersed groups, psychological studies on interpersonal relationships with minimal face-to-face contact, and research on communications and media use.

Theory

Our content focus on coordination and control suggested a number of research streams that were relevant to our research objectives. We refined our initial selection based on early empirical work. We also emphasized some degree of commonality across the approaches. That is, similarity of constructs and outlook in order to avoid a too diverse and unrelated base.

Within the broad contours of coordination and control, future research could rely on a subset of our theory selection, or adopt other theories. For instance, exchange theory, activity theory, network theory, work in the area of human computer interactions, and human factors research. Other researchers may want to explore new venues that are more technical (Dertouzos, 1999), operational or philosophical. Anthropological and cross-cultural angles could contribute to our understanding of how people with diverse backgrounds adapt in dispersed work environments. Communication and cognitive approaches could reveal the role of meaning, representation and inclusion.

Empirical research methodology

A third area of limitation and opportunity concerns empirical research. Our qualitative investigation of two case studies has its flaws. We could not immerse ourselves for months in these environments to enhance our insights in the contexts. We could not collect an infinite amount of documentation or conduct multiple interviews over prolonged periods of time. We faced constraints related to resources and the geographical dispersion of our research object.

The cases' description is limited, it serves mainly to fuel theory development. Other researchers may like more substance there, or conversely prefer a more positivist approach. Case studies enable replication logic as a form of generalization. More case studies would have contributed to this notion.

Our unit of analysis was the temporary system. As indicated, one could choose a more detailed framing (e.g., individuals, relationships, what happens at a single site), or explore topics that are external to a project, like how it relates to an organizational context and business environment (Ancona, 1992).

The empirical of our research relied on extensive theoretical baggage. This may have biased the researcher during data collection and analysis. Certainly, very interesting opportunities exist for grounded theory approaches.

Our focus on coordination and control appeared quite inclusive. The constructs invited a broad perspective on how people collaborate, manage and communicate. We maintained this scope for its internal coherence, and the chances of collecting interesting data. Future research could zoom in on sub-dimensions, like only communications or only managerial relationships.

The temporal perspective of our work was retrospective and longitudinal where possible (CarCo case). Data collection for the DiskCo case was compressed to a 2 weeks period. For CarCo the author visited one site, but worked with an onsite participant-observer.

Sites from our cases were located in North America, Europe, India and the Pacific region. Future research should extend this to regions like South America, Africa, and Eastern Europe.

Finally, the case study methodology advances theory in a front-runner role (Eisenhardt, 1989b). It offers opportunities for describing, exploring and explaining. At the same time, the methodology lacks some of the qualities of alternative approaches. Case studies in organization science do not match the intricate immersion in research sites that is common to ethnographic approaches. Case researchers cannot control their research object in the sense of an experimental setup. Unlike survey research, case studies cannot be statistically generalized to a larger population. In short, future research can conduct more extensive case study research, and complement that with alternative empirical methodologies. This is indispensable for advancing our understanding of geographically dispersed collective action. Our study is merely a link in an ongoing process of understanding and managing collective action that includes people from across the globe. Their positive and productive collaboration is what ultimately counts.

EXECUTIVE SUMMARY

The geographical scope of collective human endeavors has expanded over the past centuries. Introduction of advanced traveling and telecommunications technologies have accelerated this process in recent years. Today's technologically advanced economies rely on workflows, supply chains and projects that span multiple sites. From a strategic point of view, successful performance of these dispersed structures is a necessity. It defines firms' efficiency and innovativeness, and therefore their competitive edge. On an operational level, however, geographical dispersion creates novel challenges. Distance eliminates many of the dynamics of collocation. By creating geographical and time separation, it creates impediments to communication. People rely on technology to mediate representations. Furthermore, they cannot take for granted that their peers, customers or bosses understand customs and protocols that are specific to a local site or organization. Dispersion thus connects a more diverse network of actors. It enforces reconsideration of assumptions.

