IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

Business & Management Section

PROCESS STUDY OF A COMPLEX TECHNOLOGY TRANSFER AND INTEGRATION:

THE CASE OF DIGITAL INTERACTIVE BROADCAST MEDIA

By

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ABSTRACT

Technology transfer has received a great deal of research interest in the field of Strategic Management as a means for achieving competitive advantage. The study emphasis however has tended to be a-processual in trying to understand organisational performance differences, with an underlying assumption that process is constant. When processual view has been taken the studies have been based in relatively simple settings. This research was concerned to understand how the process of technology transfer and integration developed in a high complexity setting. High complexity was considered particularly relevant given an increasing shift towards this form of organising and substantial organisational interest to engage in these arrangements for strategic advantage.

This research contributes to the technology transfer literature in the field of strategic management in two ways: First, it takes a dynamic process view of technology transfer and second, it extends a dynamic process theory of Learning and Mutual Adjustments to a high complexity collaborative technology transfer setting. High complexity was contributed by a multi-organisation set with complex interdependent technologies, diverse organisational forms from various nation states, organised as a dispersed or virtual team, engaged to jointly create knowledge in an 'emerging' industry context. This single case study design consisted of a qualitative, longitudinal, fine-grained processual study that relied principally on documentary method to understand how the social process of technology transfer and knowledge creation unfolded and how change outcomes developed. By combining a deductive-inductive research approach, the starting dynamic process theory was enriched by synthesising it with important concepts from the Communities of Practice literature stream.

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What we observe is not nature itself,

but nature exposed to our method of questioning

Werner Heisenberg (1958)

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SETTING THE SCENE

CHAPTER 1

SETTING THE RESEARCH SCENE

> *Collaborations are complicated relationships that can be nuanced, intense, glorious, illicit, imbalanced, unrecognised, unrecognisable, titillating and tiresome. The nature of a particular collaboration depends on the task and the goal, the parties involved and its evolution over time, to name a few impinging factors. Collaboration cannot be treated as a hardened structure, a 'done-deal' in theory or in practice. It is a process, not an event.*
>
> (Mintzberg, Dougherty, Jorgensen & Westley, 1996:70)

1.0 INTRODUCTION

How does the process of collaborative technology transfer and integration take place in a complex setting, such as Interactive Digital Broadcast Media?

Although transfers of technology are considered an important means for organisations to sustain competitive advantage, they are associated with high rates of failure (Harrigan, 1986). Poor success rates are reported even in relatively simple settings (Simonin, 1999; Szulanski, 1996; Teece, 1976). Despite the widely known difficulties and high rates of failures, the phenomenon of technology transfer has continued at quite a pace. The phenomenon is not limited to a few industries but extends across diverse industries including transport, manufacture, telecommunications, electronics, pharmaceuticals and professional services (Doz & Hamel, 1998). This suggests that highly variable outcomes occur in both capital intensive and service industries. Clearly, there are important implications for managers and policy makers.

This thesis argues that understanding of technology transfer in the field of strategic management is limited. This limitation is characterised by two shortcomings:

- First, with notable exceptions (Doz, 1996; Arino & de la Torre, 1998; Doz, Olk, & Ring, 2000), the field has relatively few empirical studies that take a processual dynamic view of technology transfer and its impact on performance outcomes

Whilst various theories of performance failure or success have been developed, a great deal of research views theory of process in terms of linear variance models. Many of these models relate certain input factors to process outcomes as if the factors were discrete and fixed over the transfer duration (Simonin, 1999; Szulanski, 1996). Explanations are often based on necessary and sufficient causality. In reality, technology transfers are complex, multi-dimensional organisational activities that cannot be reduced to a handful of variables. Moreover, they do not play out constantly

nor do their properties remain unchanged over time. If this were the case then external influences, changes in variable characteristics, or any interaction effects over time would be inconsequential: transfers would be considered highly mechanical and deterministic.

A dynamic view of process captures the impact of human action either as individuals or in social groups; their response to changes in context and the shaping of their emerging situation. It helps provide insights into what people do and do not do and reasons why they might make certain choices at a given time. More holistic explanations can therefore be constructed. The beauty of the dynamic approach is that it gives process a sense of life; it 'catches reality in flight' (Pettigrew, 1997). Moreover, dynamic process does not contradict the variance approach. It complements and enriches it by giving important insights into how an outcome develops in its space and time from a state of 'being' to becoming (Pettigrew, Woodman, & Cameron, 2001). There remains a call for researchers to engage in process study from scholars in strategic management in general (Barnett & Burgelman, 1996; Pettigrew, 1997) and at inter-organisational level specifically (Ring & Van de Ven, 1994).

- Second, when empirical processual approach has been taken, it has generally been in simpler settings with complementary and interdependent technologies, constructed as dyadic relationships (Doz, 1988; Doz, 1996; Arino & de la Torre, 1998). When more complex settings have been studied they have been descriptive, involving multiple partners from the same industry (Browning, Beyer, & Shelter, 1995); or have studied reasons for entering inter-organisational relationships (Doz, Olk and Ring, 2000; Sakakibara, 2002). There seems little research on how a more complex setting consisting of disparate yet complementary technologies, contributed by multiple organisations from different national and industry contexts affects the evolving process and its strategic change outcome.

If organisational capabilities are honed by technological heritages (Leonard-Barton, 1992; Prahalad & Hamel, 1990) then little is known about how collective groups that are contributing diverse technologies achieve mutual understanding; how learning adjustments to individual tasks, commitments and interactions are made to maintain some sort of social order; how interdependent activities are synchronised or how changing expectations or circumstances influence the final outcome. Learning is an important concept in strategic management for sustaining competitive advantage (Teece, Pisano, & Shuen, 1997). It is defined by organisational theorists (Lyles, 1988; Fiol & Lyles, 1985) as development of insights, knowledge and associations between past actions; effectiveness of those actions and future actions; and the ability to make adjustments as a way of adaptation. In essence it is a two step process: i) the acquisition of insights and ability to understand the significance or consequence and ii) to act on that understanding. Individual subjectivity is implicit, and understanding is dependent upon how the context is perceived or understood. The use of the concept of learning in this thesis draws on this definition. Learning here

is not limited to technological learning but includes learning about industry and organisational contexts, partners' behaviours, expectations, commitments and so on; actions, behaviours and how they might contribute to organisational expectations of Alpha's performance outcome.

Process issues in this kind of setting are likely to be much more complex than the sum of dyadic relationships (Doz, Olk & Ring, 2000), when decision-making and developing consensus may be difficult (Evan & Olk, 1990). This sort of higher complexity setting is particularly relevant for research because it seems to be an emerging organisational form that transcends national borders (Osborn & Hagedoorn, 1997). The aim of this research was to uncover social and organisational issues that might be relevant to managers and policy makers. The novelty and theoretical value of the setting was its potential to offer insights into how collaborative technology transfer took place when mutual inter-dependence was the overriding condition; when the threat of direct competition from partner organisations was considered relatively small.

A process theoretical approach has inevitable implications for methodology (Chapter 6), where there is less concern for input/output relationships of a handful of variables. Instead it aims to study an unfolding process within its context, seeking to understand various co-influences and consequences on outcome development (Pettigrew, 1997). This research adds to the empirical technology transfer literature in strategic management by taking a processual approach from both, theoretical and methodological standpoints. It applied an existing dynamic process theory of learning and mutual adjustments (LaMA) (Doz, 1996) to a single, higher complexity setting (pseudonym Alpha), in an emerging industry sector of Interactive Digital Television (IDT). LaMA theory characterises the dynamics of dyadic relationships and predicts the pattern and paths of change over time. Documentary evidence was used as the main data generation methodological technique. A longitudinal process picture was constructed linked to actual change outcomes. Process outcomes were expected to be variable and unpredictable. Their development was considered important in providing clues to how and why they developed in that way. Application of the theory to a more complex setting provided an opportunity to test its relevance and limits of its applicability. It also provided an opportunity to use inductive reasoning for theoretical refinement.

Alpha, a EU sponsored collaboration, comprised 12 organisations contributing technologies represented by the various IDT segments (Chapter 4). Alpha's key goal was to create economic opportunities for the entire constituency. Organisational mix consisted of small and large commercial organisations and academic centres, mainly European but included US and South Korean partners. Its major business and technological objectives were to: develop product concepts that integrated technologies across multiple technology platforms[1] (Internet, Broadcast and

[1] Discussed in detail in Chapter 4

Telecommunications) in IDT, and to construct business models[2] that demonstrated economic value for constituent organisations. There was organisational[3] assumption and expectation of developing broader revenue bases[4] enabled by integration and application of existing and newer technologies in novel ways. Importantly, this integration could not be achieved by any single organisation; implicit supposition being that collective social participation required interdependence and mutual adjustment.

Alpha's higher complexity was thought to arise from five dimensions: i) different organisational forms (large and small commercial organisations, academic centres and research institutes) ii) the disparate yet interdependent technologies along a particular value chain[5] iii) variety of industry and national heritages, existing competences associated with distinct industry domains iv) different speeds of organisational learning and v) virtuality or geographic dispersion of participants. The likely effects of these dimensions are discussed in Chapters 3 and 4. These dimensions were expected to complicate the transfer development and performance outcome. For instance academics are used to particular ways of working: they enjoy greater freedom from daily direct management control than their commercial counterparts. Their knowledge sharing ethic is based on a principle of knowledge advancement (Geisler, 2001). Commercial organisations however have greater concern for intellectual property and retention of knowledge within organisational bounds. Significant differences in organisational practices were expected from national cultural differences (Hofstede, 1980). Hofstede's classic analysis finds for instance that Europeans are more individualistic than South East Asians. In new idea generation and decision making, the former may be more spontaneous whereas the latter may rely on lengthy internal discussion and consensus building. These differences may impact the speed and efficiency of the transfer process, because of process tensions and internal conflicts.

According to the EU, organisational selection for construction of Alpha was on the basis that

> *'...their knowledge and skills are absolutely complementary and cannot be found within one single European nation. For the project to succeed trans-European cooperation was a pre-requisite and as it intended to play a part in a worldwide domain, inclusion of partners from US and Asia was deemed to bring greater strength to it.'*

The EU and participant organisations believed that a technically integrated IDT product had not been demonstrated; particularly given its span of content production, transmission and consumption using 'open' technological standards. Since proof of concept did not seem to exist, it was unclear

[2] A business model represents the economic architecture of a business: its costs, revenues, customers and business processes
[3] The terms organisation, partner, participant, and firm are used interchangeably throughout this thesis
[4] An explicit assumption made by the funding body and participant organisations
[5] See Chapter 4 for a description of the IDT value chain

whether an integrated technology could achieve robustness and performance of innovative multimedia content. Moreover, there was reluctance to invest because of lack of business models, which showed clear revenue generation for the entire constituency. Alpha was conceived to address two key concerns and it seemed that participating organisations believed they could benefit from the collaborative effort.

The process of technology transfer in strategic management study can be conceptualised using two broad approaches: classicist and incrementalist. Each approach has implications for how process is viewed and studied. The classicist approach (Porter, 1980) conceptualises strategy as a rational and planned process, which implies a fixed transfer structure. It ignores impact of human action or agency; or influence of market or organisational change and uncertainties. Time is immaterial. With this approach, the technology to be transferred is identified; course of action is plotted, the objects of action take steps to carry out the set actions towards the objective. The objective itself is singular and rational, be it profit maximisation or some other organisational advantage. It is pledged by the entire organisation. There is no reason to doubt the achievement of plan because future knowledge is known in full and with certainty: the same path would be enacted at another time. This approach is closely allied to the natural sciences.

The incrementalist approach (Mintzberg & McHugh, 1985; Teece, Pisano & Shuen, 1997; Pettigrew, Ferlie, & McKee, 1992) on the other hand, argues that there are too many uncertainties not just in the changing context but in the way humans (the objects of action) carry out organisational activities. Self-interests often cloud the path towards an organisation's objective, leading to pluralistic goals and variable outcomes. The steps one takes with this approach is to start with an objective, move towards that objective, regularly assess and evaluate effects of those actions and make any necessary adjustments to subsequent actions. The outcome may diverge from that conceived at the start, but emerges within the constraints and influences of changing conditions and human action. Structure and actions are interlinked; they influence and are influenced by each other. In contrast with the former approach the process is contextualised in its time and space. The same process may be enacted very differently in another time and space, illustrating its indeterminate nature.

Whittington (1993) has reviewed the approaches to strategy. His categorisation is based on four generic typologies: classical, systemic, evolutionary and processual. Each typology has implicit assumptions about process and its implications. The typologies are compared and contrasted along two dimensions: outcome (singular vs. plural) and process (planned vs. emergent). Classical and systemic approaches lie at the deliberate planning end of process; their difference lies along the outcome dimension. Classical, has a singular outcome focus e.g. profit maximisation, whereas the systemic approach is more relativist. It argues that strategy is undeniably linked to cultures and powers of local social systems, thereby enduring pluralistic outcomes. At the emergent end of the

process continuum lie the processual and evolutionary approaches. Their difference along the outcome dimension is explained by learning and adaptive adjustments that give rise to pluralistic and variable outcomes. Evolutionary approach by contrast, whilst emergent in nature is viewed to be more fatalistic; survival depends on random mutations and environmental selection processes resulting in singular outcomes.

Technology transfer and integration in this thesis involved higher complexity contributed by various dimensions including diverse technologies and heterogeneous organisational contexts. Partners were expected to have limited understanding beyond their immediate knowledge boundaries and how those technologies might be integrated. As no technological blueprint existed, difference in understandings and expectations of what had to be done was highly likely. Market developments may diminish in partners' minds the collaboration's strategic fit (Parkhe, 1991). The transfer process was largely creative in that new knowledge would be integrated through social interaction, idea generation and joint problem-solving (Tsoukas, 2002); content (what) and action (how) were closely inter-related. Technology transfer was therefore viewed as a social process, emergent in nature that may lead to variable or divergent outcomes. An incrementalist or processual view was adopted as it was not known how the process might be affected by partners' changing circumstances or strategies; or likely effects of an evolving industry on technological tasks.

The purpose of this first chapter is to introduce the key themes and thesis outline. The central research question introduced earlier is developed. Theoretical perspectives and underpinnings of the study are presented. The research industry context is introduced followed by a definition of the empirical scope. A high level outline of the methodological approach is given, followed by an outline of the entire thesis structure. The chapter concludes with an explanation of why the research question was considered significant, timely, and important and specifically why the particular empirical site represented a puzzle worthy of study.

1.1 BACKGROUND

If a firm is to survive and grow in a rapidly changing, global market place, it would be expected to enhance its capabilities to innovate with new products or services. The broadening of capabilities (Teece et al., 1997; Prahalad & Hamel, 1990) may give it flexibility to respond to emerging threats or opportunities by introducing more cost efficient products, new product offerings, or entry into new markets. Ideally, internal capability development enables some control over new proprietary knowledge against immediate misappropriation. However, when development costs are high, product innovation cycles are short, or when investment outcomes are uncertain, even when internal R&D capability exists, firms may seek to transfer technologies from an external source.

The phenomenon of technology transfer is not limited to the strategic management field. It slices across various disciplines including engineering management, international business, development

economics, and so on. It has been applied at a macro level as a strategy for enhancing an entire industry, region and even a nation, in the fields of development economics and international business. Each field seeks to understand technology transfer characteristics using its own set of theoretical models and research methods (Zhao & Reisman, 1992). In management study, technology transfer serves the role of strategic asset for competitive advantage.

The basis for technology transfer in this research is drawn from the Resource Based View (RBV) (Wernerfelt, 1984) of the firm and Dynamic Capabilities Perspective (Teece et al., 1997). How this view fits with the rest of the broad theoretical base in the strategic management field and its implications is discussed in Chapter 2. There now follows a brief introduction to the industry and research contexts.

1.1.1 THE INDUSTRY CONTEXT

Increasingly, newer technologies and products are interdisciplinary in nature (Tidd, Bessant & Pavitt, 1997), particularly in Biotechnology, IT, and Aerospace industries (Liebeskind et al., 1996; Doz & Hamel, 1998). Inter-disciplinarity arises from application of technologies in totally novel fields; where older activities are linked in new ways and product scopes are widened (Harrigan, 1987). For example, biotechnology is applied in pharmaceuticals, agriculture and waste management (Liebeskind et al., 1996); mobile telephones are used for telephony, visual images, radio and email (OECD, 1992). The consequence of this interrelatedness, complementarity and speed of change is that organisations have to share, pool, and jointly create new technologies, particularly in the form of social collaborative technology transfers (Inkpen, 1996). Moreover, it relies on organisational dispersion across national borders (Lam, 1997; Doz & Hamel, 1998). Yet, there seems little research to understand how organisations carry out complex activity towards achievement of mutually interdependent and collective goals. Powell (1998:224) observes: *'even though the awareness of the importance of both external sources of knowledge and external participation has grown, we know much less about how knowledge is generated, transferred and acted upon in these contexts'.*

Before considering the nature of the problem this creates, the substantive problem area is introduced briefly.

1.1.2 THE CONVERGING INFORMATION INDUSTRY CONTEXT

Over the last decade, various factors including advances in digital technology have contributed to restructuring of the IT Industry. The restructuring has manifested itself in the way firms compete with each other; the nature and scope of products they offer; the markets they serve and choices consumers face (Tarjanne, 2000). Much of this organisational re-orientation is a result of technological integration across previously separate, yet neighbouring industry sectors (See

Diagram 4.1): referred as convergence of telecommunications, broadcasting and computing industries.

The following discussion illustrates the concept of convergence as change in product offering and organisational technological activities. Chapter 4 discusses this change in detail. The concern here is to consider broad changes resulting from technological change, the impact on incumbents and organisational responses expected:

i) Digitisation is enabling interchangeability and connectability of various modes of communication and information: audio (sound), video (picture) and text (data) can smoothly travel across different networks, which include fixed telecommunications lines, mobile networks, satellite or cable. This suggests that organisations can bundle services, and gain access to customers previously outside their market domain. E.g. digital radio can be received on a mobile phone, a Television (TV) set or a PC.

ii) Multi-functional products (terminals) are replacing previously distinct product offerings in distinct markets. E.g. TVs are now more PC like in information processing and storage and Internet access or home shopping. PCs have become more TV-like for handling video and audio. With internet technology, PCs can offer voice telephony as an alternative to traditional telephones.

This interconnectivity and multi-functionality has potentially a profound industry impact. Whereas, separate industry sectors represented separate markets of home entertainment or information and data processing, they now compete by offering similar products and services (Mueller, 1999). The nature of competition is further complicated by the ability of the digital signal to travel round the globe without loss of signal quality. International players can therefore enter global markets seamlessly. This can be seen in the globally recognised US TV channels, CNN and MTV. Competition is faced from local and international players (Doz & Hamel, 1998).

Convergence of inter-sectoral technologies is occurring through collaborative technology transfer (www.itvt.com), but in a fragmented way (Tarjanne, 2000). This activity is not restricted to larger organisations. It has allowed smaller, highly innovative firms to enter the arena (Swedlow, 2001; Mueller, 1999; Doz & Hamel, 1998). Despite the technological diversity, integration is being carried out in collaborative structures similar to those seen in the Biotech industry of early 1990s (Powell, Koput, & Smith-Doerr, 1996). They aim to be first to introduce and benchmark an integrated concept (Doz & Hamel, 1998). This scale of change resulting from an emerging technology has potential to remake an entire industry or render established strategies, assets and skills obsolete (Day & Schoemaker, 2000).

A related sector affected by technological change is the broadcast TV industry, called IDT. It is replacing the traditional 'single' broadcast for mass consumption with interactivity, tailored to individual needs. It combines broadcast technology with internet-like interactivity and a two-way

communication link between consumer and broadcaster or service provider (KeyNote, 2000). Traditional telecoms technologies are integrated with newer internet and software technologies, which would be expected to create some process difficulties. IDT's value chain consists of industry segments of broadcaster, network provider, device manufacturers, service providers, software authors and integrators (segment competences are discussed in Chapter 4).

The difficulty that arises is that disparate technologies have evolved through vastly different competences and skills (Prahalad & Hamel, 1990), determined by specific customer or market needs. Organisations have learned to operate under different business models, selling cycles, regulatory environments, and business risk. Traditional sectors have evolved into large bureaucratic organisations, contrasting sharply with newer, highly entrepreneurial, flexible and innovative sectors (Doz, 1988). Telecoms development has occurred in a relatively stable environment where efficiency and reliability were the overriding principles; technology innovation was a secondary concern. Competition was non existent. Computing industry however has faced rapid change and competition. Its aim has been to capitalise on immediate benefits without striving for absolute product reliability (Verdonik, 1997). Also, previously business models were relatively simple with clear organisational activities, boundaries and associated costs and revenues. As technologies become integrated, there is less clarity about distinct organisational activities and their value.