We have focused on these challenges in the context of global software projects. These have become one of the most prevalent types of distributed temporary systems. Numerous reports have surfaced issues people experience when making the transition from local towards globally distributed IS projects. Our objective is to better understand the impact of global distributedness on software projects. Specifically, our research conceives the consequences of global dispersion in terms of its impacts on coordination and control processes in these projects. These processes are considered pivotal to project management. Our initial research questions focus on coordination and control modes. Next, we assess the nature of global dispersion and the way it impacts coordination and control processes in software projects.

Research approach

The empirical problem and research questions drive the design of our inquiry. We combined theory development with empirical research. For both areas and their connection to the overall research questions we adopted methodologies to enhance transparency, traceability and overall coordination.

Theory development concerns the review and integration of current research. We adopted a structured approach that takes into account the current stage of theory development in our topic area and the research objectives.

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Empirical research complemented the theory development work. Using our conceptual lens, we conducted two qualitative case studies on real-life projects. The case studies generated data and insights that confirmed and expanded our initial understanding. We followed Lee's (1991) proposal for combining interpretive and positivist analysis as one of the few empirical studies to date. We devised a method for applying his principles to multiple case studies, thus extending Lee's (1991) approach and literature on cross-case analysis (Miles & Huberman, 1994; Yin, 1994). Our interpretive analysis was strongly driven by qualitative data, similar to our literature reviews and reinterpretation (Meadows, 1996b). At the same time, we kept the overall focus of our study as a guideline.

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Findings

This research study delivered results that contribute to our objective. On the one hand, we found with our conceptual lens that gaps have multiple ways of impacting coordination and control processes. On the other hand, the study revealed new themes that extend our initial understanding. Both categories of findings are discussed here.

- *Impact of gaps*

Our study assessed how the gaps change collaboration patterns. First, we found that geographical distance separates people and cuts out informal exchanges. Connection and reciprocal awareness come less naturally. Electronic tools provide a linkage for transmitting representations of reality. But mediated communications require more effort and lack the richness, multi-modality and interactivity of face-to-face meetings. These still remain important for building relationships and understanding of a collective task, especially when it is a novel task like requirements analysis. The success of remote contact depends on people's proactive attitude and regular contact patterns. Explicit (documented) communications on expectations and actions compensate for limited interpersonal exchanges. People's prior relationship and common knowledge base enrich electronic contact.

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People prefer communications with remote counterparts having a similar background, vocabulary, and training. This ameliorates problems associated with remote contact. As a consequence, cross-functional dependencies require similar functional variety at the dispersed sites. People connect within their relatively homogeneous dispersed functional community, while solving cross-functional issues locally. Sometimes, people try to connect a polycontextual project through liaisons. This increases project risk since it depends on the functioning of one or a few pivotal individuals. These linking pins often add little value to a project, and are likely to become bottlenecks.

Remoteness enhances the need for explicit awareness of knowledge and information dependence. These dependencies could be like agency relationships between the users and developers in IS development. Or, they could be a form of pooled dependence on standardized knowledge applicable to multiple cloned implementations of a standardized IS like ERP.

Distance changes managerial processes of communicating, planning and controlling. Managers maintain a regular pace of contact with remote subordinates, contributors and stakeholders. Micro-managing on a distance appears unfeasible. Instead, managers build relationships through visits. They reduce uncertainty in their dispersed project by sustaining multiple linkages and outlining plans that are as comprehensive as possible. They use a multinational's hierarchy to exert local control. In the case of outsourcing, relationships between executives foster remote collaboration on an operational level.

Control processes in a distributed project rely strongly on individual's local responsibility. Selection and pre-project socialization thus become essential. It appears challenging to monitor progress at a remote site since communications are less intense. A shift occurs towards a more formalized way of working where people share detailed activity outlines. IS support this control mode in the form of workflow systems and groupware. Control in remote outsourcing relationships requires more explicitness and formalization than collocated projects. Often, eager vendors sign incomplete contracts for complex IS projects. Their underestimation leads to situations that lack both task clarity and relationships across firms (Ouchi & Johnson, 1978). These projects are characterized by conflicts, delays, budget overruns and (expensive) ad hoc measures.

With respect to application development, distance complicates the use of prototyping. This approach centers on interaction between developers and users. In a dispersed project, these groups cannot meet frequently and they miss rich face-to-face discussions. Liaisons between the vendor team and users further constrain inter-group exchanges. Lack of knowledge transfer and mind melting have a negative impact on the quality and timeliness of system development. Consequently, development and implementation methodologies take on a pivotal role in dispersed projects.

Second, time zone differences force a shift towards asynchronous communications media like email and vmail. This conflicts with situations that demand urgent attention or increased information processing (like novel tasks, diversity, and intense task dependencies). In the latter case, asynchronous media often lead to endless chains of messages with requests for clarification. This causes considerable delays and tensions. People respond by adapting their working hours, or communicating in a more formalized, comprehensive manner to avoid feedback questions.

Third, our empirical work suggests that the impact of diversity is not limited to cultural differences. Other forms include differences in operations (R&D versus mass volume manufacturing), function (IT versus various user departments), and language (English versus localized versions of English or other languages like Chinese and Japanese). We elaborate here on these forms of diversity.
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Fourth, global projects would not be feasible without technologies that move people and physical resources, or information (air travel and IT). In terms of the last category, people suffered from incompatibility of IT resources (different development tools), absence of IT resources at some sites, and slow or low quality remote connections (server access, telephone lines to some countries). This constrained remote collaboration and delayed projects. Upfront investment in commonality and appropriate infrastructures is required. Technology should become a reliable resource that underpins seamless interactions and enables people to focus on the job at hand.

- *Additional findings*

In addition to the impact of gaps, we found other themes that help us understand coordination and control of global software projects. First, the very nature of projects implies that tasks are novel and incompletely understood. People's perception of their collective task and the impact of gaps often does not map to the enfolding reality of a project. This gap between perception and 'realism' often takes the form of underestimation of task complexity, intricacy of technology, and challenges of interpersonal collaboration. Underestimation leads to a project setup that does not do justice to the complexity of distributed collaboration. People experience tensions of unfeasible work demands. Eventually, those responsible for the project must adjust their thinking to the reality of a project. This adaptation process includes ad hoc measures. It complicates and delays a project. Looking back, people prefer realism and comprehensive plans as early in the project as possible. This reduces distributed information processing and adaptation needs.

Second, just looking at a project does not reveal its problems in sufficient detail. People mentioned the importance of what we refer to as ex ante coordination and control mechanisms. They emphasized the importance of ex ante global IT infrastructures, knowledge of project-related topics, interpersonal contacts, and international experience from earlier projects. Lack of ex ante mechanisms occurs when teams within a multinational organization connect for the first time, or companies outsource to a novel partner. In these cases, the initial project phase requires extensive investments in coordination and control mechanisms before the 'real' project work can start. Failure to do so (possibly caused by underestimating the impact and severity of the gaps), spreads out these costs over subsequent project phases. This may cause mismatch of expectations, and result in tensions and delays.

A final new finding was the role of task urgency and criticality. Global IT projects play a vital role in today's business strategy. This translates into strong pressure on the work floor level to deliver, and leads to several adaptation patterns in global projects to deal with tensions. Management monitors more closely daily or weekly progress. They cannot afford to delegate this involvement. Project members work more proactively. They keep each other informed on their activity schedules to economize collaboration processes. People use more interactive, richer media to solve problems in a short time span. They connect more directly to circumvent dependence on liaisons or hierarchical layers.

Contributions

These findings answer our research questions and bear relevance to practitioners and academics. We translated these findings into prescriptions for the first group. These provide them with a resource that extends existing resources.