The implication of this change is a mutual reliance for interdependent technologies. Yet, no single 'knowing' entity possesses the knowledge that can set out a detailed plan for action and integration (Tsoukas, 1996). Knowledge has to be created in the context of its creation (Nonaka, Toyama & Konno, 2001; Tidd, Bessant & Pavitt, 1997). A number of process concerns arise: how can one know whether participants do indeed have the knowledge required for an integrative goal? The goal itself may be fuzzy or indeed change over time. In the presence of these conditions, how does a mutual goal become enacted over time; how do organisational differences play out over time? To what extent do individual goals contradict collective goal and how does that affect the performance of a high complexity collaborative technology transfer?

This research aimed to fulfil some of these process concerns by tracking process changes over time and by linking the collaboration's initial conditions with final process outcome.

1.1.3 THE NATURE OF THE PROBLEM

The problem is that technology transfers suffer high rates of failure (Harrigan, 1986). Whatever means or forms of transfer are selected, in practice, they are difficult. Whether they are domestic or international (Teece, 1976), intra-firm (Zander & Kogut, 1995) or inter-firm (Lam, 1997), into developed or developing countries (Teece, 1976), between larger and smaller firms (Doz, 1988), they are difficult and costly (Teece, 1976). They are complex, laborious and time consuming (Szulanski, 2000), and not smooth (Kogut & Zander, 1992).

Failures seem to occur under various modes of governance: ranging from independent to wholly owned subsidiaries, from various equity levels in strategic alliances to even arms length licensing, including networks and inter-organisational relationships. Given their diverse forms, true failure rates are unavailable; but anecdotal reports are plentiful. For instance a study of almost 900 JVs reported a mutually agreed success rate of only 45%; more than half considered the ventures unsuccessful (Harrigan, 1986). Interestingly, when firms do acknowledge transfer difficulty, it is often viewed as an anomaly rather than a characteristic (Szulanski, 2000). This suggests that despite reports of widespread difficulties over almost three decades, when many managers may even have first hand experience of those difficulties, organisations might be continuing to undertake transfers without really understanding and learning about the complexities of the transfer process.

The causes and theories of transfer effectiveness are discussed in Chapters 2 and 3, but here the key points are summarised. Typical causes tend to present along dimensions including:

- Technological differences and knowledge complexity
- Partner characteristics
- Motivations and degree of mutual trust
- Contextual differences arising from national and organisational cultures

Much of the research treats the dimensions in a variable-like way with implicitly fixed characteristics.

The dynamic capabilities view of firm strategy views transfer of technology and new capability as a process of learning (Teece, Pisano & Shuen, 1997). Difficulties arise from the extent and quality of learning. Even in replicative transfers, when the exact same technology is operationalised in a different setting, a great deal of learning has to take place (Teece, 1976). Failures might be explained by the quality of learning in these settings. Interestingly most empirical research has focused on either unidirectional transfers where one organisation gives something to another e.g. manufacturing process or 'best practice'; or bi-directional where some form of technology exchange and joint creation is required. They view knowledge as extracted objects, separate from the process or action of transfer.

In high complexity technology transfer, pluralistic views and understandings of task requirements were likely. The nature of transfer was unlikely to be a giving or taking of an objective thing; it would need social interactions for creation of new knowledge. Difficulties were likely to present along multiple dimensions: e.g. geographical dispersion and mutual understanding (Cramton, 2001). Disadvantages may arise from different work habits and time zones. Extra demands for communication, synchronisation and management of a complex project were likely (Boutellier et al., 1998). The research concern therefore was to understand how higher complexity influenced the transfer process and its performance outcome.

1.2 RESEARCH ISSUES AND CONTRIBUTIONS

The two key research issues are:

First, although much of the empirical research in strategic management is underpinned by a theoretical school that is processual in nature, a great deal of research method is based on variance models that focus on a few isolated variables. Variables are linked to outcomes as if they acted independently of each other. Whilst these models provide some really useful insights, they are partial in providing understanding of an unfolding, complex and dynamic process. The co-influences over time and contextual effects on process are ignored. Relatively little scholarly attention has been paid to studying developmental processes of inter-organisational relationships (Ring & Van de Ven, 1994). Processual study is considered particularly valuable when performance may not be clear to measure; it may be partial or contested. Process research is considered an important addition to the existing technology transfer literature in strategic management.

Second, there seems a lack of process study in higher complexity settings, particularly one that combines a theory of LaMA (Doz, 1996). Whilst previous research may have dealt with some of the complexity dimensions singly, there is little empirical work that synthesises the many dimensions in a single setting. In the presence of market uncertainties, it was highly likely that as transfer progressed circumstances of one or more partners might change, altering their commitments and expectations. It is known for instance, that over Alpha's life, the telecoms industry experienced a global economic crisis. Organisations from this industry might well have undergone structural changes that affected their contributions and impacted project outcome. Alpha was conceived at a time when Internet boom was at its peak. Given the inclusion of some Internet related technologies and the subsequent industry 'meltdown' these partners may well have affected the outcome. When two or more partners collaborate and no single partner is theoretically more dominant, it is not known how mutual adjustments occur, or what the limits of those adjustments might be. As a consequence, it is argued that the existing empirical literature is limited in its understanding of technology transfer process.

This thesis contributes to the strategic management literature by addressing the two gaps. An empirical processual research was undertaken in a complex setting; designed as a single case study, contextualised in a changing industry environment. The research aim was not to reveal a universal theory applicable to all technology transfers but to generalise the findings to the theory of LaMA. The empirical findings helped extend the theory with important concepts of 'Communities of Practice' (CoPs) (Lave & Wenger, 1991; Brown & Duguid, 1991; Wenger, 1998; Swan, Scarbrough, & Robertson, 2002), as highly dynamic emergent structures within which cycles of learning and mutual adjustments took place. CoPs served to overcome or simplify complexity and contributed to development of more successful outcomes.

Generic themes from single studies provide important insights (Goffman, 1961; Doz, 1988). This synthesised pattern may apply to other settings and may be of particular relevance to practitioners to better understand, design and manage complex collaborative transfers (McNulty & Ferlie, 2002).

1.3 JUSTIFICATION OF THE RESEARCH

Collaborative technology transfers are on the increase in the Information Industry and other diverse industries (Doz & Hamel, 1998; Liebeskind et al., 1996). They are invaluable for knowledge creation (Inkpen, 1996). They do not represent 'symbolic social affirmations' but are based on assumptions of strategic complementarities (Gulati, 1998). Yet, technology transfers are littered with difficulties and can be highly unsuccessful (Harrigan, 1986). It can safely be assumed that the potential benefit of a great deal of collaborative activity is unrealised. It has been argued that there remains a gap in dynamic process research, particularly in respect of higher complexity. This then led to the central research question:

How does the process of collaborative technology transfer and integration take place in a high complexity setting, such as Interactive Digital Television?

The question was particularly significant in its timing given the changes in the industry changes. It provided an ideal opportunity for this kind of process research. IDT sector as an empirical example was chosen on an *a priori* basis that technology transfer amongst broadcasters, network providers, device manufacturers, software authors, and academia and technology integrators would be an interesting area of study. It contributed a number of complicating dimensions:

i) Organisational mix of different technological heritages
ii) Commercial viability of product concepts was uncertain as consumer usage patterns were still forming
iii) Diverse organisational forms with different participation incentives and motives
iv) Complex, social interdependencies had to be played out in practice

Whilst integration of diverse technologies was inherently difficult, organisations were expected to want to work together for mutual benefit. The processual view suggests that organisations were unlikely to hold 'fixed' expectations, commitments and contributions over the course of transfer. Any divergences from initial plan, as market conditions evolved would therefore be interesting to follow. Moreover, in this research the unfolding process was linked to actual outcomes (Pettigrew, 1997). Such outcome based approach provides an opportunity for key users of process research such as the 'reflective managerial constituency' to engage with that work (McNulty & Ferlie, 2002).

1.4 METHODOLOGY

A deliberate methodological choice was made using i) qualitative, interpretative and ii) single case study (Yin, 1984). Qualitative methods of course offer greater opportunity to gather rich detail from a research site. Case study affords the flexibility to gather eclectic data, without restricting the researcher to standardised data that are better suited to quantitative methods. The overall research design consisted of a longitudinal, qualitative, single case study of a high complexity technology transfer setting. The single case was selected on the basis of theoretical usefulness, to uncover peculiarities that this type of organisational life was likely to bring out. A dynamic process theory of LaMA (Doz, 1996) was applied to examine the nature of process, with the objective of extending and refining it. This rendered the style as a combined deductive-inductive study.

Documents were used as the main methodological technique. When compared with interviews, documents represent an unobtrusive method of gathering real-time data (Webb et al., 1966). Whereas most process studies are constructed from retrospective accounts (Johnson, Melin, & Whittington, 2003), documents in this study allowed close engagement with process from outputs generated in real time; produced for purposes other than this research. Generated as products and by-products of project activities they provided an extraordinary opportunity to discover in detail the task and contextual issues faced; how decisions were taken, conflicts resolved and problems solved. It enabled construction of a fine-grained process[6] of a system in its natural state. Documentary interpretation was carried out by the researcher as single judge of meaning. Advantages and disadvantages of design choices are discussed in Chapter 6. The longitudinal timeline of 24 months was retrospectively constructed and linked to actual process outcomes. The narrative strategy involved the chronological construction of a detailed story from raw data (Pentland, 1999; Langley, 1999), generating two internal comparative analytical modules associated with differential outcomes. They represented two micro-cases in a single macro case (McNulty & Ferlie, 2002). The fine-grained process analysis helped surface important constructs for theory development. Document analysis progressed via interpretation and cycles of self-reflection; key events were identified and linked to theoretical concepts by manual display and linking of changing structural transfer conditions.

1.5 OUTLINE OF THE THESIS

This chapter has introduced the research question, identified the research gaps and justified this empirical investigation. This section outlines the thesis structure, which is organised into four sections: First section sets the scene. Second section deals with the research design and methodology. Third section details and discusses the empirical findings. Section Four deals with theoretical contribution and conclusions. Each chapter within the sections is now introduced.

SECTION I - SETTING THE SCENE

Chapter 2: represents the first of two literature reviews. It fulfils a key role of illustrating the process gap in the study of technology transfer in the field of strategic management. Three broad process theories that range from relatively static to highly dynamic are introduced (Van de Ven, 1992; Pettigrew, 1992). Pettigrew's (1992) process meaning best fits the process assumptions in this thesis. The review is organised into two categories that map the studies and help clarify prior work in the dynamic process area and how the chosen research setting was expected to add to existing knowledge.

Chapter 3: represents the second of the two literature reviews, but does not pretend to be exhaustive. Its purpose is to discuss dimensions of higher complexity; key debates and concerns that arise and illustrate why the research site was potentially so interesting. The dimensions were not specified for the purpose of tracking but as context to understand organisational actions and behaviours and likely impacts on the outcome.

Chapter 4: analyses the industry context and provides the reader with insights into the substantive problem area. This analysis is particularly relevant given the importance of 'contextualism' in process study (Pettigrew, 1992). Alpha's structure and objectives are introduced. The discussion cascades from the general converging IT Industry to the specific IDT context. It reviews technological developments in the market place in this specific IDT context. The purpose is to help contextualise the empirical findings by clarifying Alpha's goals, its performance outcomes and their consistency with the contemporary market.

SECTION II - RESEARCH DESIGN AND METHODOLOGY

Chapter 5: discusses the process theory of LaMA (Doz, 1996) and reasons for its selection and appropriateness. The theory represents a theory of change in social structure and includes time as a key system component; the relationship between structure and action, and tension between change and stability (Van de Ven & Poole, 1988). Two dynamic theoretical propositions are developed for empirical verification. Process research has been criticised for being a-theoretical, merely descriptive with limited contribution to knowledge (Pettigrew, 1992; Johnson et al., 2003). By starting with a theory the research was considered robust and provided an opportunity for further theoretical development.

Chapter 6: presents the research design and methodology. It discusses the deliberate design choices of a longitudinal, qualitative, interpretative research using documentary evidence to construct a single case study. Quantitative design would have been inappropriate given the desire to understand contextual influences on human action, and depth and flexibility needed to gather non-standard process data. The choice and selection of process analytical approach is presented. The strengths, weaknesses and limitations arising from the overall design are discussed. A learning reflection of why the data was analysed manually without the assistance of a software package is given.

[6] Fine grained process analysis is discussed in detail in Chapter 6

Chapter 7: details the analytical procedures adopted: the 'what' and 'how' the research was carried out. A criticism of qualitative research, particularly of single case study is the potential for disorganised and haphazard data generation and analysis. This criticism is tackled here by providing a detailed analytical account: document catalogue, construction of a chronological data set and database. This helps demonstrate the research rigor in its own terms.

SECTION III - EMPIRICAL FINDINGS

Chapter 8: provides a descriptive account of empirical process findings by making a great deal of the text transparent. Two differential process outcomes are uncovered that constitute the 'objects' of study and provide the hooks for building a fine-grained process chronology. An important concern of this chapter was to enable the reader to develop a sense of data richness and its high internal validity.

Chapter 9: presents a fine-grained process analysis using the process theory of LaMA, and acts as an intermediate step between analysis and theory development. Process variations in development of the two differential outcomes help illustrate the point at which the theory was supported and the point at which it became inadequate. The analysis helped surface some concepts that were used to develop theory.

SECTION IV - THEORETICAL CONTRIBUTION AND CONCLUSIONS

Chapter 10: provides the theoretical contribution of the research. The theory is extended in the high complexity setting by synthesising important concepts from the 'Communities of Practice' literature in the field of knowledge management. Emergence of communities in the process represented facilitating mechanisms for development of successful process outcome.

Chapter 11: brings this thesis to a close by drawing broader conclusions. Implications of the empirical findings for managerial practice are discussed. Personal learning reflections are presented and finally, recommendations are made for further research.

1.6 RESEARCH CONCEPTS

Four concepts used extensively in this thesis are now defined:

i) Technology
ii) Transfer of Technology
iii) Destination or Flow of Technology
iv) Collaboration

i) Technology

Physical equipment or hardware is associated with older more traditional technologies. Over the last two decades however, a marked shift towards more people or knowledge-embodied technologies has occurred, particularly in the IT industry. Strategic management literature uses the terms

technology and knowledge interchangeably. Technology has been defined as any form, material or social, into which knowledge is embodied (Rebentisch & Ferretti, 1995), including hardware, software, products, rules and procedures, organisational know-how and technical expertise. Non-hardware technology, also called knowledge is dichotomised into explicit and tacit knowledge (Polanyi, 1967; Grant, 1996). The conceptualised differences have implications for process of technology transfer.

Explicit knowledge is codified into designs, blue prints, manuals and techniques. This type of knowledge is more accessible to transfer from one context to another and can overcome national differences through conversion into different languages. Kogut & Zander (1992) refer to it as declarative knowledge; when one knows what something means and can articulate it; it can be taught easily through instruction (Lam, 1997). Tacit knowledge in contrast is more subjective in nature. It is embedded in individual skills and social arrangements and is procedural (Kogut & Zander, 1992) and hence difficult to articulate. It tends to be system specific, whether in an organisation or industry; may include managerial and organisational practices or even organisational strategies and behaviours. These characteristics raise interesting and complex issues regarding its transfer both within and across organisational and national boundaries.

This simplistic dichotomy suggests that knowledge is easily separable from process. Critics of this simplistic typology argue that knowledge becomes reified (Orlikowski, 2002). Tsoukas (1996) maintains that tacit knowledge is a necessary component of all knowledge; both types of knowledge are mutually constituted. Its processual, dispersed and inherently indeterminate character better reflects the nature of knowledge. Nonaka et al. (2001) similarly argue that knowledge needs a context for creation in terms of who participates and how they participate.

Alpha's disparate technologies might be viewed to span the entire knowledge spectrum: highly tangible at one end to highly intangible knowledge held by individuals at the other. The working definition adopted in this research draws on the work of Tsoukas (1996), emphasising its processual nature, inseparable from the practice of transfer. The terms technology, knowledge and capability are used interchangeably throughout the thesis.

ii) Transfer[7] of Technology

Transfer of technology has been referred as purposeful transfer of resources or capabilities from one location to another, for use in production or service (Edosomwan, 1989). It conceptualises technology as objective and separate from the transfer process. Traditional transfers, particularly in heavy manufacturing industries constituted movement of 'finished' technology. A trend towards

[7] Transfer here is intentional in nature. Unintentional transfer referred in the literature as technology diffusion is not the focus of this research. It has received a great deal of research interest in its own right as a stream of study

more people-based technology views transfer and new knowledge creation as a concurrent activity (Tidd et al., 1997); people-embodied knowledge leaves few visible tracks when transferred (Gupta & Govindarajan, 2000). The concept of transfer in this research represents not just physical movement but also outputs or processes of human actions and interactions. As a result process cannot be separated from technology; transfer process was viewed as a social process of knowledge creation intimately interlinked with technology itself. Processual transfer and knowledge creation presents a tricky problem of method. How can one know if knowledge has been transferred when human engagements and interactions leads to knowledge creation that is not easily deciphered? The qualitative research design using an interpretative analytical approach aimed to help infer when and if this might have happened.

iii) Destination or direction of Flow of Technology

Technology transfers are often represented as unidirectional technology flows from donor to recipient organisations in intra- or inter-firm arrangements; as bi-directional flows of complementary technologies between alliance partners; or multi-directional flows amongst multiple organisations that share and pool knowledge through social interactions. Although organisations might have the opportunity to learn and exploit technologies for individual gain, the primary research concern was technology flow for mutual benefit. The destination of technology transfer was therefore at the collaborative interface, where ownership of the final collective knowledge could not be attributed to any single participant organisation.

iv) Forms of Collaboration

The term collaboration is used under various labels (see also Chapter 3) as: inter-organisational relationship, partnership, alliance, social network, JV, contract, etc. It illustrates the range of relational and social intensities. Contracts are at arms length, and less relational, where organisational requirements are agreed at the outset and there is an expectation of fulfilment of those obligations. Collaborations however are more relational in nature. They may be formed upstream with suppliers, or downstream as franchises. They may represent interactions amongst teams or business units within a single organisation. They may be constructed as lateral arrangements involving a number of organisations in R&D of new products (Mintzberg et al., 1996).

Collaborations may occur amongst different organisational forms e.g. non-commercial academic institutions and commercial organisations. Their differences lie in respective incentives, motivations and even transfer outputs. What seems important is that whilst they may do things differently for different reasons, they do interact in synergistic ways (Nelson & Winter, 1977). The biotechnology industry illustrates this synergy: small entrepreneurial biotechnology firms, large pharmaceutical houses and research institutes (Powell et al., 1996). Universities provide basic research expertise; smaller biotech firms generate creative product ideas for application developments, whilst pharmaceutical houses provide regulatory and marketing skills for product commercialisation.

Collaborations as Research Consortia consist of a relatively well-specified technology transfer project, with some government sponsorship (Tidd et al., 1997). Consortia may involve competitors too (Browning et al., 1995). They have occurred in various industries, including automobile, aerospace and telecommunications (Liebeskind et al., 1996). The background to this is that since the 1980s, fuelled by a concern over the competitiveness of domestic firms, the US, Japanese and West European governments have provided subsidies to participant organisations. The Information Industry in particular has seen an unprecedented level of activity. In this respect, the EU has funded programs such as ESPRIT (European Strategic Program for R&D in Information Technologies), EUREKA and JESSI. JESSI was undertaken to strengthen the European electronics industry and secure its future worldwide competitiveness (Ham, Linden & Appleyard, 1998). The EU's key concern has been to influence development and adoption of common technological standards. Organisations join these consortia to share costs and risk, to pool expertise and equipment, and to influence and set common technological standards (Tidd et al., 1997). Their remit generally is to carry out applied research with the objective of putting the created knowledge to commercial use. The empirical findings show that one of Alpha's goals was to use generic standards and to contribute to their further development.

Essentially, collaboration is based on the principle of shared goal or vision for mutual benefit. Its logic is that the sum gain is likely to be greater than that achievable independently. At a micro level, it represents an exchange of ideas, experiences and expertise between organisational individuals (Rappa, 1989). The key assumption is that collaborating organisations bring unique skills, assets and abilities to create new knowledge. This occurs through experimentation, problem-solving, shaping and re-shaping of new technology ideas. It is this social and processual nature of collaborative technology transfer that was expected to influence the performance outcome and have important implications for research method.

Alpha represented an EU sponsored R&D consortium, consisting of 12 organisations, working together on a relatively well-specified technology transfer project. It epitomised a highly relational arrangement consisting of a horizontal value chain (see Chapter 4). Its objective was to develop an integrated product concept contributed by various technologies across the three industry sectors in Information Industry for mutual benefit.