Our contribution to the academic community takes several forms. First, we integrated coordination and control theory as separate fields of study, and moved on by integrating the two.
Second, this contribution drove one of the most comprehensive literature studies to date on polycontextual, distributed collaboration. The second literature study maps this field for investigators and resulted in a summarizing conceptual lens.

Third, we conducted two in-depth qualitative case studies on global software projects. This is an important contribution to a field that has relied mostly on experiments, dispersed student projects, and research that is based on interviews with a few individuals in multiple companies.
Fourth, the case studies are one of the few that combine interpretive with positivist approaches, as proposed by Lee (1991).
Finally, our integrative analysis extends knowledge of coordination and control processes in dispersed software projects. We wanted to understand the impact of global distributedness on coordination and control processes.

Researchers in the area of global software projects and adjacent fields can use these results as a starting point for further inquiry.

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CURRICULUM VITAE

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Selected publications:

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SAMENVATTING (SUMMARY IN DUTCH)

Innovatie op technologisch terrein heeft de scope van intermenselijke samenwerkingsverbanden verbreed, met name vanaf begin jaren 1990. Bedrijven zijn in staat processen en projecten te organiseren waaraan mensen deelnemen vanuit meerdere locaties. Tegelijkertijd is na de initiële euforie duidelijk geworden dat de beschikbaarheid van geavanceerde informatie technologie (IT) nog niet betekent dat geografisch verspreide samenwerking succesvol verloopt. Mensen van verschillende locaties hebben vaak een minder gemeenschappelijke achtergrond in termen van cultuur, opleiding, ervaring, manier van werken en belevingswereld. Dit bemoeilijkt samenwerking, zeker als het om technologisch en/ of cognitief complex werk gaat.
Wij hebben ons op deze problematiek gericht in het kader van internationaal verspreide software projecten. Dat wil zeggen projecten waarbij locaties in bijvoorbeeld Noord Amerika, West Europa en Zuidoost Azië betrokken zijn. Met name midden jaren 1990 werden een groot aantal van dergelijke projecten opgestart voor het jaar 200 probleem, Enterprise Resource Planning (ERP) software implementaties en wat later *electronic commerce* projecten. Ons doel was om beter te begrijpen hoe coördinatie en controle processen beïnvloed worden door internationale verspreiding. Deze processen worden doorgaans van fundamenteel belang geacht voor samenwerking in projectverband. Een beter inzicht in deze problematiek wordt geacht te leiden tot meer succes bij het managen van internationale software projecten.
Voor dit onderzoek zijn een aantal stappen gezet. Allereerst is uitgebreid gekeken naar organisatiekundige literatuur over coördinatie en controle. Een tweede literatuur onderzoek bouwde hierop voort en concentreerde zich meer specifiek op verspreide samenwerking in brede zin - telewerken, regionaal verspreide projecten, en internationale (software) projecten. De bevindingen van deze fase leidde tot een definitie van internationale verspreiding waarbij 5 'gaps' werden onderscheiden: (1) afstand, (2) tijdzone verschillen, en diversiteit van (3) cultuur, (4) organisatievorm, en (5) infrastructuur. Daarnaast werd in een onderzoeksmodel samengevat op wat voor manier project coördinatie en controle processen veranderen ten gevolge van deze gaps. Dit onderzoeksmodel werd toegepast op een tweetal cases. Met een kwalitatieve onderzoeksopzet onderzochten wij hoe mensen in de praktijk internationale samenwerking in software projecten ervaren. Het eerste project betreft de implementatie van ERP in een aantal vestigingen in de Zuidoost Aziatische regio van een internationaal opslagmedia bedrijf. Bij de tweede case werd software ontwikkeld in India voor de Noord-Amerikaanse en Europese vestigingen van een multinationale autoproducent.

Het bleek dat de 'gaps' op een aantal manieren de wijze van coördinatie en controle in dergelijke projecten beïnvloeden. (1) Afstand maakt het voor mensen lastiger om up-to-date te blijven over voortgang op andere locaties. Aangezien project deelnemers niet op een makkelijke manier frequent bij kunnen praten (het koffie- of kopieerapparaat effect), moeten zij bewuster investeren in contacten met mensen op andere locaties. Dit geldt des te sterker als mensen nog nooit met elkaar hebben samengewerkt en als hun achtergronden verschillend zijn. (2) Tijd zone verschillen zorgen ervoor dat meer asynchrone media worden gebruikt zoals electronic mail en voice mail. Dit werkt vertragend op project voortgang als mensen nieuwe of moeilijke problemen moeten oplossen tussen de verschillende locaties. (3) Uit de cases bleek dat diversiteit niet alleen op cultureel vlak een rol speelt, maar ook in de zin van taal verschillen, manieren van werken, en functionele achtergrond van project deelnemers (bijvoorbeeld de gebruikers versus IT). Diversiteit intensiveert met name de initiële fase van verspreide projecten. Organisaties moeten investeren in kennis van en begrip voor de 'anderen' die ook nog eens elders werken. Dit vergt een geleidelijke project opbouw om te voorkomen dat wederzijds onbegrip blijft en conflicten ontstaan. (4) Organisaties die over afstand samenwerken opereren vaak op een verschillende manier. Dit geldt met name voor outsourcing naar bijvoorbeeld een 'offshore' partner in landen als India, Filippijnen en China. Voor project managers is het belangrijk goede contacten op te bouwen en in een zo vroeg mogelijk stadium afspraken te maken over de inrichting van de project organisatie. Contacten op een 'werkvloer' niveau moeten expliciet worden opgezet zodat mensen over afstand de weg kunnen vinden bij de partner organisatie. Een alternatief is om een liaison/ verbindingspersoon in te zetten die contacten tussen locaties verzorgt. Dit lijkt samenwerking te vergemakkelijken maar maakt tegelijkertijd interlokale samenwerking sterk afhankelijk van individuele competenties en capaciteiten. Dat laatste kan vertragend werken. (5) Verspreide projecten zijn kritiek afhankelijk van IT infrastructuur met voldoende snelheid, beschikbaarheid, homogeniteit, gevarieerdheid en capaciteit. Problemen waar organisaties mee kampen is dat verbindingen niet snel genoeg zijn. Ook kunnen er verschillen optreden tussen de IT omgevingen per project locatie in termen van beschikbaarheid, typen resources, capaciteit en standaarden. Deze factoren zorgen voor vertraging en irritatie.

Naast deze bevindingen bleken een aantal gerelateerd thema's te spelen. In de eerste plaats onderschatten mensen een aantal vitale project dimensies zoals taak complexiteit en afhankelijkheden van activiteiten. Dat betekent dat de inrichting van een project onrealistisch wordt: men is zich niet bewust van coördinatie en controle manieren die benodigd zijn in een bepaalde situatie. Later moet dan worden bijgestuurd waardoor vertraging optreedt.

Ten tweede bleken *ex ante* coördinatie en controle manieren van groot belang te zijn. Verspreide coördinatie en controle worden vergemakkelijkt als mensen al hebben samengewerkt bij eerdere gelegenheden, of relevante en vergelijkbare ervaring hebben. Bijvoorbeeld iemand uit India die al projecten in de Verenigde Staten heeft uitgevoerd vindt het makkelijker om vervolgens een nieuw project vanuit India met andere Amerikaanse klanten te doen.

In de derde plaats blijkt dat de tijdsdruk op projecten invloed uitoefent op de manier waarop coördinatie en controle plaatsvindt. Hoe urgenter en meer kritiek een project (fase) is, hoe meer medewerkers en management de nadruk moeten leggen op snelle respons tijd en grote betrokkenheid bij de relatie tussen hun werk en andermans activiteiten. Dit patroon wordt versterkt in internationaal verspreide projecten.