1.7 DELIMITATIONS OF SCOPE, KEY ASSUMPTIONS AND THESIS LIMITATIONS

Competitive advantage can be sustained in various ways. Collaborative technology transfer may be used to exploit knowledge for individual organisational gain. This thesis was delimited to technology transfer as a social process within the collaborative setting. As a result its aim was to study interactions amongst partners and not specifically at partners' intraorganisational levels.

Thesis limitations are:

The industry in which this research study was set was viewed as rapidly changing. It may represent significantly different conditions and process influences to those in a more stable or mature context. Nonetheless, the selected context was viewed as important given the increase in collaborative activity generally and specifically in the IDT industry (Swedlow, 2001).

The methodological limitation was contributed by the use of a single case study and its limits on external validity. Like most social science research that uses single cases, generalisation could not be made to all collaborative transfers; further research has to verify the findings in other collaborations. This limitation was justified however on the basis that there was little understanding of transfer process in a higher complexity setting. Moreover, the limitation of process research and single case study was countered by locating the research in an existing theoretical framework (Pettigrew, 1997; Johnson et al., 2003). It provided for theoretical generalisation in which 'previously developed theory is used as a template with which to compare the empirical results' (Yin, 1994: 38).

Documentary evidence was used as the main methodological technique. Unlike combined techniques or even single techniques such as interviews that seemingly allow multiple realities to be gathered, this method represented a single investigator's interpretation and version of process events. Use of a single judge of meaning might be considered by some as a weakness. Critics would argue that this can lead to an unbalanced view of reality. This criticism was countered on the basis that the richness of the data normally used only to supplement other data provided some really useful insights. It also provided insights into the various realities of participants. The data was interrogated repeatedly with reflexivity, allowing a greater understanding and a detailed picture to be built.

1.8 Concluding Remarks

This chapter has introduced the nature of the problem of technology transfer by identifying two research gaps: dynamic process gap and the problem of high complexity. It has argued that the processual view of technology transfer in the field of strategic management provides deeper insights into the process of outcome development. It has developed the central research question: how does the process of collaborative technology transfer and integration take place in a complex setting, such as Interactive Digital Broadcast Media? It has justified the significance, timeliness and relevance of the research and has outlined the thesis.

The next chapter presents the first of the two literature reviews. It discusses the process gap and identifies the dynamic process theoretical framework.

CHAPTER 2

LITERATURE REVIEW (1)

OF DYNAMIC PROCESS STUDY

2.0 INTRODUCTION

The central research question about the process of a high complexity collaborative technology transfer was developed in Chapter 1, consisting of two elements: i) how does the collaborative technology transfer process develop over time and ii) how does the process influence the final performance outcome. The linking of an organisational outcome to its process signifies a research approach that extends beyond an ethnographic study. The concern being that ethnography might be limited to the study of process in its own right (Pettigrew, 1997). The research interest was to understand how process influenced outcome development. Two research gaps were introduced: 1) Dynamic process study and 2) Problem of higher level Complexity.

The purpose of this chapter is to discuss the first of the two gaps by reviewing the strategic management literature. Differences between a-processual (relatively linear) and processual (emergent) views of technology transfer were introduced in Chapter 1. Understanding emergent process was considered important because of the highly variable, uncertain, partial and even contested natures of process outcomes (McNulty & Ferlie, 2002); outcome development in a highly complex technology transfer was expected to be no different. Process study provides an opportunity to understand how and why particular outcomes occur; what critical events influence their developmental path. Essentially, understanding the development of transfer failure was considered as important as understanding performance success, for academic knowledge and managerial practice.

The review found a preponderance of studies that use cross-sectional methodologies with a different process focus to that adopted in this research. These studies generally treat transfer dimensions as discrete input factors as if they were static concepts, extractable and independent of the process. This type of research inevitably links few variables to single outcomes in a fixed structure, implying necessary and sufficient conditions for outcomes to occur (Poole, Van de Ven, Dooley, & Holmes, 2000; Barnett & Burgelman, 1996). Evolution of partial or plural outcomes fit less well with these models. Although large scale quantitative studies may generate wider generalisable results, they provide limited insights into the dynamics of the transfer process and contextual influences (Pettigrew, 1992); organisations are treated as if they were homogeneous. In dynamic process study, time does not stand still; process in one time may play out remarkably differently in another period. The past influences and shapes the emerging future, through an intimate

interchange of action and structure. As a result, process studies are much more detailed and typically based on smaller-scale more intensive case study designs (Langley, 1999).

The limited dynamic process empirical research is reflected in various observations:

> *'...despite a growing literature on the transfer phenomenon, a profusion of conceptual work exists with still limited empirical process related research'* (Simonin, 1999: 596);
>
> *'....even though awareness of the importance of both external sources of knowledge and external participation has grown, much less is known as to how knowledge is generated, transferred and acted upon in these new contexts'* (Powell, 1998: 228).

The dearth of study might be due to the messier and more demanding nature of process method (Parkhe, 1993; Langley, 1999). It may also reflect the fact that interest in technology transfer in strategic management has been dominated by industrial economics that relies on a more rational view of process. Processual research influenced by greater sociological interest is slowly reversing this trend. The aim of this thesis was to contribute to the literature by taking a processual view of technology transfer.

This chapter starts with the method of literature search, followed by a brief definition of performance success. Broad theoretical perspectives in strategy are discussed to illustrate the research fit. Three process meanings are introduced that represent an increasing dynamism when moving from the first to the third meaning. The third process meaning best describes the view of process adopted (Pettigrew, 1992; Van de Ven, 1992). The literature review is organised into two categories with the intention of illustrating the dynamic research gap. The conduct of the literature review helped design the research to help accumulate further knowledge (Hart, 1998).

The first category discusses less dynamic studies that use either or both of the first two process meanings; the second category deals with studies that utilise the dynamic process meaning. A dynamic process theory of learning and mutual adjustments (LaMA) (Doz, 1996) is introduced as a promising theory applied in this novel setting. Its selection for research application was based on a belief that it represented a relatively simple, yet well developed general theoretical model, developed by a respected strategy process scholar. The fact that it had not previously been applied in higher complexity settings offered an opportunity for theory enrichment. Starting theory was considered important (Miles & Huberman, 1984) because in its absence, process might be limited to mere description (Pettigrew, 1997). Moreover, the advantage of applying a pre-existing theory helps accumulate further knowledge (Johnson, Melin, & Whittington, 2003). Application of this theory in the IDT setting was considered an important and significant research contribution to the strategic management literature.

2.1 METHOD OF LITERATURE SEARCH

The literature search was conducted in a structured manner starting June 2000. The search terms were progressively refined as understanding of the field increased. At the start, the search was limited to academic publications from 1990 to the then current year of 2000. The ten-year period seemed appropriate on the basis that it would reveal recent research and any repeated citations would help uncover important publications from the previous decade. This approach was reinforced by the fact that key strategy and organisational theorists (Chakravarthy & Doz, 1992; Pettigrew, 1992; Van de Ven, 1992; Barnett & Burgelman, 1996) had appealed for more process oriented research in the early 1990s. It indicated that research developments since those calls might be more fruitful.

The terms 'technology/knowledge transfer' and 'process' were used for on-line searches. The search consisted of PhD theses abstracts (UK, US and others) and the following journals in strategic and general management that were considered of high academic quality and relevant to the field of study: Strategic Management Journal, Journal of International Business Studies, Academy of Management Journal, Academy of Management Review and Administrative Science Quarterly.

On reading some research, it seemed that the concept of technology or knowledge transfer was an implicit activity in studies that considered various forms of organising and performance effectiveness: strategic alliances, partnerships, joint ventures, networks, inter-organisational relationships, collaborations, mergers and acquisitions. Also, depending on different disciplines, the role of technology transfer, the use of the term process and its analysis seemed to be studied at different levels: at a micro level the technology itself, at macro level the industry or nation (Zhao & Reisman, 1992; Bozeman, 2000). The research concern here was a more micro collaborative organisation level, in the context of emerging industry changes. In the abundant alliance literature, knowledge transfer was also synonymous with knowledge combination, creation or learning (Bresman, Birkinshaw, & Nobel, 1999; Inkpen, 1996; Powell, 1998). It was hence important to be clear and explicit about what was meant by technology transfer and the level at which process was applied (see Concept definitions Chapter 1).

The second search effort was undertaken manually. It started January 2001 and lasted 3 months. As search terms were extended to include organisational forms which could be used to conceptualise technology transfer, it was thought that a manual search might be more effective. Based on recurring citations, the following journal titles were added to the search: California Management Review, Management Studies, Organization Science and Research Policy. A vast literature seemed to have amassed particularly on alliances with a particular interest in how they influenced organisational competitiveness. The specific research concern to link process with performance helped narrow down this mass.

From November 2001, subscription to an electronic alert service including all journals listed above was made. Latest content index was received regularly via email. From this index, relevant studies were accessed to keep the research process informed of developments in the field. This process was continued until October 2004.

Before reviewing the literature, the concept of success is discussed. Success is an important concept because this research does not just describe process but links it to process outcome (Pettigrew, 1997). Assessment of organisational impacts of technology transfer process can be challenging because they can be numerous and almost always difficult to separate from other parts of organisational life.

2.2 DEFINING SUCCESS

Success is a much more complex a concept than some studies might suggest. In social science, simple success or failure is relatively rare for no single objective truth exists (Lincoln & Guba, 1985). How success is viewed depends on the assessor, criteria they use and motivations or expectations they have. From a processual perspective, an assessor's criteria may change as the process unfolds; the view of success may not remain fixed over time. Given this plurality, diversity, even dynamic nature of success, how can one know if a process has been successful, particularly in relation to Alpha's performance? Before exploring this brief discussion follows on how the concept of success has been used by researchers in the strategy field.

Large scale a-processual studies tend to rely on aggregated proxy measures of success: sales, profitability, market-share, etc. The problem is their de-contextualised nature; conditions that might have influenced those outcomes are ignored. Organisational performance contributed by a specific technology transfer may not easily be disaggregated from other organisational activities. Strategic alliance longevity is a commonly used success factor, with the assumption that organisations seek a long relationship; in reality, termination may represent much greater success (Osborn & Hagedoorn, 1997). Patents as measures of successful organisational learning have been used (Mowery, Oxley, & Silverman, 1996; Hamel, 1991). The problem with these is the difficulty to control for managers' view of technology readiness for patenting. Moreover, some national contexts may me more conducive to patent submission than others. Other popular static concepts are cost or time: did technology transfer occur within the set budget and timeframe?

Processually oriented researchers acknowledge that technology transfer provides an opportunity to learn new skills and knowledge for future benefit: a concept reflected in the social network perspective where collaborative ties act as spring boards for future relationships (Powell, 1998; Gulati, 1998). Quantifying future value of relationships is however difficult. Another measure of success is whether knowledge has been transferred effectively; whether it has been accumulated through learning (Kogut & Zander, 1992). The problem with this view is that knowledge cannot

easily be isolated from the transfer process (Bozeman, 2000); its embeddedness and inter-linkages means that it rarely leaves behind obvious tracks when moving across organisational boundaries (Gupta & Govindarajan, 2000). Learning, an amorphous concept is difficult to measure. The social constructionist view of knowledge better represents the simultaneous knowledge enactment and creation (Tsoukas, 1996). In this research, social actions and behaviours were considered better indicators of whether and how knowledge was created. The advantage of a process study is that from a mass of data, certain actions and behaviours might be interpreted to help deduce whether learning and knowledge creation occurred.

Another issue with a-processual research is that impressions are often gathered from top executives whose perception of success may vary from individuals involved in daily knowledge creation activity. Moreover, impressions are often collected from just one side of the relationship. The problem is that organisations often enter collaborative relationships with different aims, as seen in relationships between emerging and developed nation firms (Hitt, Dacin, Levitas, Arregle, & Borza, 2000; Hagedoorn, 1993). Organisations from more mature industries had greater interest in market access than learning. These differences might have implications for Alpha's diverse organisational constituency; the relatively newer technology organisations might prefer to learn for future individual benefit than for collective success. How does this influence the overall success?

Success of a collaborative technology transfer may be viewed at various levels: at collaborative project level, participant organisational level or at the level of participating individuals. When multiple stakeholder interests exist, single performance measures rarely capture those views (Doz, 1988). A transfer may also be highly successful from a social, collaborative point of view, but may represent commercial failure if market needs are overlooked (Littler & Leverick, 1995).

Dodgson (1991) study of a dyadic collaboration between SSL and Quantel illustrates plural view of success: SSL considered it a technological success because it developed a new product. Quantel however viewed it as commercial failure because it failed to produce an envisaged product. Despite this apparent failure, Quantel's knowledge accumulation led to an innovation within a short time of terminating the relationship. Whilst Quantel's view of collaborative failure might be correct at one level, its future capability might not have been enhanced without the knowledge gained from the 'failed' collaboration. Process research can reveal this detail and richness that might not be captured using de-contextualised, quantitative methodologies.

Collaborations that include non-profit organisations are likely to have non commercial objectives (Bozeman, 2000; Rogers, Carayannis, Kurihara, & Allbritton, 1998). A study of Finnish companies participating in collaborations spanning various industries similar to Alpha, found differentiated organisational goals: large companies were concerned with technological access while smaller firms had greater market orientation (Luukkonen, 2002). These goal differences have process

implications on organisational engagements in the collaborative technology transfer. The processes cannot be studied effectively using static, linear process models.

Acknowledging the multiple organisational goals and expectations, in the context of this research, Alpha's success at the collaborative level had been defined by the EU as:

> *'Achievement of the project goal of technology integration, driven by novel business models and for the integrated technology to generate commercial interest from within and outside the collaboration'*

This goal was stated in the formal contract document produced by the EU, the project sponsor. The contract provided a common basis of understanding for organisational engagement in technology transfer. It also provided the basis for EU's assessment of the final outcome. For the sake of simplicity, it was assumed that all organisations subscribed to this goal initially and that divergent expectations would be revealed. The qualitative research design enabled the interpretation of changing actions and mutual adjustments as indicators of changing expectations and commitments over time.

The empirical findings showed some changes in organisational expectations and the basis for Alpha's final performance assessment. A narrowed scope of technology integration occurred without development of novel business models and little immediate commercial interest in the integrated concept. Yet, the EU assessed it as a success; it even funded a follow on collaboration (see Chapters 8 & 9). Its main criterion for success was Alpha's ability to create external organisational linkages.

There now follows a brief discussion about the broad theoretical perspectives and a review of technology transfer studies in the field of strategic management.

2.3 TECHNOLOGY TRANSFER IN THE STRATEGIC MANAGEMENT FIELD

The strategic management literature has dealt with questions such as why organisations collaborate and transfer knowledge (Hagedoorn, 1993); how collaborations form (Doz, Olk, & Ring, 2000; Sakakibara, 2002); how partners are selected and the degree of control or influence they exert (Yan & Gray, 1994); and which technology is preferred by different organisations (Hagedoorn, 1993). Whilst recognising that findings from these literature streams may influence the process of collaborative technology transfer, these strands of enquiry were relied on to a lesser extent. A greater research concern was to understand the transfer process itself once organisations had committed to collaborate and had agreed on the content of the collective task. In essence, there was less concern to understand Alpha's genesis but more for its development: a shift from a static to a more dynamic concept.

In strategic management the transaction cost approach (Williamson, 1975) explains the relationship between collaborative reason and structure, but the strategic learning approach (Teece, Pisano, & Shuen, 1997; Inkpen, 1996; Hamel, 1991) better explains inter-organisational relationships and collaborative outcomes. In essence, the former approach views organisations as transaction performers with the aim of cost minimisation where collaborative integration represents the least cost method. The learning approach argues that organisational activities are more than mere transactions; it is through social learning interactions that knowledge is transferred and created. The two broad theoretical bases in strategic management are now discussed in more detail (Hoskisson, Hitt, Wan, & Yiu, 1999):

The first, more traditional and outwardly focussed view looks at organisational positioning relative to its environment. Contributed by Industrial Organisation (Porter, 1979) it uses Structure-Conduct-Performance as an analysis to understand industry structure and organisational performance. Rationality is assumed; the strategist has all necessary information to formulate his plan. Transaction Cost Economics (Williamson, 1975) builds on this approach. This theory argues that firm activities are a collection of transactions that have associated costs. Cost minimisation is best achieved through hierarchical integration. The extent of this integration reflects the comparative costs of market versus hierarchical organisation. In conditions of market uncertainty and technological change, organisations are probably best placed to source the technology to help minimise internal developmental costs and risky returns. A great deal of technology transfer research utilises this view with a specific concern in terms of efficiency. It seems to ignore future value of collaborative activity (Madhok, 1997). The methodologies utilise large scale comparative samples, which use aggregated and de-contextualised data. Whilst this view may give useful insights it ignores human influence, organisational heterogeneity and temporality.

The second stream looks inside the organisation. Organisations are viewed as heterogeneous bundles of resources that contribute to building and sustaining of unique capabilities for competitive advantage. This paradigm is known as the Resource Based View (RBV) (Wernerfelt, 1984). It builds on Penrose (1959) work, which views firms as collections of productive resources made up of physical things and people; their heterogeneity confers organisational uniqueness. Resource possession is not sufficient; it is the ability to put the resources to distinctive use that helps explain why two organisations with similar resources may perform differently. Organisational theorists have contributed to this approach with work on limits of human action and understanding and organisational learning (Simon, 1991; Cyert & March, 1963).

RBV has also contributed to the emergence of sub-streams that focus on specific resources. One such stream: the Knowledge Based View (KBV) (Kogut & Zander, 1992) focuses on knowledge as a resource and firms as heterogeneous knowledge-bearing entities. Tacit nature of knowledge and its social complexity are important determinants of competitive advantage. Prahalad & Hamel's

(1990) notion of core competence similarly arises from a curiosity into why two firms with comparable portfolios can end up performing markedly differently. They view core competence as a collective organisational learning; in the way diverse production skills are coordinated and multiple technology streams are integrated. It is this distinct ability that makes it difficult to imitate. A competitor may acquire technologies that constitute core competence but may be unable to duplicate the entire pattern of learning and internal coordination.

The Dynamic Capabilities framework (Teece et al., 1997) analyses organisational wealth creation process in the context of rapidly changing environments and complements the work of Prahalad & Hamel (1990). It draws on RBV and argues that wealth creation depends upon sharpening and refining of internal technological, organisational, and managerial processes. Search for new opportunities, good internal organising and renewal of competences that better fit the changing environment is more fundamental to organisational success than strategising (Porter, 1980). Exploiting existing firm-specific knowledge and organisational learning are considered a fundamental concern for any firm.

The preceding sub-streams clearly argue that competences maintain value through continuous knowledge development and organisational learning. Learning is an important concept (Lyles, 1988; Fiol & Lyles, 1985) discussed in Chapter 5. If achievement of organisational success is a continuous process of learning then the second of the two schools illustrates the dynamic nature of strategy process. Not surprisingly, research in this second stream is more process-oriented as evident in Nonaka's (1994) conceptualisation of knowledge creation as an interactive amplification between tacit and explicit knowledge and learning. Cohen & Levinthal's (1990) notion of absorptive capacity also implies a processual acquisition of knowledge on a path development basis, the logic being that current knowledge facilitates accumulation of further related knowledge.

Three meanings of process are now presented. They are used as a basis for mapping the existing strategic management literature to illustrate the dearth of dynamic process study.

2.3.1 THREE PROCESS MEANINGS

The term process has been used with a variety of underlying meanings resulting in diverse conclusions about how effective technology transfers occur. Various process models have been conceptualised, which have influenced the research questions, explicit or implicit theories used, methodologies chosen, and contributions to understanding change process (Van de Ven, 1992). To achieve consistency between theory and method, it is important to state the assumptions at the outset. 3 conditions are listed:

i) Definition and meaning of process
ii) Theory of process and

iii) Research design that encapsulates the defined process

Van de Ven (1992) defines three meanings of Process. First and to some extent the second of the three meanings reflect theories and methodologies generally used in cross-sectional study with an underlying assumption of steady state equilibrium. Despite the unstable nature of organisational life, few empirical studies in strategy process research test the validity of this assumption (Chakravarthy & Doz, 1992). The last of the three meanings is more dynamic and represents the meaning of research interest here.

If technology transfer is conceptualised as a simple input / output process model, then the three process meanings can be characterised as follows:

i) PROCESS MEANING 1

This meaning is based on a logic that explains a causal relationship between inputs (independent variables) and outputs (dependent variables) as if they were static concepts. Although process is used to explain variance, process is not observed in any way; it is assumed. Variables with fixed properties contained in the process are linked linearly; any interaction effects or co-influences are ignored. Time stands still and methodologies are generally quantitative and cross-sectional. The problem is how one can know if what occurs at a point in time has caused that outcome (Chakravarthy & Doz, 1992). This meaning has been favoured by researchers who take a more rational view of technology transfer or a seeming need for generalisable results.

ii) PROCESS MEANING 2

Here, a category of process concepts or variables representing individual or organisational actions are linked to outcomes. Concepts such as communication frequency are operationalised and measured as independent variables; the concept attributes vary along numerical scales from say high to low but they have only one causal meaning or pattern of effect in a given study. As a consequence, at different points in time one can only measure if, not how, a change occurred. A desire to quantify the results means that methodologies are usually combined, with a heavy reliance on quantitative rather than qualitative aspects. Although the concepts imply greater dynamism compared with the first process meaning, their use is relatively linear; neither interactionism nor changing properties of the concepts are of particular concern. This meaning was also considered less representative of the dynamic process view adopted in this research.

iii) PROCESS MEANING 3

This is underpinned by the work of Abbott (1992) that considers interactionism as a force that shapes the character of process. This meaning characterises a sequence of events that describes how things change and develop over time. It denotes an underlying pattern of evolving understanding of emerging issues and actions to deal with them. Dynamic theory predicts the

pattern and path of change, sometimes even the rate of change (Barnett & Burgelman, 1996). In contrast with the second definition, historical development is included in understanding the sequence of incidents, activities and stages that unfold over the course of a subject's existence: in this research, Alpha was the central subject. Contextualism and embeddedness are included in the emergent process (Pettigrew, 1992), which helps explain how something developed in the way that it did, in that time and space. The implication is that the same process may play out rather differently in another situation. Embeddedness refers to the complexity of a process and various influences that bear upon it from multiple levels. Inner and outer organisational contexts have important influences on content and process of strategy development. Context and action are interwoven and importantly, process and outcome are intimately interlinked.

Of the three meanings, this meaning was thought to closely observe process in action or 'to catch reality in flight' (Pettigrew, 1992). To observe these actions, process has to be studied using methods that allow eclectic data collection. It is not conducive to the use of de-contextualised standardised datasets. This shows that a key difference amongst the three process meanings is the methodology used to capture the view of process. Pettigrew also argues that linking process to outcomes offers a better means for accumulating useful knowledge. Unlike an ethnography, which might study process in its own right, outcomes serve as good anchor points to link process and help explain their development. Given its heavy reliance on qualitative methodology, dynamic process study is limited to a small number of rich and detailed cases where temporality is realised through longitudinal study. The research method that captures this view is discussed in Chapter 6.

The literature review is organised into two categories: the first category discusses studies that seem to adopt either of the first two process meanings considered relatively linear and less dynamic; the second category reviews studies that adopt the third more dynamic process meaning. The categories are labelled as follows:

i) Less Dynamic Process study (Process Meanings 1 & 2)
ii) Emergent Process study (Process Meaning 3)

This categorisation helped to understand what research had been done utilising the three process meanings; to review the findings and to determine how they related to the research question. In reading the research studies, a constant concern was to look at how researchers had implicitly or explicitly used process to understand the sharing and creation of knowledge.

Many studies in the first category relate certain technology transfer dimensions as input factors to transfer outcomes in a variable like way. Whilst the variables better represent transfer dimensions, they are extracted into objects whose temporality and interacting complementarities are ignored. In

arriving at conclusions no direct observation[8] of process is made; when more than one input is considered there is little concern for the sequence, or temporal co-influences on outcome development. Outcome performance is generally stated in single measures as if uncontested and pledged by all collaborating stakeholders. The structure is fairly linear, implicitly assuming simultaneous and constant effect over time. The wide use of quantitative method in strategic management is probably reflective of its dominance by industrial economics. Studies that use the second process meaning use organisational concepts constructed as variables, measured as fixed entities whose attributes vary along numerical or intensity scales, again linked to outcome using variance theory. The fixed nature of the attributes allows understanding if change has occurred but little opportunity to study how change occurs. Despite an implied dynamism, the concepts are used in a relatively linear way. Most studies combine a small qualitative element to operationalise these organisational concepts.

The second category illustrates the rather limited research that uses non-linear, more dynamic process theory. This view seeks to understand organisational life beyond the surface, by opening the 'black box'. It seeks to observe organisational interactions and processes by which people respond to and shape the situation in which they are immersed (Pettigrew, 1992). Structure and process are interlinked by tracking the nature of social adjustments that maintain some kind of social order (Poole et al., 2000). Most studies use longitudinal, qualitative methodology, either constructed as two or three cross sectional panels or as process followed over time. The unwieldy nature of data generated by this method (Langley, 1999) also helps illustrate why complex dynamic processes are not reducible to a handful of variables; otherwise the apparently inconsequential micro-events that lead to major changes in process development might be overlooked. This category also reflects the small study samples used to capture the thick detail and process richness.

Research that utilises the first two of the three process meanings is now discussed.

2.4 Less Dynamic Process Study (Process Meanings 1 & 2)

This first category reviews studies that isolate certain transfer dimensions as if they were variable-like inputs that either facilitate or constrain a technology transfer. The so called variables can be considered to fall into four broad groups each associated with its 'causal process' explanation: i) knowledge characteristics that affect the ease of transfer ii) characteristics of partnering organisations that influence the outcome iii) organisational motives that can lead to difficulties in forming trusting relationships iv) organisational contexts that may be influenced by national systems and values. Other research within this less dynamic process category uses the second of the three

[8] Direct observation does not signify existence of physical evidence left behind by the transferring technology. That would suggest that technology was separable from process. Observation here represents actions, decisions, changing conditions that give clues to what happened and why it might have happened

process meanings, using constructs such as frequency or intensity of communication to facilitate the transfer of tacit knowledge. Whilst the concepts convey dynamism, their variable-like use signifies only if change has occurred rather than how it has occurred. It is not known how choices and decisions are made and actions modified. The studies often mix large scale, cross sectional quantitative method with a qualitative element; some use case studies but fail to capture detailed process development over time.

Some research has focused on single variables with a particular concern for their attributes: knowledge tacitness (Zander & Kogut, 1995), whilst others have studied two or more variables (Teece, 1976; Szulanski, 1996; Simonin, 1999; Gupta & Govindarajan, 2000). Although simultaneous effects of variables are studied (Simonin, 1999; 2004), the models are relatively linear for their limited interest in interaction effects or changing characteristics of the variables. The sequence of effect is ignored with an implicit assumption of necessary and sufficient conditions for outcome to occur. Many studies reviewed in this section are concerned with unidirectional, intra-firm transfers. They fail to capture the impact of inter-organisational complexities that are of research interest. Almost all studies focus on dyadic relationships but often studied from one side of the partnership. The more process and practice-oriented studies discussed later in this section illustrate multiple influencing inputs, but are a-theoretical and more prescriptive in tone; they lay out a 'to do' list to achieve success (Littler & Leverick, 1995).

Knowledge characteristics have received a great deal of interest in the study of technology transfer in strategic management. The concept of knowledge (discussed in Chapter 1) seen as tacit and explicit, has mostly been studied in a variable like way. It is considered to be separate from the transfer process; a view that fits poorly with the processual view of knowledge.

Tacit knowledge is the most commonly cited reason for transfer difficulty (Polanyi, 1967; Zander & Kogut, 1995; Simonin, 1999). Tacitness is said to arise because knowledge is socially and contextually embedded, and is resistant to clear communication (Simonin, 1999). Embeddedness refers to its organisation-specific nature; its linkages with individuals, processes, procedures, and infrastructure and so on. Despite knowledge being perceived as processual, this characteristic is reduced to a discrete variable. The difficult to transfer nature renders tacit knowledge a strategic resource that is highly sought after in collaborative arrangements. The sticky property (von Hippel, 1994) of location specific knowledge makes it especially difficult to transfer across country borders (Kogut & Zander, 1993; Teece, 1976; Subramanian & Venkatraman, 2001). Explicit knowledge on the other hand is codified into procedures or manuals. It is easier to explain, understand and therefore easier to mobilise between contexts. In knowledge intensive industries such as information technology or software development, knowledge characteristics would be expected to be highly embedded and resident in individual skills, in the tools and techniques people use. They would be resistant to transfer.

To facilitate transfer of tacit knowledge, it has to be codified for ease of teaching, learning and communication (Nonaka, 1994; Inkpen, 1996). But people may be unaware of what they know; an inability to articulate the entire scope of knowledge known makes codification difficult (Polanyi, 1967). Various metaphors are used to signify its embedded or context bound nature: causally ambiguous (Szulanski, 1996; Reed & DeFillippi, 1990), sticky (von Hippel, 1994), ill structured, complex and idiosyncratic (Kogut & Zander, 1992). Causal ambiguity represents the uncertainty about causal linkages between action and outcome, between input and output or between cause and effect. An inability to identify a set of relevant variables involved in the process and an inability to control for them negatively affects the learning necessary for knowledge creation and effective transfer (Dierickx & Cool, 1989). Despite the processual nature of these concepts, researchers like Szulanski (1996) have studied causal ambiguity in a variable like way by asking respondents to rate the ease of comprehension of knowledge held by partners, rather than observe action over time.

Other 'process' logics that explain the difficult nature of knowledge and its transfer are: the degree of codification, knowledge newness and relatedness. But they are not studied processually e.g. how codification or knowledge newness evolves over time.

Zander & Kogut's (1995) research to understand the speed of knowledge transfer and imitation of organisational capabilities used a cross-sectional study of 44 intra-firm unidirectional transfers of manufacturing capability by 20 Swedish multinationals. Various dimensions of knowledge were operationalised as separate constructs to represent ease of understanding and communication of knowledge: codifiability, teachability, complexity, product observability. They concluded that greater the degree of codification, easier it was to teach and transfer. Bresman et al. (1999) multi-method study of 42 international acquisitions argued that patents signifying codified knowledge were easier to transfer than individually held tacit knowledge. Codification was also easier when partnering was under equity rather than arms length conditions (Kogut, 1988; Mowery et al., 1996). The rationale being that ownership confers greater trust and willingness to share firm-specific knowledge. This assumes that ownership is a necessary and sufficient condition for transfer effectiveness.

If this view is applied to Alpha then the degree of knowledge codification was expected to be relatively low and therefore much more difficult to transfer. Given the non-equity based collaborative arrangement it was not known how trust might develop, how partners would share unique technological knowledge over time.

It has been suggested that as long as one knows how much and what type of knowledge is under transfer then methods can be adjusted for successful transfer (Rebentisch & Ferretti, 1995). The problem is that it may not be possible to identify and quantify all knowledge contained in a transfer. When considering diverse industry sectors, partners may be unaware of knowledge held by others until the integration process begins.

Teece (1976) cross-sectional study linked transfer costs to ease of transfer. He concluded that higher cost reflected the effort needed to codify knowledge. This might suggest that as long as a great deal of money is spent on a transfer then codification is achieved for successful transfer. It also assumes that organisations are homogeneous in their effective use of resources. Teece also argues that newer and more firm-specific knowledge is difficult to codify. When technology is older, and its properties are widely known in the market then it is easier and less costly to transfer. In the context of technology transfer across different industry sectors, knowledge familiarity about neighbouring technologies was likely to be low. A great deal of effort to communicate, understand and mobilise knowledge was expected.

The characteristics of collaborating organisations and their learning ability or absorptive capacity (Cohen & Levinthal, 1990) is another dimension considered by researchers. Development of absorptive capacity is not guaranteed by simple participation in related activities but has to be learnt and internalised. Unique organisational knowledge develops through technological and market history and experience (Zander & Kogut, 1995). Organisations generally find it easier to stay within the vicinity of their past experiences. They adapt and learn in an incremental fashion, suggesting that current knowledge limits the future steps. But researchers do not observe this concept in an emergent, path dependent and processual manner. It is treated as if it exists at a given point in time and that this existence (or lack of it) contributes to performance outcome. When partners have successfully collaborated previously, one might expect learning in their future collaborations to be enhanced.

Similarly, organisations are viewed as possessors of distinct knowledge architectures (Rebentisch & Ferretti, 1995). The assertion being that greater the difference in knowledge architectures, greater the effort required to transfer and greater the technological scope transferred. This finding may be relevant in this research given that organisations with older technologies have probably had little exposure to neighbouring sectors. It may have an impact on the speed of learning: for instance a telecoms operator may be adept at network maintenance whereas software author at understanding individual customer needs and responding flexibly and rapidly.

With respect to knowledge relatedness, an internationalisation study found cultural barriers experienced by firms when they first entered a foreign market. But they learnt from previous experience both in how to transfer and how to deal with foreign conditions for transfer (Barkema, Bell, & Pennings, 1996). Although the findings might suggest that the study was processual, it used cross-sectional data from 225 foreign entries by 13 Dutch firms analysed using statistical methods that linked prior entries to current effectiveness.

An important determinant of transfer effectiveness is organisational ability to understand what is required to transfer knowledge. The importance of this starting competence is confirmed in a cross-

sectional study of internal transfers of 'best practice' in multinationals (Szulanski, 1996). Firms exposed to transfers with diverse customers or products, have a greater capacity to learn (Ghoshal, 1987); conversely, those that have dealt with fewer competitors and customers have a narrow range of experience; having faced fewer challenges they find it difficult to participate in new routines (Barkema & Vermeulen, 1998).

Simonin (1999) research of 151 US firms used a linear process model. It found that collaborative experience was not enough; for future benefit, experience had to be internalised and transformed into collaborative know-how. The concept of collaborative know-how was operationalised using concepts that were considered important for knowledge transfer but measured in a variable like way: skills in identifying, negotiating, managing, monitoring and terminating collaborations.

In Alpha, organisations with previous knowledge transfer experience with neighbouring sectors were likely to be better able to deal with collaborative transfer than those without previous exposure. It was not known how differential organisational experiences might complicate social learning, particularly if different speeds of learning and transfer occurred.

In a recent study Simonin (2004) sought to test a model of organisational learning in the process of knowledge transfer in international strategic alliances. Using a sample of 147 multinationals, a cross-sectional method was applied to investigate the simultaneous effects of learning intent, learning capacity and knowledge ambiguity on knowledge transfer. Learning intent facilitated knowledge transfer whereas knowledge ambiguity impeded it. The effect of organisational culture on learning, size of firm and the fact that partners may or may not be competitors affected the process. Whilst most concepts are clearly dynamic, the study did not follow an emergent process of transfer over time.

The alliance literature is replete with evidence that organisations often have hidden motives that cause precarious relationships in joint working. The collaborative / competitor tension (Hamel, 1991), and fear of future strategic divergence that cause fragile relationships (Doz, 1988) are important considerations in a complex technology transfer. Szulanski (1996) concept of 'arduous relationship' is an indicator of distant relationship and a major barrier to transfer success. He operationalised it using survey questions on a Likert scale. The questions centred on ease of communication between source and knowledge recipient or collaborative ease between source and recipient. It did not follow the course of transfer to determine how the concepts developed.

A large study of motives for engaging in alliance relationships, spanning various industries, used almost 10,000 agreements involving 3500 partners. Two dominant motives were found: market or technology (Hagedoorn, 1993). Mature industries were more likely to seek market knowledge and access, whereas high-tech industries predominantly sought technology complementarity and

reduction of innovation time-span. Unless motives are honestly declared and behaviours are consistent with those declarations, distrust may pervade the process. The study however fails to give insights into how organisations overcome their differences for success development. This finding may be particularly relevant in Alpha given the technological mix.

A study of intra-firm transfers by multinationals found that the source firm was reluctant to share its knowledge for fear of losing a privileged position (Gupta & Govindarajan, 2000). This manifested as an unwillingness to release resources to support the transfer. Recipient firms by contrast were often unwilling to take on new ideas, reflecting the not-invented-here syndrome (Katz & Allen, 1982). Another problem was the perceived value of knowledge being transferred, which affected the recipient attitude to it.

Johnson, Cullen, Sakano, & Takenouchi's (1996) cross-sectional dyadic study investigated the formation and outcome of inter-partner trust in non-equity alliances. To investigate reciprocal views and effects of trust, dyadic data were gathered from Japanese and US partners in 101 alliances. Results showed that partners' cultural sensitivity was an important contributor to building trust on both sides of the dyad. Complementarity with partner (operationalised as technical skills, market knowledge etc.) contributed to trust for the US partner but not for Japanese. On the other hand, similarity between partners (operationalised as firm size, product lines, strategy for introducing product lines, technical expertise etc.) led to trust for Japanese but not the US partner. Although high level of trust facilitates collaborative success, trust is strongly influenced by partners' cultural or societal settings (Dodgson, 1993). The studies do not show how organisations deal with these differences.

Influence of organisational context has received research attention but again treated in a variable like way. Instead of viewing it as a changing and evolving concept, it is isolated and related to a transfer outcome at a particular point in time. Context refers to an organisation's external and internal environments: the former refers to national culture, economic system, competitors, customers and suppliers and government policies. The latter refers to organisational culture, business practices, and values towards employees, customers and suppliers. Organisational practices and decision-making differences evolve from socio-cultural environments of each context (Hofstede, 1980). Cultural ambiguities arise due to national differences in language, institutions and political systems or levels of education and degree of industrial development. Transfers that involve a number of partners from different national contexts and indeed organisational contexts are likely to encounter difficulties along many of the dimensions illustrated.

The variable like treatment of these concepts is illustrated by Simonin (1999) study. Using a 7 point Likert scale, organisational distance is operationalised as two questions. Respondents are asked about similarities in business and operational practices, corporate cultures and management styles.

Cultural distance is operationalised using questions about differences in national cultures and language and whether they constitute major communication obstacles; statistical techniques are then used to test the strength of the relationships.

Pothukuchi, Damanpour, Choi, Chen, & Park's (2002) quantitative study of 127 JVs between India and 21 countries, looked at national and organisational culture differences in JV performance. They argued that previous studies had aggregated national differences with organisational culture, whereas disaggregated the two. Based on interviews and perceptions of Indian partners only, a negative effect of cultural distance on performance was found due to organisational difference rather than national culture. Organisational culture was important along dimensions such as open or closed communication style. Although these findings have implications for process in complex collaborations constituting different technology sectors, different organisational forms and national origins, the study itself gives little insight into how partners overcome their emerging differences.

Whilst most studies link inputs with transfer outcomes independently, Simonin (1999) linked knowledge tacitness, complexity[9], partner protectiveness, prior collaborative experience, cultural and organisational distance as precursors to knowledge ambiguity. The simultaneous effect on transfer process occurred through a concept of knowledge ambiguity. The effect was moderated by collaborative know-how, ability to learn and alliance duration. As the alliance matured the amount of knowledge shared increased. The study used a cross sectional survey and a structural equation to test various hypotheses on a sample of 147 multinationals selected on the basis of sales volumes and employee numbers. Most inputs were operationalised as questionnaire items with 7 point Likert type scale. For instance, respondents were asked to rate knowledge ambiguity based on: the technology/process know-how held by your partner is easily transferable back to your company; the association between causes and effects, inputs and outputs, action and outcomes related to the technology/process held by your partner is clear. Learning capacity was operationalised with the question: your company has committed a lot of personnel to this alliance. Whilst the research design allows wider generalisability, it fails to capture social interactions and their effects on process development. The inputs are treated as if they can be extracted from the context. Simonin acknowledges the limits of drawing conclusions from measures at single points in time. He concludes that there is need for longitudinal process research.

The more practice-oriented studies have generated a list of factors for outcome success advising practitioners how to avoid transfer difficulties. The methodology is generally based on large scale cross-sectional survey. The problem is that one might start with optimal conditions but conditions may change over time. How this change develops and influences the process is not studied. Two such studies are now described.

[9] Complexity refers to knowledge content represented by the number of different work routines, individuals, interdependent technologies and any other organisational resources linked to it

A survey of 300 UK suppliers of IT products aimed to identify factors that affected outcomes of collaborative product development. The following factors were major contributors to success: equal perception of collaborative importance; existence of a collaborative champion; substantial degree of inter-partner trust; defined project plan and task milestones; frequent communication; participation consistent with commitments and expectations; similar perceptions of benefit (Bruce, Leverick, & Littler, 1995). Presumably absence of the factors would lead to transfer difficulty or even collaborative failure. It is not known how temporality and contexts influenced the factors and how decisions were made over time. The authors acknowledge that surveys represent a snapshot whereas collaborative product development is an evolving process.

A similar study of collaborative product development, aimed to understand influences of inter-organisational cooperation on outcomes by asking respondents to rate factors that led to performance outcome. Six success factors were identified: selection of partners with good cultural fit, work style, and past collaborative experience; similar problem solving style; establishment of ground rules, method to monitor and control the project; setting up a project team or champion; ensuring equality or perceived equality in benefit and contributions; and maintaining a market focus (Littler & Leverick, 1995). Many of these factors would be expected to evolve and influence each other, but the methodology did not capture the complexity, interactionism and dynamism.

The lack of use of dynamic process is criticised on the basis that a great deal of empirical evidence in strategy research is concerned with cause-effect relationship (Barnett & Burgelman, 1996), where cross sectional data analysis at single points in time illustrate or test rationales such as consequence of particular capability or market position on performance. Without observing the dynamics through which outcomes develop it is questionable how what exists at a point in time can be linked to an outcome. The focus has to shift from the result of the process to the process as well.