Het onderzoek vertaalt inzichten op de genoemde terreinen naar aanbevelingen voor de praktijk, en sluit af met beperkingen en mogelijkheden voor vervolg onderzoek.

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ABOUT THE COVER

The front cover features a picture of the ‘Circle of Peace’, a sculpture by Gary Lee Price. Here is what inspired this piece of art:

“My sculpture ‘Circle of Peace’ is a symbol and a participatory teaching aid for life. Let me explain why.

I recently watched an interview on television with a former white supremacist. At age eighteen he was imprisoned because of his violent anti-racial acts. The interview got extremely interesting as he recounted his reformation while in prison.

He said that prior to his sentence he vehemently avoided other races. They were to be hated, abhorred and despised. Overnight he was placed in an environment where interaction with all of mankind was a welcome experience to solitary confinement. Play was introduced in the form of team sports. Relationships developed, bias subsided and upon release from prison he was free from the prejudices and bondage that had tied his hands and soul. Today he takes a radical stand against his sordid past by speaking out in public forums exposing the violence and thought processes of hate groups. Today he coaches youth hockey to multi-cultural kids.

The story is fascinating to me. The prejudice could only occur when there was no interaction. When the associations occurred the barriers went down and friendships happened.

To me, that’s what this piece represents. I feel comfortable naming this sculpture “Circle of Peace” for it depicts children from all walks of life playing and enjoying each other. The circle that the children form represents the continuum of humanity. The clasped hands represent the interaction and cooperation that engender a humanity full of compassion and respect. Respect for each others uniqueness and compassion that bridges the gap between any indifference. You’ll notice I created a space in the circle. It’s fascinating to watch children interact with the piece. The second they notice the gap they automatically clasp the two out-stretched hands and complete the circle! Exactly so! Each and every child is a vital link in this wonderful circle of life we call humanity!”

- Gary Lee Price

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Design: B&T Ontwerp en advies, Rotterdam, The Netherlands, and the author

In the context of our research, Gary’s sculpture symbolizes the importance of bringing together people from diverse backgrounds. Connecting them in global projects cements relationships across geographical and cultural barriers. This process is supported and accelerated by widespread availability of information technology and traveling infrastructures.

At the same time, we need to realize how difficult and vulnerable global connectivity remains. The sculpture symbolizes this too.

Physical dispersion implies that people live in different contexts, i.e., a multi- or polycontextual work environment. They exchange less richly and interactively than in a collocated situation (without idealizing the latter).

Resources and know-how remain locally unless they are shared in a proactive manner. In this process, people engage in mediated collaborative patterns in which representations take on a pivotal role. People connect mainly through representations and mediation. Technology takes on a central role in this collaborative processes.

The nature of representations and mediation means that people run the risk of connecting in a different mode, possibly less frequently and more superficially. They engage in temporary interaction patterns that run the risk of lacking depth and meaning.

From a pragmatic angle, this has the potential of constraining the type and level of collective, purposeful action required in advanced economic systems.

To make global collaboration succeed, we therefore need to know more precisely how global distributedness impacts important organizational processes like coordination and control. We then must find ways to handle these challenges and adapt. This research contributes to that goal.

- Paul C. van Fenema
Rotterdam, The Netherlands

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Coordination and Control of Globally Distributed Software Projects

Recently, software development and implementation projects have globalized at a rapid pace. Companies in North America, Europe, and the Far East are beginning to integrate international IT to support operations across the globe. Offshore outsourcing of IT services has become a prevalent strategy to tap into emerging resource bases of countries like India, Phillipines, Eastern Europe. However, global distributedness has introduced a number of gaps: distance, time zone difference, socio-cultural diversity, differences of infrastructure, and governance differences. These gaps create challenges for the way software projects are coordinated and controlled. This research investigates the impact of gaps on coordination and control modes. It develops these ideas through an extensive theoretical basis and two qualitative case studies to further our understanding of globally distributed software projects, and extend our capability to manage these.

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