In this small study of two international JVs dealing with mature technologies, the aim was to understand mechanisms needed to transfer different types of knowledge (Rebentisch & Ferretti, 1995). Knowledge was categorised according to its tacitness and codifiedness and linked to different communication methods. Simple knowledge transfer was enabled by impersonal communication such as letters, memos or objects. As knowledge scope widened to include people-based behaviours then physical relocation was most efficient. People-based behaviour was represented by actions and interactions of a process engineer in his approach to problem solving and dealing with technical issues. Despite the mature nature of technologies, it was found that transfer of physical hardware constituted only a small fraction of embodied knowledge shared. Whilst this study hints at knowledge complexity and process implications, its reduction of knowledge and modes of communication suggests that it could be quantified and planned at the outset. The simplistic approach fails to capture the unfolding events over time.

Subramanian & Venkatraman's (2001) study of 90 trans-national product development transfers in multiple industries determined how firms overcame the problem of location specific knowledge and how knowledge was harnessed from geographically dispersed sources. Using a survey method the study found that product development capabilities depended on the ability to transfer and deploy tacit knowledge about overseas markets. Use of team members with prior overseas experience or frequent communication between members led to greater product development capability and better products tailored to specific markets. Grosse (1996) study of technology transfer by multinationals to Latin American subsidiaries in 5 service industries, similarly found that transfer of experts were key to success. The large scale studies however fail to capture the micro-processes and temporality of the process. As a contrast, Bjorkman, Barner-Rasmussen, & Li (2004) study of intra-firm knowledge transfers in 134 Finnish and Chinese subsidiaries found that use of expatriates did not influence the extent of knowledge transferred from foreign subsidiaries. The quantitative study failed to uncover how and why expatriates did not influence the transfer.

The social component of knowledge creation is captured in concepts of meetings or visits. They constitute a more protracted form of communication, as an opportunity to improve the quality of relationships (Bresman et al., 1999). Kogut & Zander (1993) study echoes this in conceptualising social communities as facilitators of transfer and communication of new knowledge but uses a cross-sectional study. Gupta & Govindarajan (2000) have also argued that richness and intensity in communication increases through a process of socialisation as interpersonal familiarity and trust is raised.

Bresman et al. (1999) studied the factors that facilitated knowledge transfer in international acquisitions. Their multi-method approach included a survey of 42 acquisitions, followed by 3 case studies. Data was collected after acquisition, at two points 3 years apart, to help identify patterns of knowledge transfer from acquired to acquirer and vice versa. Their view of acquisitions was the merging of two social communities into one over time. It evolved from market to hierarchy. Acknowledging that process complexity was unlikely to be captured through simple transfer incidences, they looked at interaction patterns between acquirer and acquired units and their impact on knowledge transfer. They expected variations in the type of knowledge, its quality and direction of transfer at different stages in the process. They found that more frequent communication led to greater knowledge transfer; face to face and other protracted interactions were positively related to transfer. Although technical meetings were task related, a social component helped build trust. As time since acquisition elapsed knowledge transfer increased. Whilst this approach was valuable, greater understanding of how participants modify their communication and how the process emerges would have provided deeper insights into social knowledge transfer.

Gupta & Govindarajan (2000) used communication theory to study international transfers, using data from 374 subsidiaries of 75 multinationals; knowledge included customer service skills and

packaging technology. Their analysis was limited to individual subsidiaries without a concern to understand reciprocal process issues. They concluded that existence and richness of transmission channels in addition to factors such as perceived value of knowledge, motivational dispositions of interacting units and absorptive capacity of the target unit were facilitators for success. Richness of transmission channels was represented by communication intensity and conditions that facilitated communication. Whilst the concepts are dynamic they were studied in a variable like way.

Mohr & Spekman (1994) viewed partnerships as purposive strategic organisational relationships that share compatible goals for mutual benefit, and acknowledge a high level of mutual interdependence. Their concern was to determine partner characteristics that led to partnership success. Success was represented by: continuing relationship, objective measure (sales volume between dyadic partners) and affective measure (satisfaction of a partner with the other). They developed a linear model consisting of 3 process variables linked to characteristics of partnership success. From a survey of 557 dyads between manufacturers and computer dealers, they found that success was facilitated by: partnership attribute, communication behaviour, and conflict resolution. Partner attributes consisted of increasing commitment, coordination, interdependence and trust; communication behaviour consisted of quality of communication and sharing of information and participation; conflict resolution techniques entailed joint problem solving, persuasion and smoothing. Trust, willingness to coordinate activities, communication strategies used and ability to convey a sense of commitment to the relationship were found to be key success factors. The method was not processual.

Szulanski (2000) introduces dynamism into his study of knowledge transfers by developing a staged model. He accepts that transfers are not acts of mere knowledge transmission and reception but processes of reconstruction and creation: he conceptualises one stage following the next in a purposeful way. He maintains that the more eventful a process the more it is remembered and stored by the organisation to solve future problems. In his cross-sectional survey of 122 intra-firm transfers of best practice within 8 firms, process is modelled into four stages: initiation, implementation, ramp up and integration. Each stage is correlated with varying degrees of difficulty and knowledge stickiness. Temporality is captured in the analysis of knowledge stickiness, which contrasts earlier and later moments of activity. The model however is relatively linear and purposeful, whereas the view of social reality in this research was much more complex.

Whilst much of this research acknowledges the social and processual nature of knowledge transfer, the theories and methodologies fail to capture the detailed processes that provide an understanding of how organisations overcome process difficulties. Although research in this category is not all static it does illustrate the need for Process meaning 3 style of research. The second category termed emergent process is now discussed. It best reflects the dynamic process meaning adopted in this research and represents the area considered in need of further research. The review

uncovers research that has sought to study simultaneous links between context, content and process of change, and their inter-connections through time, using dynamic process theories; theories that explain both stability and organisational change.

2.5 EMERGENT PROCESS STUDY (PROCESS MEANING 3)

Emergent process seems to be the least understood and utilised of the three process meanings. This perspective includes more detailed study of actions, behaviours and underlying motivations to explain how change occurs and outcomes emerge. In essence, a dynamic process theory describes the pattern or sequence of critical events and the mechanisms that contribute to pattern formation for development of a particular outcome (Abbott, 1992). The most significant difference between this last and the first two views of process is that it takes on a historical path-development (Teece et al., 1997), contextually embedded in its time and space (Pettigrew, 1997). In other words, past actions have a cumulative and enduring effect on future events and outcomes. Compared with the others, independent variables are not the substance of analysis. Instead there is concern to capture dynamic micro-processes over time. This has implications for the research method.

The embedded nature of actions and the need to study them across various levels of analysis has to be considered (Pettigrew, 1992). In a collaborative technology transfer this may mean study of the project itself or interactions within and between partnering organisations (Doz, 1996). This helps build explanations that link various contexts and actions to outcomes, allowing a shift from a mere descriptive unfolding of process, to explanation of how an outcome develops.

Langley (1999) has reviewed process studies spanning different organisational and management disciplines (Allison, 1971; Garud & Van de Ven, 1992; Pettigrew, 1985; Mintzberg & McHugh, 1985; Doz, 1996). She has categorised them according to their implied process meanings and associated process methodologies. This categorisation and constituent studies are discussed in Chapter 6 with a particular concern to understand the method they utilise. The reason for not reviewing many of the studies here was because the focus of this review was the strategic management literature that dealt with technology transfer and its process outcome.

An important observation from this review was that most studies are based on small sample sizes that used qualitative case study method to capture the detailed complexity and process temporality. It should be noted that research that utilises the social network perspective (Gulati, 1998; Powell, Koput, & Smith-Doerr, 1996), a more dynamic theory involving higher complexity organisational settings, is not discussed here. Chapter 3 argues that this perspective fails to satisfy the dynamic process criteria of interest in this thesis.

Whilst the Doz (1988) study neither represented a particularly recent study, nor did it utilise a dynamic process theory, it was included in this review because of its use in the development of a

dynamic theoretical framework applied in this thesis (Doz, 1996). The 1988 processual study of a single, dyadic collaboration between a large bureaucratic and small innovative firm in the pharmaceutical industry, aimed to explore process issues that impacted outcome effectiveness. Multiple complex issues evolved with time and caused process pitfalls. Despite the larger firm's motive to collaborate with the smaller firm for its agility and flexibility, organisational differences could not be overcome. 3 sets of issues in particular impacted its success: i) convergence of purpose or logical complementarity where both sets of organisations needed to share common purpose and benefit. They had to overcome cultural distance, technological misunderstanding and potential hidden agendas; ii) consistency of position where the relationship had to be supported consistently by people at different levels within the participating organisations and no single organisation was considered more powerful or superior; iii) interface where more formal arms length work processes were difficult and inefficient.

From this exploratory study, Doz (1996) developed a theoretical model of learning and mutual adjustments (LaMA) and then tested it in four other dyadic projects. These projects involved technology transfers in 3 different industry settings: pharmaceutical, aerospace and computers. He used qualitative methodology, consisting of repeated interviews over time, supplemented by documentary evidence. He investigated whether organisations merely implemented by design what they set out to do or whether they adapted their collaboration to learning and feedback. He found that technologies were integrated neither by design nor did they evolve in a random manner. Instead initial conditions played an enduring role either by facilitating or blocking learning; initial conditions either became readjusted or remained rigid. Over the course of the transfer learning along a number of dimensions: task, process, skills, goals and environment led to re-evaluation and readjustment of the initial conditions. Highly successful transfers underwent interactive cycles of learning and mutual adjustments; relatively unsuccessful transfers demonstrated a non-adjustment inertia leading to lowered commitments and eventual failure. The process theory of feedback learning and mutual adjustments made a distinction between understanding and action. Learning involved change in understanding whilst adaptation involved change in behaviour or actions. Non-adjustment resulted from a tension between successful understanding of what had to be done, but an inability or failure to modify behaviours to implement the necessary change. The LaMA theoretical model was considered promising and selected for application in this research setting.

The theory was considered particularly attractive because it was a general development theory that incorporated mechanisms and explanations for development of continuous and discontinuous process. Sources of change could be explained from both within the social structure and its external influences; importantly, time was included as a key historical accounting system (Van de Ven & Poole, 1988). It was thought that putting an already well developed theory to work in a new and markedly different setting would help enrich it. Later in this section, it will be noted that other

scholars have used it to produce incremental theoretical advances (Arino & de la Torre, 1998; Larsson, Bengtsson, Henriksson, & Sparks, 1998), but again limited to simpler dyadic settings.

A conceptual dynamic process theory developed by Ring & Van de Ven (1994) in the study of inter-organisational relationships was also considered. They view cooperative relationships as socially contrived mechanisms for collective action that are continually shaped and restructured by partners' actions and symbolic interpretations. Using a developmental process perspective the authors developed a cyclical model that sought to demonstrate achievement of balance between formal, legal processes and informal, social processes. They theorised that initial safeguards established a context for inter-party actions. Alliance evolution consisted of a sequence of stages of negotiation, commitment and execution. Each stage comprised a number of repeated interactions, the outcome of which was assessed by participants in terms of efficiency and equity (or fair dealing) and internal solutions to emerging conflicts. Whilst this process model was interesting, Alpha's structure and relatively short duration was unlikely to present opportunities for repeated formal relationship readjustment. The model was therefore rejected.

Kumar & Nti (1998) view collaborative R&D as building of organisational competence and developed a conceptual dynamic model that complemented the frameworks of both Doz (1996) and Ring & Van de Ven (1994). They separate partner contributions into what they term psychological relationship attachment. The theory examines partner interactions leading to emerging outcomes and process discrepancies, where performance depends on organisational capability and collaborative strategies adopted. Outcome discrepancy refers to partners' ability to achieve economic and learning objectives; and process discrepancy refers to partners' satisfaction with participant interactions and their feelings of psychological attachment to relationship. How partners assess and react to the discrepancies shapes the collaborative developmental path. Whilst this theory was attractive and overlapped many of LaMA Concepts, it was rejected on the basis that Doz's model was well developed and would be more additive it in a complex setting.

Inkpen & Currall (2004) recent dynamic theoretical framework is concerned with the evolution of initial JV conditions as partners develop an understanding of each other and adjust the collaborative process. They explore the relationship between trust and control on learning processes as central to the evolving dynamics. As initial conditions are adjusted, learning and trust co-evolve and impact decisions about the nature of controls adopted by the partners. Many concepts used here overlap those in the theory of LaMa (Doz, 1996).

Hamel (1991) studied the competitive / collaborative tension in international strategic dyadic collaborations as a process of inter-partner learning. Alliances represented two basic processes: either value creation or value appropriation. Using a longitudinal, multi-level fine grained study of 9 international alliances, various process issues that determined inter-partner learning were identified:

concerns over partners' intentions; openness versus transparency; receptivity / ability to absorb skills; inter-partner bargaining power in a race to learn. He argued that partners were not equally adept at learning; learning asymmetries altered their relative bargaining powers and emergence of future competitors. If one partner acted opportunistically the relationship was likely to suffer. This theory was rejected on the basis that the complex interdependent technological setting presented a greater opportunity to study social collaboration and mutual adjustments rather than inter-organisational competition.

Complementing Hamel's (1991) work, Larsson et al. (1998) developed a theoretical framework with a specific concern for sources of asymmetry and processual barriers to joint learning. They argued that the way collective learning was managed by organisations had a central role in strategic alliance outcomes. They theorised that dynamics of power, opportunism, suspicion and asymmetric learning strategy constituted processual barriers to collective knowledge development, and concluded that collective learning was most likely when all organisations chose strategies of transparency and receptivity. Although these concepts were thought to be relevant in a complex social relationship, the model was again rejected on the basis that Doz's model was already well developed and provided an opportunity to accumulate knowledge.

Larson (1992) exploratory research draws on institutional theory to develop a process model of dyadic collaboration formation. She studied how entrepreneurial firms used alliances for growth, and how and why they persisted. Her sample consisted of a set of high growth firms in telephone equipment, clothing, computer, environmental systems industries. Using interviews, firms were asked to identify relationships of more than 5 years that had contributed to significant growth. The 7 dyadic relationships studied, consisting of supplier and subcontractor relationships found that dyads developed in 3 phases. Each phase had important social aspects: preconditions for exchange was dependent on prior personal relationships, known reputations reduced uncertainty and enhanced early cooperation; established conditions necessary to build the relationship were mutual economic advantage, incremental growth of trust and evolution of reciprocity norms during a trial period; as rules, procedures and expectations were established organisations became strategic and more tightly integrated. In lieu of cost considerations or legal contracts, effective control and coordination were achieved and opportunism avoided through regulatory presence of moral obligations, trust and concern for preserving reputations. Although the model was dynamic, it was considered too simplistic for the complex setting and the specific process concern.

Arino & de la Torre (1998) study used a qualitative, longitudinal case study to track a failed dyadic international joint venture. They integrated Doz (1996) and Ring & Van de Ven (1994) models to study an alliance's 4 year life from inception to dissolution, divided into 14 process events. The series of events traced inter-partner interactions and impacts of external events on perceptions of alliance efficiency and equity. Assessments led either to engagement in renegotiation of contract

terms or organisation's unilateral modification of behaviour. Social balance was restored through process feedback until a new mutual understanding and sense of equity developed, otherwise the relationship deteriorated into dissolution. They concluded that positive feedback loops were critical in emergent process; that relationship quality was both an outcome and a mediating variable; and that procedural issues were critical from the start in fostering a climate for positive reinforcement and building a trusting relationship. Although the model was interesting, it was thought that Doz's LaMA Model alone would be more useful in this complex setting.

In summary, the review found limited research that has used the third process meaning in technology transfer. There remains a call for more dynamic process research to be undertaken. The studies that have adopted this more dynamic view have gathered eclectic, messy data by using qualitative method that contrasts sharply with studies using the first process meaning. The LaMA theory selected has been used by others to make small additions but in simple dyadic settings. Its selection for application in a more complex setting was therefore considered appropriate and timely.

2.6 CONCLUDING REMARKS

This chapter has reviewed the technology transfer literature in strategic management with the objective of illustrating a research gap in the use of dynamic process theory. Three process meanings were discussed illustrating an increasing dynamism and non-linearity. Theory has implications for research method. The review found a preponderance of studies that use relatively static, linear process view of technology transfer. They use process dimensions in a variable like way, to analyse, explain and predict causal linkages with performance outcomes. They tend to utilise large scale, quantitative methodologies implying that if those conditions were present then transfer outcomes would be efficient, and instantaneous. It also assumes organisational homogeneity. Some researchers have linked dynamic concepts such as communication intensity and structural linkages as facilitating mechanisms as a means for achieving success. The problem with these studies too is that these mechanisms are portrayed in a relatively linear and deterministic terms. In reality, process is complex and unpredictable. What is not known is how various external and internal influences affect the process and development of process outcome; how different choices and changing circumstances affect it. This fine-grained approach to process is used much less frequently. Hamel (1991) has observed *'...whilst there is nothing wrong with the narrow focus of a-processual research, the theories are so under-developed and so partial in coverage they illuminate only a fragment of the path between choice, actions and outcome'*. The chapter also discussed the plural view of success, which is ignored in linear, a-processual research. A well developed, dynamic process theory of LaMA was introduced as a theory believed to be particularly appropriate in this research for its potential to add to existing knowledge.

The next chapter deals with higher level complexity and the expected impacts of the dimensions of complexity on the process of technology transfer.

CHAPTER 3

LITERATURE REVIEW (II)

OF HIGHER COMPLEXITY

3.0 INTRODUCTION

The previous chapter dealt with the first of the two research gaps by reviewing the literature relating to the dynamic process gap in the study of technology transfer in the field of strategic management. The process theory of LaMA was introduced with a particular emphasis on why it was deemed relevant and appropriate. The purpose of this chapter is to deal with the second of the two research gaps concerning the issue of high complexity.

High complexity was believed to be an important multidimensional concept, whose individual dimensions are the subject of discussion later in this chapter. Literature was reviewed to specifically uncover the complicating dimensions and their likely impacts on the collaborative technology transfer process and outcome development, a matter neglected by Doz (1996). The research concern was not to specifically track the individual dimensions over the collaboration life, because they were unlikely to remain fixed over time. The social network theory is briefly reviewed to illustrate its poor fit with the research intention, reinforcing the decision to use the theory of LaMA.

In the previous chapter it was argued that process research has predominantly focussed on simpler, dyadic settings (Doz, 1996; Arino & de la Torre, 1998; Doz, 1988). Scholars have argued that inter-organisational relationships represent a much more complex set of conditions than dyadic relationships; especially in conditions of different national cultures and languages (Ring & Van de Ven, 1994). Others argue that the greater number of collaborating partners raises a bigger risk of goal divergence due to conflicting priorities, organisational values, and expectations (Doz & Hamel, 1998) and difficulty in reaching consensus (Evan & Olk, 1990). Collaborations rely largely on social interactions and emerging knowledge, and are indeterminate in nature. The social process might involve a great deal of nebulous concepts and idea generation for knowledge to flow across multiple organisational boundaries. The emergent knowledge continually reconfigures through social interaction and is influenced by trusting relationships (Inkpen, 1996). Yet despite the growth in complex settings, there seems little progress in dynamic empirical study of intra-collaborative settings: if and how organisations achieve and sustain a common purpose throughout the technology development.

The key research concern was that if knowledge transfers are difficult in simple, dyadic arrangements (Teece, 1976; Kogut & Zander, 1992; Doz, 1988), then multiple organisation sets might lead to added complications. If organisations with unique interdependent technologies have to interact socially, they are likely to generate tensions and conflicts in the process. It was

not known how mutual agreements and coherent action are achieved over time; how individual and collective learning adjustments are made.

The theory of LaMA stated that in a simple dyadic interdependence, failure to make mutual learning adjustments led to failure. In other words, unilateral action was inconsistent with interdependence (Thompson, 1967); disunity led to a dysfunctional social entity. In a high complexity setting, one would expect divergences in mutual adjustments. It was also highly likely that some partners are slower learners than others (Levinthal & March, 1993); suggesting that the collaboration might move at the pace of the slowest learner. This might suggest that in a highly interdependent relationship where each partner has to contribute distinct technologies in a timely fashion, development of failure is inevitable. If that was the case, why would any organisation want to participate? More importantly, why would governments wish to sponsor and invest in knowledge creation relationships?

It could be argued that if little empirical process research exists in higher complexity settings then perhaps the settings are unimportant; or perhaps the issues are not critical enough for managerial or academic concern. This thesis contends that the concept of high complexity was important because of a general shift from simple to more complex collaborations, often comprising multiple partners from different industry sectors. It has been acknowledged that complex collaborations are an emerging organisational form for organisational competitiveness (Osborn & Hagedoorn, 1997; Doz & Hamel, 1998; Geisler, 2003). Since the 1980s, in high tech industries particularly, large scale collaborations have increased. To strengthen European competitiveness, the EU has responded to market developments by following the US and Japanese example of sponsoring various European consortia (Ham, Linden, & Appleyard, 1998).

An effective performance outcome would be expected to be an important concern for organisations and sponsors. Assuming that performance of technology transfer does matter then it is not known what mechanisms are brought into play to compensate for technological interdependencies if one or more partners fails to learn; if and how partners self-organise and adjust their expectations and tasks over time to work towards a collective goal. The dearth of process study in these complex settings has probably less to do with a lack of academic interest but more to do with the fact that as an approach it is time consuming, unwieldy and messy (Langley, 1999). It may also reflect the fact that the field of strategy has been dominated by industrial economists who do not generally think in process terms. The limited external generalisability of smaller processual studies is a method incongruent with the rational economist view.

This chapter starts with a brief description of the method of literature search. From the reviewed literatures, five dimensions of complexity are identified: organisational forms, virtuality in organisational structure, technological differences, learning speeds and national contexts. Their likely influences on the transfer process are discussed. The literature review does not pretend to

represent a comprehensive review of the field. Instead it aims to identify key debates and insights that might be relevant. Indeed, the essential purpose of a literature review is to relate and illustrate how the research fits with those key debates (Hart, 1998).

3.1 METHOD OF LITERATURE SEARCH

The literature search was conducted in a structured and organised manner, but was highly evolutionary. Online databases of peer reviewed management journals were searched using a number of search terms. The search was not a separate, isolated activity from that for the first research gap. Instead it was part of an evolving search to gather existing knowledge of more complex technology transfers. Search terms used were: 'multiple organisations', 'collaborations', 'alliances' coupled with 'process of technology transfer'. It was found that simpler settings were repeatedly discussed under these headings. For instance it seemed common place to refer to JVs or strategic alliances between two partners as collaborations. Given the apparent lack of process research on technology transfer involving complex settings, research on social networks in strategic management was scanned. Search terms of 'organisational networks' and 'collaborations' linked with 'process of technology transfer' were used. It was thought that they might better reveal research in complex social settings. This decision was influenced after finding studies where researchers had sought to look at 'process' issues of alliances beyond dyadic arrangements, using a social network perspective (Gulati, 1998).

The findings from this particular search are discussed in the next section. But first, the social network theory as the framework used in the study of collaborations is briefly discussed. This stream contributes some important insights into complex organisations or networks, such as why firms enter inter-organisational relationships and how levels of satisfaction and trust influence prior and future organisational ties (Gulati, 1998; Powell, Koput, & Smith-Doerr, 1996). It fails however, to deal with the specific process concern of the dynamics of collaborative transfer that was of research interest here.

A further search term 'research consortia' was used after finding that networks were sometimes referred in this way (Doz, Olk, & Ring, 2000). Whilst reading some management and organisational publications, a view was formed that a complex collaboration such as Alpha might be conceptualised as a 'virtual team': collective technology transfer undertaken by a dispersed team located in different geographic locations and of different national origins, through social interactions.

As organisations begin to use virtuality as a form of structuring to respond to global markets, virtuality as a novel organisational dimension is increasing in popularity in organisational and management study. Groups are constituted fairly rapidly from different organisational offices to tackle specific organisational problems; particularly constructed as intraorganisational, dispersed R&D teams (Boutellier, Gassmann, Macho, & Roux, 1998). It is worth reiterating that up to the late 1980s when majority of technology transfer was capital intensive, this form of

organising was probably less pervasive and therefore less relevant. Traditional technology transfer required greater movement of physical technology. Over the last decade however, the nature of technology is more people-based; what is being transferred is not always ready-assembled; much of the creation and transfer of knowledge takes place while people interact, exchange ideas and solve problems together (Tidd, Bessant, & Pavitt, 1997). This notion is echoed by Tsoukas' (1996) conceptualisation of distributed knowledge system and challenges of knowledge integration. It is the subject of a growing literature stream in knowledge management (Brown & Duguid, 1991; 2001; Swan, Scarbrough, & Robertson, 2002). In a sense, collaborations also resonate with the concept of Communities of Practice (CoPs) contributed by this literature stream (Lave & Wenger, 1991; Brown & Duguid, 1991); but perhaps constructed less spontaneously than CoPs. The CoPs literature stream is reviewed briefly in Chapter 10. It is not reviewed here because it surfaced inductively after the empirical material had been analysed. The separate review better fits with its later use in theory development.

The search was extended to study of dispersed teams to include R&D Management journals, with search terms of 'virtual / dispersed' teams. Not surprisingly, the broad themes of difficulties experienced in this type of organising resonated with those found in studies discussed in Chapter 2. Difficulties were attributed to communication difficulties due to tacit knowledge (Kogut & Zander, 1992; Polanyi, 1967); differences in work practices, national and organisational cultures (Szulanski, 1996).

Before discussing the five dimensions of complexity, there follows a brief look at the research that has considered the 'process of collaboration' from a social network perspective (Powell et al., 1996; Gulati, 1998). This stream is included to illustrate its fit with what was intended to be studied in this research and the reason why the perspective was considered unsuitable here.

3.2 Multi-Partner Complex Collaborations as Social Networks

Researchers have sought to understand why organisations take part in research consortia and what economic and strategic inducements exist. Consistent with research findings in the alliance literature, network formation is typically influenced by long term strategic considerations such as knowledge creation and learning, to secure organisational competitive advantage (Inkpen, 1996; Powell, 1998).

Social network perspective contributes to understanding of how organisations located in their social networks of relations lead to future collaborative ties (Granovetter, 1992). It gives clues about organisations that are more or less central to the linkages with other organisations. The perspective does not indicate how they interact with each other within a single constructed social network, such as Alpha. In essence, social networks as inter-organisational relationships are temporary mechanisms that generate longer lasting relationships. The focus is on the overall network structure and the intensity or frequency of dyadic linkages within the network structure. It is a patterning of collaboration (McKelvey, Alm, & Riccaboni, 2003).

Although organisations may seek to accumulate particular knowledge from a specific collaboration, it is the emergent benefits that seem to be more important (Osborn & Hagedoorn, 1997). Gulati (1998) argues that current alliances generate opportunities for future alliances because partners tend to first turn to existing relationships for potential partners, or they rely on referrals of potential partners from them. Powell et al.'s (1996) processual study in the biotechnology industry, consisting of multi-partner inter-organisational collaboration found that learning intensified further collaborative ties; in other words, there was a path-dependence. They concluded that as partners became more trusting and comfortable with each other they were more likely to collaborate repeatedly with the same partners. This would suggest that when partners have collaborated previously, conditions of greater mutual trust are generated for the relationship to be efficient and effective. Themes such as trust and partners' learning ability echo those seen in dyadic settings discussed previously in Chapter 2.

This stream of research however was believed to neglect the dynamics through which technology transfer occurs as conceived in this study. The research aim was to gain a better process understanding of organisational actions, accommodations and adjustments beyond initial collaborative design; to understand if and how social stability developed. The social network perspective does not seem to focus on the micro-processes within a single intra-collaborative social structure. It ignores the multiplicity of social interactions and their effects on the emerging structure of the single collaboration. Instead it has a greater focus on the dynamics of collaborative structures and evolution of organisational positions and their linkages within the network structures over time. Although the network perspective may be informative about historical, current or even future ties of collaborating organisations, or of relative organisational influences, in this study the interest was to understand the process and outcome of a specific project, Alpha: an isolated network embedded in its specific context.

That said, it is worth noting that some characteristics of social networks were evident in Alpha particularly with respect to its composition and as a platform for genesis of a future collaboration: Partners (see Table 3.1 below) G and K's conception of Alpha, its collaborative goal and utilisation of respective networks and those of others to compile Alpha. On completion, a small number of organisations coalesced to form a further collaboration by inviting other external organisations that relied on each other's networks to include the necessary technological competences. The empirical findings also suggested EU's seemingly higher level objective to utilise collaborations as triggers for future collaborations within a web of complex collaborations. Knowledge created from Alpha was further funded by EU to help with future technology development and organisational utilisation and to influence setting of common technological standards.

Each of the five dimensions of complexity is now discussed, with a particular focus on the likely process issues. The sector-specific industry context as a contributor to this complexity is discussed separately in more detail in Chapter 4.

3.3 Dimensions of Complexity and Process Issues

Alpha's composition suggested at least five dimensions of complexity that might impinge upon the social collaborative process. Its constituent organisations[10], their industry sectors, country of origin and location and organisational forms are classified below in Table 3.1. They represent three of the five complicating dimensions. Virtuality and difference in speeds of learning are two other dimensions discussed below.

Alpha's constituency represented interdependent technologies along a horizontal value chain (see Chapter 4), in the Interactive Digital Television sector.

Table 3.1 Alpha's Constituency

Partner	Country	Industry Sector	Organisational Form
A	France	Telecoms Operator	Large commercial organisation
B	Netherlands	Content provider	Small innovative commercial organisation
C	South Korea	Broadcast and technology development	Research Institute
D	United States	Technology developer and service provider	Large, global, innovative commercial organisation
E	Netherlands	Service provider and platform developer	Small, innovative commercial organisation
F	Belgium	Electronics and Entertainment products	Large, multinational, commercial
G	Italy	Telecoms operator	Large commercial
H	Israel	Technology developer	Small commercial
I	Germany	Application developer	Research Institute
J	Germany	Telecoms operator	Large commercial
K	UK	Telecoms and management expert	Academic Institution
L	Netherlands	Business & Consumer Electronics Producer	Large multinational, commercial

Some of the complexity dimensions were discussed in Chapter 2. There it was argued that researchers had treated them in a variable like way with fixed characteristics, linked relatively linearly with performance outcomes. In this research, the dimensions were not viewed to be 'independent'. They did not remain constant over the transfer duration; nor was it known how and when they might influence each other. Importantly, the five dimensions of complexity were not intended to be correlated (in a statistical sense) to a dependent variable. Instead, they served to inform the interpretations of events or actions, to help explain why something may or may not have happened during the collaborative process. It was also believed that they may help explain why certain participants acted in particular ways. In essence, they contributed to the rich research context (Pettigrew, 1992).

3.3.1 Organisational Forms

Although organisations possess unique knowledge (Penrose, 1959; Prahalad & Hamel, 1990; Teece, Pisano, & Shuen, 1997), with particular structures and organisational processes, different organisational forms are associated with distinct characteristics. It is these

[10] Coded to retain anonymity and confidentiality

characteristics that were believed to represent conditions that might influence the technology transfer process and its performance outcome.

Here, two pairs of organisational forms are contrasted and discussed:

i) Commercial / Non-profit making organisations and

ii) Smaller entrepreneurial / Larger bureaucratic organisations

i) Commercial and Non-profit making (Research) Organisations:

There is a growing worldwide trend towards greater collaboration between industry and academia, encouraged by governments to enhance national competitiveness. The guiding principle of this relationship is symbiosis: a mutual gain. Commercial organisations have looked for novel technologies from research institutes. This is particularly well illustrated in the biotech industry where collaboration amongst universities/teaching hospitals, small biotech and large drug companies has occurred to develop and commercialise new drugs (Liebeskind, Oliver, Zucker, & Brewer, 1996; Doz & Hamel, 1998).

Collaborative process difficulties were expected because the two organisational forms have different goals, expectations, motives, incentives, reward systems and dissimilar organisational cultures. Studies of academia-industry cultures have identified problems of differences in perspectives, priorities or time horizons and values (Barnes, Pashby, & Gibbons, 2002). Despite their interdependence and need for specific knowledge, such differences are a major obstacle to successful university – industry collaborations. Dodgson (1991) found that scientists, engineers and managers found it difficult to work effectively with people that they perceived were less able than themselves. Mutual respect for other's abilities greatly assisted successful collaboration. This sort of elitist behaviour was probably less relevant to Alpha because the majority of participants were technologists. The empirical findings also showed process rigidities contributed by Alpha's dominance by technologists.

Commercial organisations have a greater concern for profit whereas academic institutions are more interested in research publications. An academic organisation may be more concerned with what it can learn and what it can contribute to its research community. A study comparing the two forms found that academic organisations were driven by objectives of improving research ability, obtaining funding, gaining credibility and prestige amongst peers (Rogers, Carayannis, Kurihara, & Allbritton, 1998). As a rule, academic institutions are rewarded according to publications rather than commercial activity (Bozeman, 2000). Commercial organisations may be far more protective about new knowledge from a concern for loss of intellectual property to competitors. By contrast, academics are likely to be more open to idea sharing with peers from external institutions; operating under a principle of free inquiry and knowledge dissemination and synthesis. A further difference that arises is that researchers probably enjoy much greater freedom of action and thought. They are under far less day-to-day management control compared to their industry counterparts.

The impression of collaborative difficulty is not new. Barnes et al.'s (2002) multi-case study looked for factors that might increase the probability of a collaboration being perceived as successful by both partners. This study confirmed existence of different motives: for industry the concern was to gain access to a greater knowledge that would normally have to be developed internally; for universities collaborative benefits included additional public and private funding, but increasingly, licence and patent income from technology transfer activities (e.g. spin outs). They found that academics tended to progress research in a direction they preferred; project benefits were often skewed towards academic valued outcomes. Academic objectives included: running projects for research students that helped generate postgraduate degrees, perform further research in specific areas and through this research, develop new teaching and case study material. They found some generic success factors not dissimilar to intra-industry collaborations. The key themes were choice of partners, cultural issues, ensuring equality between partners and effective project management. A balanced requirement between partners was necessary for success. Each partner had to understand the needs and constraints of the other and to work towards a solution that benefited them equally. In other words, success was strongly dependent on achieving mutual benefit. This reflected the theory of LaMA in the dyadic setting.

Geisler (2001) and Geisler, Furino, & Kiresuk (1991) recognised the recent growth in inter-sectoral cooperation and asked why firms, universities and government laboratories had initiated cooperation and what had made them successful. They similarly found industry's drive for commercialisation, outsourcing and opportunity to recruit future scientists. Universities' need for research monies had increased following gradual reduction in government funding. Social interaction was based on expediency rather than trust. An interesting finding was the different criteria used for measuring success versus that for initiating the cooperation. To some extent this reflected the empirical findings in Alpha: EU's assessment of the final outcome was highly successful yet the starting goals required business model development as an important priority. This difference reflected a seeming greater concern to facilitate organisational relationships for future collaborative technology developments.

Table 3.1 shows that there were 3 research institutes and 9 commercial organisations. Organisational differences arising from these two forms were believed to have important implications for Alpha. It would be interesting to track how organisations interacted and learned to work towards a mutual goal; how they achieved equity in relationship.

ii) Smaller Entrepreneurial / Larger Bureaucratic organisations

The principle on which this type of collaboration is based is similar to that discussed above: symbiosis, where smaller more innovative organisations are expected to contribute new knowledge whilst larger organisations contribute expertise in production, marketing, etc. for joint development of novel products (Liebeskind, Oliver, Zucker, & Brewer, 1996).

Just like the distinctive character of academic and commercial organisational forms, differences exist between small entrepreneurial and larger organisations. Although both forms may be highly efficient within their respective domains, larger organisations tend to be more bureaucratic. For technological development, they tend to seek flexibility and agility from smaller more innovative organisations. But joint working can cause process difficulties. Doz (1988) studied a partnership between Alza (a small US technology firm) and CibaGeigy (a Swiss global pharmaceutical firm) that sought to develop technological drug products. Major cultural differences were found in the type and speed of decision-making, which contributed to the collaboration's eventual failure.

Doz deduced that bigger, more bureaucratic organisations operated a more formal explicit decision-making process. Participants were highly analytical but had lower contextual awareness; they relied heavily on formal plans and meetings for decision-making. Smaller firms however operated informally, used intuitive judgements and tacit, shared decision-making. They were incredibly adept at cutting across organisational boundaries through personal relationships and circumvented 'obstructive' members. They were highly aware and responsive to their context, and particularly comfortable with continuous, rapid and unscheduled decisions. This behaviour unnerved those used to formal working. The different styles meant that Alza viewed CibaGeigy as '*ponderous, slow or stupid, preoccupied with reviewing everything to death*', whereas CibaGeigy viewed Alza as '*a bunch of cowboys, shooting from the hip, disorganised and clannish*'. It led to much unrest and distrust and eventual failure. Doz argued that success was only possible if individuals from larger organisations were able to step out of their organisational roles and adopt similar work practices and pace of action. Success also relied heavily upon a strategic complementarity and convergence of purpose. Many CibaGeigy members did not understand the collaborative importance.

Alpha was believed to provide an important opportunity to understand how organisations with potentially different strategic logics converged in action, if at all. With its 3 smaller entrepreneurial organisations working alongside larger organisations, similar tensions were likely to arise. For instance, a software authoring firm's working style may be similar to Alza's, whereas bigger organisations such as telecoms network providers may be slower and more bureaucratic, like Ciba-Geigy. Chapter 4 provides further insights into the path dependence and respective speeds of innovation of these organisational forms in the Information Industry.

3.3.2 VIRTUALITY OR GEOGRAPHIC DISPERSION

This dimension represented the dispersed organisational locations, particularly in different nation states. It was discussed earlier that 'virtual' teams can be constructed quite rapidly to deal with complex problems. A further advantage offered by this form of organising is the feasibility of part-time participation. Many organisations e.g. IBM, rely on virtual teams to respond to customer needs and for flexible and speedy completion of technology projects. Sole & Edmondson (2002) have argued that whilst geographic diversity provides access to unique competences, such as better understanding of global customers and suppliers, evidence

suggests that accessing, combining and applying knowledge in these teams is problematic. Virtuality is disadvantaged by geography, national cultural differences and work habits as well as time zones (Boutellier et al., 1998).

If knowledge creation and transfer is a dynamic social process based on situated interactions (Inkpen, 1996; Bresman, Birkinshaw, & Nobel, 1999), then geographical distances would be expected to complicate the social process. It is known that physical separation can cause communication difficulties, which is further complicated by language differences. Roberts (2000) argues that although the knowledge-based economy is highly dependent on information technology (IT) for knowledge interactions, the complex and tacit nature of knowledge requires co-location and co-presence. Boutellier et al. (1998) similarly found that intensive use of IT lessened the disadvantages in this type of organising but was insufficient to deal with the problems of working across distance and cultures. IT neglected non-verbal communication: body language, gesture and intonation. Despite the enormous advantages of IT, face to face contact was still essential for problem-solving and interpersonal communication, like traditional teams. Team members needed to know each other before working together. Team spirit had to be developed by a socialisation process in one place. This assembly needed continual revival as social relationships dropped off over time. In Alpha, whilst emails were the mainstay of communication, planned and ad hoc meetings were also used for problem solving and socialisation.

Suchan & Hayzak (2001) too argued the need for trusting each others' capability, motives and commitments. Members needed to feel that they could share power, even leadership based on technical or managerial expertise at any given point in time. They found that team leaders used a face to face 3 day project kick off meeting as a mechanism to build and maintain team trust. The empirical findings in Alpha showed a similar socialisation mechanism at the start of the collaboration.

Sole & Edmondson's (2002) study of dispersed teams in a multinational found that despite the teams' single ownership, problems were common. They proposed that location-specific situated knowledge was the reason for these difficulties. Team members from different functions or occupations struggled to understand each other; geographical distance limited interactions to develop trusting relationships. This echoes the work on tacit knowledge and its consequent transfer difficulties (Zander & Kogut, 1995; Szulanski, 1996; von Hippel, 1994), and emphasises the collective, situated and provisional nature of knowledge (Tsoukas, 1996). Cramton (2001) argues that dispersed teams suffer from the problem of maintaining mutual knowledge that hampers collaborative viability. Lack of mutual knowledge resulted from: failure to communicate and to retain contextual information; speed of access of certain individuals and difficulty interpreting the meaning of their silence. This was seen in Alpha: Partner D attended the start-up socialisation meeting but beyond that became silent in communication and contribution. It was almost 12 months before D finally confirmed its formal disengagement from the collaboration.

Distance presents difficulties if participants have conflicting priorities. In Alpha, no participant was deployed entirely on the project; each member had other organisational duties. The problem with this arrangement is that members may be pulled in different directions (Doz, 1996). A greater effort is therefore needed to avoid major misunderstandings in working towards a common goal.

Given the organisational and technological diversity, Alpha's particular constituent members had not all engaged in prior collaboration; they needed to get to know each other and develop a degree of mutual trust. Some partners[11] did indeed have prior linkages in other technological projects. Although Alpha's process interface was predominantly based on remote interaction, regular face to face problem solving and socialisation was planned[12]. As the project evolved, partners were expected to assess the project effectiveness, its expectations and the need for adjustments or change[13]. An increasing commitment and flexible participation was likely to show organisational satisfaction with the project.

3.3.3 Technological Differences and Knowledge Boundaries

Creation of highly sophisticated technological products and processes depends on the work across several areas of science and technology (Day & Schoemaker, 2000). Technologies are rarely controlled by single firms and few possess the breadth of knowledge or indeed understanding to undertake the entire integration (Doz & Hamel, 1998). This reflects the technological expanse of Alpha and was believed to represent important process issue for technological understanding across multiple organisational boundaries.

In Browning et al.'s (1995) study of collaboration in a single industry sector, despite creation of a discrete organisation in a single location, the group experienced technical language problems. Organisations came with their own set of acronyms and vocabulary. One of the early techniques used to bridge these differences was the compilation of a dictionary of technical terms that all participants could use. With multiple sectors in Alpha, despite the dominance by technologists this type of difficulty was highly likely.

Just like distinct characteristics attributed to different organisational forms discussed earlier, organisations from specific industry sectors possess distinct knowledge architectures (Rebentisch & Ferretti, 1995) and competences. These develop through technological inheritance and organisational practice of putting that knowledge into use. Knowledge develops from supplier relationships specific to the sector; or specific consumers and their expectations; government agencies, and technical and industry associations. In other words, organisational interactions and business transactions are shaped by institutional rules and regulations they are embedded in (McKelvey & Riccaboni, 2003). These differences influence organisational receptivity and level of comfort with new and diverse knowledge (Prahalad & Hamel, 1990). If

[11] The empirical findings indicated that Partners G and C had prior ties
[12] The analysis showed that an initial project start up meeting lasting 3 days was held for socialisation followed by 3-monthly face to face meetings for the entire group
[13] An example of interface adjustment was C's location of some participants to G's facility

organisational competence has been honed to provide customer support at the expense of rapid product development then collaborative difficulties might arise. It would influence how organisations interact and how problems are solved and decisions are made; particularly when technological integration is not regimented and pre-defined. It is this distinct characteristic that confers both a competitive advantage and problem of technology transfer across organisational boundaries (Teece et al., 1997). For instance, although telecoms operators from France or Italy might have organisational differences, they would be expected to have some important similarities, particularly when compared with say a software developer. Although most participants in Alpha were technologists, these differences were expected to have an impact on the social learning processes.

The central belief was that when a wide scope of knowledge was to be integrated involving diverse partners, there was likely to be little common knowledge amongst the constituency. This might contribute to difficulties in communication and integration of knowledge across organisational boundaries (Grant, 1996). In Alpha, technologies were being integrated across three industry sectors comprising five industry segments (see Chapter 4): ranging from broadcast content development to distribution. Content owners are less concerned with capital intensive technology but more in understanding consumer usage patterns and developing new product concepts. Distributors of content on the other hand are more focused on ensuring product reliability and elimination of errors. Their technology evolution had not required much innovation. For instance, the television or telephone technologies are both associated with highly stable and reliable platforms whereas computer reliability is much less so. Consumers probably perceive these instabilities as an inconvenience but offset by the many advantages of advanced computing technology. Clearly, the priority for the computer sector is to innovate rather than eliminate all faults. The research interest was to understand how the different partners created an environment of mutual understanding and joint working towards a collective goal.

3.3.4 Speed of Learning or Absorptive Capacity

Hamel (1991) study suggests that collaborating partners are not all equally adept at learning. Organisational asymmetries can lead to differences in bargaining powers. This heterogeneous learning has important process implications in a complex technology transfer when knowledge has to flow across multiple organisational boundaries and timely completion of processes is essential.

What makes some organisations learn faster than others? It has been said that learning breeds further learning to such an extent, that the process of learning new knowledge becomes organisationally ingrained or institutionalised; it reflects the concept of organisational absorptive capacity (Cohen & Levinthal, 1990). In this vein, prior collaborations allow many organisations to learn about collaborative participation for future effective collaboration (Kanter, 1994). This perhaps also reflects the organisational linkage patterns suggested by the social network

theory, discussed earlier. The more frequent and intense the linkage an organisation engages in, the greater is its ability to learn and its speed of putting that learning into practice.

In essence what this concept suggests is that collaborations perform a dual role of generating new knowledge and enhancing a firm's ability to collaborate. An important point here is the diverse learning: if new knowledge remains within the bounds of specialisation then it has a limiting impact. An organisation can become constrained through institutionalised practices. Its ability to relate some prior knowledge with much more diverse knowledge enables greater flexibility than if it stays within the vicinity of existing knowledge and capabilities (Levinthal & March, 1993). To illustrate the concept of specialisation and diversification as two contrasting development paths, one might apply the analogy of enhancing the capability to drive. A specialist might learn to drive different makes of cars or perhaps increase his capability by progressing from manual to automatic cars. A driver who has learnt how to drive a bus may be better placed to learn to drive an articulated lorry than the specialist. With some effort, the specialist may still be able to handle different vehicles but is likely to be a slower learner.

Smaller firms are also associated with greater absorptive capacity than larger firms. They are faster learners (Dodgson, 1993); a reason why larger firms often look to collaborate with them (Doz, 1988). The development of the biotechnology industry has occurred through collaborative technology transfers amongst highly innovative small technology firms and large pharmaceutical firms that contribute marketing and production skills (Powell, 1998). Alpha consisted of three smaller innovative organisations with various larger, more stable organisations. Individuals representing the smaller partners may be exposed to broader skills than specialists from large organisations. They may be better able to straddle across different technological boundaries than the specialists. In fact some of these differences were seen in the empirical findings, discussed in Chapters 8 and 9.

Given the technological diversity, the key process issue here was the influence of differential absorptive capacities on synchronisation and technology integration. It was not clear how a common and mutual understanding would be reached. Fast learners might become frustrated with slower learners; this might influence the course and speed of the collaborative process. It was not known how partners might evaluate each other for equity in participation and collaborative efficiency. Would a greater influence be exerted by some partners over others? If so, what were the process implications particularly when there was high technological interdependence? It must be noted however that the central concern was not to measure or track organisational absorptive capacity per se, but to be sensitive to the concept in interpreting the project dynamics.

3.3.5 National Context as Contributor of Organisational Culture

This section complements the discussion in Chapter 2 about national influences on organisational cultures, and national technological choices (see also Chapter 4) that help define organisational work practices. This dimension was considered important because Alpha

represented 12 organisations located in 9 different nation states. With the exception of one[14], all organisations were under domestic ownership. The national diversity was expected to contribute misunderstandings and tensions in joint problem solving (Lam, 1997).

Despite the variety of national languages, English was the language adopted for all interactions in Alpha including written and spoken communication. When a nation does not use English very widely (in speech or text), major communication difficulty and achievement of common understanding might arise; perhaps the case with the Asian partner. Interestingly, language differences for Partner C meant that it integrated and developed a parallel product incorporating its local language characters.

Despite an increasing cultural global fusion (Mueller, 1999), other than language differences, national contexts do contribute distinctive organisational cultures and organisational work practices (Hofstede, 1980). The contributory factors can be categorised into two broad areas: first, arising from national regulatory and technological environments and second, societal values and influences on organisational practice.

Nation states are associated with differences in educational systems (thus educational background of its population), organisational practices, national and institutional systems of development (Osborn & Hagedoorn, 1997) that may affect their work practice. These differences are reflected for instance in an international technology transfer study involving a relatively simple, one-way transfer of traditional technology (Teece, 1976). The study found that difficulties in technology transfer were correlated with differences in local infrastructure, level of education and degree of industrial development. It was easier for a multinational to transfer technology to an organisation in a developed nation than one in a developing nation where the level of education and basic technical skills were much lower. Lall (1987) argued that if a national context had a centrally controlled regulatory environment, which encouraged little industry involvement to influence policy this might affect how firms interacted with government agencies, suppliers and even customers.

Different societies are associated with significant differences in communication methods adopted, their decision-making and even how organisational problems are solved (Lam, 1997). Societies contribute distinct organisational cultures (Hofstede, 1980). From his classic multi-nation study, Hofstede defined dimensions that might be used to compare a country's values and therefore different organisational styles; these differences were expected to have important process influences. The dimensions were termed: power distance, social distance - collectivism or individualism and uncertainty avoidance. Power distance specified equality of power distribution between a manager and a subordinate. High power distance meant that in that culture, managers exerted greater personal power than subordinates: Belgian and French cultures preferred high power distance. This dimension was probably less relevant in Alpha

[14] Partner F

because inter-organisational participants were mostly from similar organisational levels. Social distance indicated whether a country was generally individualistic or collectivist. Western countries are said to be more individualistic than those in the Eastern block. Individualists tend to be influenced by their own needs, rights and thoughts. In Alpha, C from a South East Asian country might rely much more on collective behaviour that impacts the speed of decision-making. High uncertainty avoidance is an indicator of a society's need to try to control its future. It prefers more stable environments, and is generally more dogmatic and traditional. Italy is said to have a higher preference for uncertainty avoidance than Britain, Netherlands or the USA. As a consequence, some participants might be more sensitive, adaptable and responsive to contextual changes than others. This difference would be expected to create tensions in the collaborative process.

The different value systems too can create serious tensions. Kanter's (1994) exploratory study of collaborative advantage, found that more than any others, North American firms had a narrower financial focus. In collaborative relationships, they tended to neglect political, cultural, organisational and human aspects. Asian firms on the other hand, were more adept at using relationships to develop further collaborations. European firms fell somewhere in between the two extremes. Alpha's single US organisation's behaviour (Chapters 8 & 9) probably reflected this value system.

Alpha's constituency was predominantly European. Despite the close proximity of these nations, individual country differences were expected. For instance, European harmonisation has been fragmented and slow to develop. A diverse adoption of equipment standards, business regulations, and government policies has occurred. In IDT, a nation's historical adoption of a technological standard would be expected to influence the technological choices organisations favoured and developed. This might generate tensions in selecting technology standards that satisfied the entire constituency. It was unclear how organisations might reach mutual agreements.

3.4 Concluding Remarks

In this chapter it was argued that the issue of high complexity (the second of the two research gaps) was important, particularly in a multi-partner complex collaborative setting: a setting that represented an emerging organisational form. It was a form expected to be of interest to managers, academics and policy makers. Five dimensions of complexity were identified. The discussion centred on their likely process impacts and a propensity to contribute to highly variable process outcomes. It argued that the dimensions of complexity were not viewed as some discrete variables to be singularly tracked over time. Their properties were expected to change as the process unfolded and were likely to have important interacting co-influences.

The theoretical orientation of the research required alternative theoretical positions to be examined. The review found that although the social network theory provided a useful framework to study patterns of complex collaborations its relevance was partial; it failed to

satisfy the particular research concern to understand the dynamic social process development of an intra-collaborative structure. It reinforced the fact that the process theory of LaMA was likely to be particularly relevant in capturing the influences of some or all of the complexity dimensions to help explain their process impact.

The purpose of the next chapter is to discuss in more detail the substantive area of research study.

CHAPTER 4

ANALYSIS OF MULTIPLE LEVELS OF CONTEXT

INFORMATION INDUSTRY & INTERACTIVE DIGITAL TELEVISION SECTOR

4.0 INTRODUCTION

The previous chapter dealt with various dimensions of complexity and discussed their likely process influences and impact on outcome development. This explication was consistent with the view that social processes are deeply embedded in the contexts that produce and are produced by them (Pettigrew, 1997). In a sense higher complexity represented some of the contextual conditions of the research setting.

Context can be conceptualised at multiple levels. Levels contribute numerous related processes, all of which can impact the change process being studied. Asymmetries between multiple levels of context and their intertwined processes produce their own momentum and pace of change that can lead to development of variable outcomes (Pettigrew, 1997; Pettigrew, Woodman, & Cameron, 2001). The purpose of this chapter is to build on the previous chapter by providing an analysis of two higher levels of context for Alpha. The contexts were believed to contribute to the complexity dimensions (particularly technological differences, organisational forms and impacts on organisational cultures and work practices). They were expected to have important influences on the transfer process by impacting individual organisations and the collective social entity. The higher levels represented the industry and specific industry sector of the substantive area of study: Converging Information Industry and Interactive Digital Television sector. They were considered important in providing background of understanding to help interpret organisational roles, actions and expectations over the collaborative transfer process.

The chapter first introduces the research setting. It then begins with the change drivers in Information Industry, its market consequences, and organisational implications. The discussion moves to the specific emerging sector of Interactive Digital Television (IDT); the sector relevant to this research. Examples of technological product developments in the market are presented to illustrate organisational engagements and relative technological success and business outcomes. They serve to compare Alpha's achievements. Issues facing industry players are explored to compare Alpha's construction and its stated aims.

This cascading down from the broad to the particular was necessary to understand why organisations would wish to participate in a complex technology transfer and what they might be expected to do. This contextual understanding was particularly important in data analysis. Deep meaning in documentary text that constituted the key data source could only be attributed in the

wider context in which it was generated (Lincoln & Guba, 1985; Pentland, 1999). Review of typical organisational actions in this technological sector, their efforts in technology integration over Alpha's timeframe provided valuable insights into the consistency of its starting goals with the market: in terms of technological relevance and responsiveness to market developments.

4.1 THE RESEARCH SETTING - ALPHA, ITS OBJECTIVES AND ITS STRUCTURE

Alpha comprised 12 organisations encompassing technologies represented by the IDT segments discussed earlier (see Table 3.1) and expanded later in this chapter. Alpha's key goal was to create economic opportunities for the entire constituency. Organisational mix consisted of small and large commercial organisations and academic centres, mainly European but included US and South Korean partners. These conditions were believed to contribute to higher complexity. According to the EU, organisational selection for construction of Alpha was on the basis that

> *'...their knowledge and skills are absolutely complementary and cannot be found within one single European nation. For the project to succeed trans-European cooperation was a pre-requisite and as it intended to play a part in a worldwide domain, inclusion of partners from US and Asia was deemed to bring greater strength to it.'*

The EU and participant organisations believed that a technically integrated IDT product had not been demonstrated; particularly given its span of content production, transmission and consumption using open standards. Since proof of concept did not seem to exist, it was unclear whether an integrated technology could achieve robustness and performance of innovative multimedia content. Moreover, there was reluctance to invest because of lack of business models, which showed clear revenue generation for the entire constituency. Alpha was conceived to address two key concerns and it seemed that participating organisations believed they could benefit from the collaborative effort.

There now follows a brief outline of the method of industry context review and analysis.

4.2 THE METHOD OF ANALYSIS

Review and analysis was conducted in a structured manner, utilising industry business literatures consisting of IDT sector-specific electronic newsletters, business magazines and market research reports. Literature was gathered for the period spanning late 1999 to early 2002, to gather a background to other industry developments over the same period as Alpha. Alpha ran from January 2000 to December 2001. In addition, when academic publications bearing upon the research question and technology transfer phenomenon were found, analysis was informed by them. The following represents the researcher's interpretative analysis of the industry context. A number of complex collaborative examples drawn from a web-based industry newsletter (www.itvt.com) are described. The discussion now moves to convergence of the Information Industry and its implications.

4.3 THE CONVERGING INFORMATION INDUSTRY

Convergence of the Information Industry represents the coming together of previously separate sectors of communication, broadcast, and information, depicted in Diagram 4.1. This has blurred technological and organisational boundaries. To better understand what this means, consider the following products previously located in three separate industry sectors:

- Telephone and Fax represented by the Communication sector
- Radio, Television, and Movies represented by the Broadcast sector
- Computers offered by Data or Computing sector

This distinction helped bound and understand organisational roles in their respective markets. It gave clues to sector specific organisational competences (Duysters & Hagedoorn, 1997). E.g. Computer industry is more responsive to new product ideas because it has been substantially more risk tolerant than telecoms industry. It has aimed to capitalise on changing technologies rather than eliminating risk. In comparison, the more bureaucratic telecoms industry has evolved in highly regulated capital markets and rigorous reliability standards; its pace of technological change has been much slower. As discussed in Chapter 3, larger, more bureaucratic organisations may look to smaller, more flexible organisations for new ideas; yet differences in organisational processes might stifle the creativity if the rest of the larger organisation cannot make the adaptive shift (Doz, 1988).

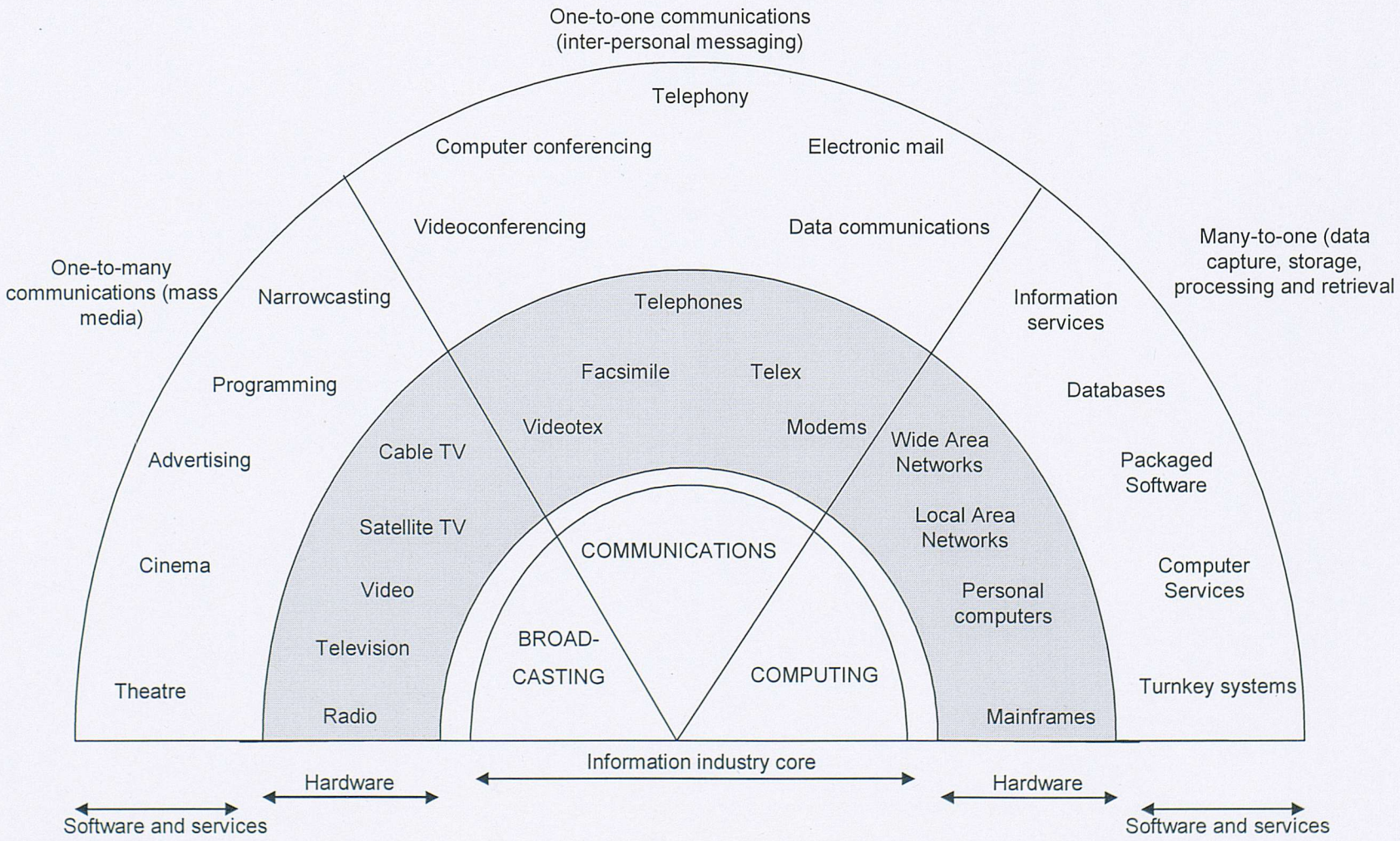
Technological change has enabled products to cross into neighbouring sectors, with multiple functionalities (www.dvb.org):

- Audio as telephony or radio can now be received via Computers and TV sets
- Video and pictures via Computers and mobile telephones
- Data or information via TV sets and mobile telephone

Loss of clear sectoral boundary makes it difficult to define an organisation's markets by just looking at its products or services. For example, a telecom operator's role (like British Telecommunications) was simply communication; now it can enter multimedia business. This change in competitors and customers has potential to render businesses obsolete (Day & Schoemaker, 2000). To defend against this kind of product or service substitution, organisations would be expected to broaden capabilities, and might engage in collaborations for complementary technologies. Even if neighbouring technologies cannot be brought under single ownership, there would be an incentive to participate in mutual technological integration.

The research interest in this Industry was based on an observation of the profound organisational impacts of technological change and the likely process issues this represented. The research was concerned with the dynamics of social knowledge integration in a complex collaborative structure. It

DIAGRAM 4.1 CONVERGENCE IN THE INFORMATION INDUSTRY (OECD, 1992:12)



was based on the premise that collaborations are generally constructed for sharing, learning and creation of new knowledge (Powell, Koput, & Smith-Doerr, 1996; Doz & Baburoglu, 2000). Yet they can cause difficulties in building consensus (Evan & Olk, 1990) Collaborative complexity was contributed by sectoral differences that contributed unique technologies, organisational cultures and organisational forms e.g. small flexible vs. large bureaucratic firms (Doz, 1988).

It has been speculated that technological change might eliminate sectoral separation entirely, *"...single application or service of information content from telephony, sound broadcasting, television, motion pictures, photography, printed text publishing and electronic money..."* (Mueller, 1999). In reality, a range of products is being developed to satisfy various consumer needs (McKenna, 2000). Essentially, organisations have been forced to move away from the notion of mass production at lowest unit cost to customised technology. The challenge this creates is how organisations manage costs and earn good profits (Swedlow, 2001). The business literature shows extensive organisational participation in global collaborations, often simultaneously in multiple collaborations, perhaps even with competing technologies. It also seems that smaller, more innovative organisations have utilised collaborations to enter international markets. Previously, this activity was probably limited to multinationals.

The change in industry structure is a result of technological advances and driven by organisational engagements in complex collaborations to creatively integrate and exploit emerging technologies. Collaborative aim is to be first to market and influence the adoption of technology standards (Swedlow, 2001). Given the conditions of organisational and technological complexity, it was not known how heterogeneous organisations worked together to integrate diverse knowledge; how increasing trust developed and learning to achieve mutual understanding; how consensus was built or collective learning adjustments made. These key concerns guided this research and the review of the industry context.

There now follows a brief discussion of specific drivers of convergence. They illustrate the many choices the collaborative constituency was likely to face; the decisions individual organisations might make and their process implications.

4.3.1 Drivers of Convergence

Three key drivers have contributed to convergence independently and interdependently (McKenna, 2000; Mueller, 1999). They help illustrate the likely process difficulties:

i) Digitisation of technologies & interconnected networks

Before digitisation, each communications platform: fixed telephone lines, cable network, satellite, wireless and microwave, dictated its own means of signal flow. Digitisation has enabled a common means for signal flow in computing, telephone switching, transmission and broadcasting, into a

seamless, interconnected network (Fransman, 2000). It has improved network efficiency by carrying larger volumes of information (Mueller, 1999). Reduced network fragmentation enables technology bundling and sectoral convergence. The consequence is that organisations with different transmission platforms can compete for each other's customers.

Technological bundling does not represent a bolting together of technologies (like pieces of a puzzle) into a fully functioning concept. It involves social interactive process of technology envisioning, knowledge refinement, adaptation and integration, and importantly utilisation of common technology standards. The social interactive activity is dependent upon context in which it is created (Tsoukas, 1996; Brown & Duguid, 2001). In some cases, competitors have to collaborate to agree and set common standards. This generates a tension. How do organisations balance the benefits of collaboration against risk of competition from competing technologies; how do organisations from different national contexts with commitments to specific standards agree a common standard? How do individuals with sector-specific knowledge achieve common understanding and jointly envision knowledge integration.

ii) Standardisation and deregulation

Deregulation of previously state-controlled telecoms networks has helped the development of alternative infrastructures such as cable and satellite. Interconnectivity amongst these platforms is only feasible through development and adoption of common standards. An example is the development of the World Wide Web, helped also by generic programming languages[15]. This, combined with the digital signals' ability to travel the globe has created conditions for organisations to offer competing services and opportunities to collaborate across national borders (Mueller, 1999; Doz & Hamel, 1998). This is illustrated in the technological developments discussed later.

If common standards are important for convergence, then collaborating organisations would be expected to incorporate those standards and to closely scrutinise market developments. The appeal of developing proprietary concepts using non standard technology might be risky unless future adoption of the technology is certain. An important issue generated is whether consensus can be reached, particularly if constrained by nationally defined standards. For instance, a non-European partner might be reluctant to develop a technology that incorporates a European standard, if that development contradicts the standard used in its national context. That organisation would be expected to include technology that easily fits with its existing technology. The study of a complex international collaborative technology transfer provides an opportunity to gain important insights into how these dual tensions are dealt with and how partners continue to engage in working together.

iii) Speed of improvements in processing power

[15] Java programming language allows integration of technologies independent of any platform

Increased processing power has enabled ordinary PCs to handle large multi-media applications, and develop broader more complex product capabilities. The simultaneous reduction in cost has led to greater consumer uptake and demand.

In summary, whilst organisations from separate industry sectors are converging with respect to products and customers, the process is highly fragmented (Swedlow, 2001). Despite speculation of a multifunctional product that might replace all others, the market has developed into various products for different consumer needs, largely 'pushed' by technologists (Mueller, 1999). Alpha's technological concept might represent one such addition. Collaborative transfers are occurring amongst diverse organisations with significantly different technologies. Competition is probably less at individual organisation level, but more as part of a bundled service chain (Mueller, 1999). Alpha was viewed as one such bundled service chain that might compete against other entities in a similar context.

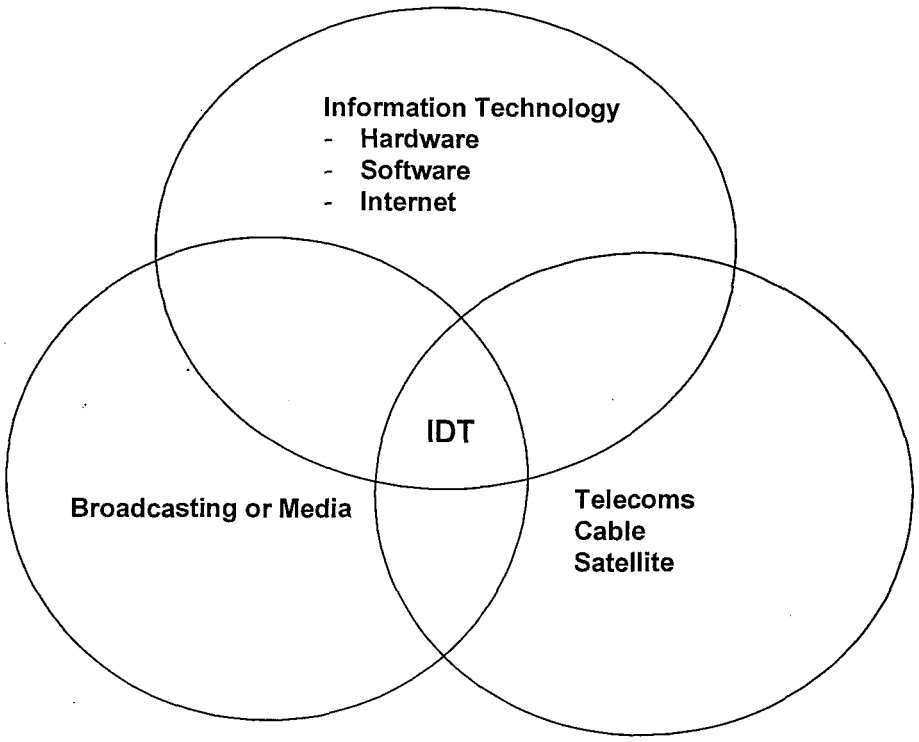
An important dimension of complexity was believed to be contributed by historical product evolutions based on often competing standards. Industry participants and regulators would have to agree common standards to bundle services and broaden product functionalities (www.itc.org.uk; SPIG, 1999). Organisational success was likely to depend on consumer orientation of the product and economic value perceived by participants. Some organisations may be driven to invest in collaborations without knowing the economics at the outset: behaviour reflective of the internet industry. This has process implications because as organisations begin to collaborate and gather knowledge and insights, expectations and commitments may change.

The discussion now turns to a converged product concept of Interactive Digital Television, the sector relevant to this research and viewed by many organisations as potentially highly 'value-added' (Allen, 2001). Its various infrastructures are detailed to demonstrate consumer choices and decisions organisations would be expected to make.

4.4 SPECIFIC CONTEXT OF INTERACTIVE DIGITAL TELEVISION (IDT)

The television industry is undergoing dramatic change through transformation of traditional broadcast content by digitisation and added interactivity. In addition to normal television viewing, IDT has enabled functions such as shopping, on-line banking, e-mails and participation in market research (KeyNote, 2001; Mintel, 1999; www.itc.org.uk). The IDT concept is represented in Diagram 4.2 depicting convergence of the three sectors discussed above and represents the specific sector in which Alpha was set. IDT merges traditional television with Internet-like capabilities, with a two way communications link (Allen, 2001). The link enables users to interact with broadcasters (Birmaier, 2001). Multimedia and interactivity provide the ability to source and manipulate text, images and sound (Mintel, 2001). The consumer decides when to interact. Organisations view interactivity as an opportunity to generate added revenues. Their aim is to develop and deliver content that promotes a great deal of revenue-generating user interactivity.

DIAGRAM 4.2 DEPICTS CONVERGENCE OF THE THREE INFORMATION INDUSTRY SECTORS FOR IDT



Whilst interactivity can be achieved in varying degrees on PC-based or mobile devices, interactive television in this research was delimited to a static TV in-home use. Its infrastructures and characteristics in this context are described below.

4.4.1 FACTORS ENABLING DEVELOPMENT OF IDT

Convergence in IDT has also been driven by factors discussed earlier. In particular, the effects of two factors are discussed below. It is noteworthy that an important incentive to invest in IDT in the UK has followed deregulation and national aim to convert broadcast transmission from analogue to digital. Whilst the 2006 deadline has slipped[16], many organisations have begun to introduce technological change. BBC for instance has made significant investment in digital broadcasting and interactive content over the last three years[17].

i) Digitisation in IDT

[16] The mandated transition to digital TV continues to prove cumbersome as industry copes with lack of standards and clear business model for the DTT platform. There is doubt whether a complete turn off in the UK of analogue is possible even by 2010 (Itvt 4.04 14/11/2001)

[17] BBC's latest IDT application to accompany its UK coverage of British Open Golf in 2 versions: for terrestrial (ITVDigital) and cable (ntl & Telewest) & other for satellite viewers (SkyDigital). Interactivity includes: full leader-board updated in real time with 12 players listed per screen; latest top news stories; individual round reports, profiles of top players from the UK, Europe, US and rest of the world; a golf based quiz, etc. Users are able to watch TV (quarter screen positioned in left middle) while using the service. The red remote control

Compared to analogue, a digital signal retains consistent quality, gives wide screen picture and CD quality sound (www.itc.org.uk). A greater number of channels can be transmitted over the same network with interactivity (KeyNote, 2000; Mintel, 1999). Increased channels have enabled organisations to offer special interest interactivity channels: knowledge, sports, travel, and health. These channels are evolving into environments analogous to the Internet portals (Whittingham, 2000).

Technically, digital broadcast consists of a synchronised stream of audio, video, data and subtitling, which can be separated into the components to add interactivity. In a basic digital TV broadcast, the signal stream is digitised, compressed and scrambled by an encoder; signals are merged in a multiplexer and transmitted over the transmission network; at the consumer end, signals are de-multiplexed and decoded (Selway, 2000). If different organisations are contributing different content streams and technologies, for seamless integration they would have to be compatible. This has important process implications.

ii) Standardisation

An important process issue arises because IDT system incorporates various hardware and software technologies in devices and signal broadcast. Each activity has been associated with certain standards. Transmission of digital information is based on MPEG[18] technology standards. MPEG-4 has been developed for interactive applications, enabling integration of digital television, interactive graphics applications and multimedia. For digital signal broadcasting, the DVB standard is being adopted by many European countries. These technologies would be expected to play an important role in Alpha's integration.

Alpha would be expected to utilise emerging standards. The sponsor would be expected to encourage development and utilisation of generic standards. Standards were therefore expected to be important concerns for discussion and debate in this IDT product development.

4.4.2 HOW IDT DIFFERS FROM TRADITIONAL TV

IDT differs from traditional television by a change from passive, linear to active, personally controlled entertainment: coined 'infotainment' (Mintel, 1999). The essential difference is that in traditional TV, information or entertainment is received by the consumer at broadcaster determined times; in IDT, some control resides with the consumer to 'pull' content when desired. Interactivity represents different intensity of content consumption (Whittingham, 2000). Traditional broadcasters have produced content for mass consumption and broadcast on a 'push' basis. Now they have to develop tailored or value-added content for different consumers. The key organisational challenge is to determine the content that encourages consumers to interact and pay; and then to develop

button is used to activate the service. Itvt's critique is that this application is truly the best in the UK (Itvt 3.74 20/7/2001)

[18] with growing international acceptance

and produce it cost effectively (Swedlow, 2001; www.carmelgroup.com). Basically, interactivity can be conceptualised along a spectrum: at the minimal end, simple channel or programme searches occur; at the other extreme, deep interaction occurs where even program content may be modified by the viewer. Creating greater consumer demand at the intensive end is what service providers are looking for to generate greater revenues.

The BBC has acknowledged the changing consumer patterns and need for broadcasters to offer interactive concepts. It is reflected in the growth of interactivity in news, sports and soap programming. In response to a question on future of interactivity, the BBC Controller of Interactive TV said recently, *'In two or three years' time, sports fans will come to expect it. This autumn, we are introducing interactivity in factual programming. Our research shows that people want alternative commentaries, additional facts and video streams, as well as Web support'* (Itvt 3.77 8/8/2001). These reports seem silent on how developments are funded and the extent to which consumers are prepared to pay for added interactivity.

4.4.3 WHAT IDT LOOKS LIKE:

Technically, IDT incorporates interactivity in video programming. It may be: data on video, graphics on video, video within video. In some cases it may involve future retrieval of video programming recorded on a hard disk. To the viewer these enhancements appear as graphic or information overlays on broadcast programs, as semi-transparent features on a TV screen. An example is real-time display of stocks across the bottom of a screen on news broadcasts or as on-screen display of parallel events during major sporting events (Swedlow, 2001). The viewer navigates content within specific programs using remote control[19] and fast key colour buttons.

The TV has been in use for several decades as a technology platform. Its familiarity, relative ease of operability by young and old, renders it far simpler than a PC. The addition of enhanced features on this platform has a greater uptake potential. A further advantage over a PC is its robustness; TVs rarely crash. Introduction of PC-like features can increase instability. The challenge is to ensure that an integrated concept maintains the robustness that consumers have grown to expect.

An IDT system (KeyNote, 2000) consists of the following components. It represents the choices consumers face in the UK and technological diversity involved:

i) A device: either an integrated digital or an analogue TV with a digital set-top box (STB). STB gains access to the digital system and decodes incoming digital signals. Excessive costs of integrated TV sets have limited their uptake. Moreover, service providers have subsidised STBs to build a subscriber base for their digital services and encouraged their addition to analogue

[19] wireless keyboards and PC-like mouse on a keyboard are also being developed

TVs. In a short time, STB has itself evolved into a highly sophisticated piece of hardware[20]. Since the collapse of ITVDigital, STBs are being retailed providing access to a limited number of free to air terrestrial digital broadcast channels e.g. Freeview box.

ii) Communications link: A broadband or digital link from broadcaster to consumer and return link from consumer to broadcaster. Return link need not be broadband as it carries substantially less data back to broadcaster and may be a normal telephone line.

iii) Conditional Access: Traditional broadcast TV may be considered 'free' despite an annual license levy. Majority of premium digital services restrict access to paying customers, by encryption of broadcast signals; decryption is activated by the STB depending on what the user is prepared to pay.

iv) Choice of transmission infrastructures for receipt of digital signals (Mintel, 1999):

- An existing Television aerial as Digital Terrestrial Television (DTT)
- A Satellite dish as Digital Satellite Television (DST)
- A cable communication as Digital Cable Television (DCT)

Each infrastructure is further elaborated:

Digital Terrestrial Television (DTT) – broadcaster transmits digital signals from land-based transmitter over the airwaves. At consumer end, signals are received by a standard TV aerial and decoded by a STB. Return link is via a separate telephone line. ITVDigital, the recently failed digital broadcast company operated on this principle, with a return link through BT, ntl or Telewest cable.

Digital Satellite Television (DST) - broadcaster transmits via a satellite upload station and geo-stationary satellites. A satellite receiver mounted on an external wall at consumer end receives signals, sends to STB for decoding. Return path is via a separate telephone line. SkyDigital broadcast uses this principle; return link is similarly through BT, ntl or Telewest cable.

Digital Cable Television (DCT) – transmission medium is via a hybrid fibre-coaxial network to individual homes. At the consumer end, a 'connection to curb' and digital STB is required. Unlike the preceding two infrastructures, return path is via the same network. Its advantage is an 'on all the time' link and a broadband width that enables speedy handling of large volumes of information (Selway, 2000). Telewest and Ntl operate using this principle but market penetration has been slow.

[20] By including a hard disk, normally associated with PCs, manufacturers have integrated vast recording capacity into STBs e.g. TiVO. Consumers can record many hours of programming. Recorded content can be replayed and interacted with.

Their subscriber base is significantly lower than DST provider SkyDigital, perhaps because of the slow speed of investment in building a nationwide cable infrastructure.

Currently the 3 infrastructures are not interchangeable; each incorporates proprietary system-specific components. Specificity is achieved by incorporating proprietary application interface and decryption process for conditional access in STBs. E.g. SkyDigital cannot be used to receive ntl DCT service; they both use proprietary STBs and internal software. Bundling of technology components is based on the principle that customers are locked into the entire package. As partners build a trusting relationship they may collectively develop other products, seeking popular content. BSkyB is a leading example in its collaboration with other IDT system firms. It has built a huge brand loyalty which has proved difficult for others to erode. In developing and bundling integrated technologies, competing platforms would be expected to strive for position of preferred transmission network of innovative content with widest consumer uptake.

IDT clearly illustrates bundling of diverse technologies. Whilst organisations may broaden internal capabilities by integrating neighbouring technologies, it is highly unlikely that individual organisations can become self-sufficient across the entire value chain. As a minimum, an IDT system would be expected to consist of the following organisations: consumer electronics firms as providers of STBs or integral digital TV sets; broadcasters or content owners; network providers such as cable or satellite; for satellite network, a telecommunications network provider would be needed for return link; software providers for encryption of STB. Alpha's constituency included all these segments for it to create its integrated technology.

The discussion now moves to the components of the IDT value chain.

4.5 Building Blocks of IDT and Organisations Involved in Its Provision

Traditional television consisted of vertical structures of content producer, broadcaster and viewer. The business models were relatively simple. They defined organisational roles, values added and revenue streams generated. In IDT, five horizontal segments have replaced this vertical structure resulting in a complex business model. Although the earlier discussion looked at organisations that would be expected to participate in IDT, the following section clarifies it further. Each segment and segment-specific technological competences is now discussed (Mueller, 1999):

CONTENT: Refers to creation and production of material encoded in a particular format using different technologies e.g. TV programming, movies or web page. This block is similar to content produced in traditional TV; the main difference is its focus on tailored content by moving away from the principle of 'one-size fits all'. This end of the value chain is less capital-intensive (Whittingham, 2000) and constitutes a great deal of 'people-based' knowledge. BBC as commissioner and producer of broadcast content is a representative example. Organisations in this segment would be

expected to develop content with a great deal of interactivity. They would want consumption using a wide range of digital devices distributed over various networks, without expensive content revision. In this way, revenue maximisation and minimisation of infrastructure costs might be achieved.

PACKAGING: Refers to an intermediary function where different types of content and/or software are assembled into a product or service bundle. The bundle may consist of supplementary information on top of some content or may include built-in interactivity. Skills needed are a combination of content production and software programming. Many software houses have established the business of building interactivity into normal content. Organisations in this segment would be expected to work with a wide range of content creators for extensive consumer coverage and revenue maximisation.

CARRIAGE: Represents distribution/transmission platforms over terrestrial, satellite and cable networks. Competition in this segment is at inter-platform level. Organisations in this segment would be expected to purchase and control popular content. They might collaborate with innovative content producers on the basis of exclusivity to differentiate its offering and to secure consumer loyalty for its platform. BSkyB's satellite platform has achieved this in areas such Premier League Football and other Sports.

EQUIPMENT or CONSUMER ELECTRONICS (CE) manufacturers: Refers to equipment that enables telecommunication and information processing e.g. TV sets, Satellite dishes, STBs. STB makers include PaceMicro, Scientific Atlanta, Motorola and Philips. Organisational objectives in this segment would be to maximise device uptake; to incorporate software likely to become a generic standard, but differentiate its product and leverage technical role into services and content development.

SOFTWARE: Refers to stored instruction in devices used for conditional access. Although often bundled with hardware, it represents a distinct product segment. In this segment, Middleware software providers have a significant role for conditional access. Middleware software contained in the STB decodes digital signals, displays information on TV screen and facilitates interactivity. It scrambles and protects against content that has not been paid for. Currently, no middleware standard exists, leading to competing offerings. Prominent Middleware suppliers with international presence include: Liberate, OpenTV, SunMicrosystems, Spyglass and Microsoft. They would be expected to work with a wide range of device makers and content owners as preferred suppliers and ensure software compatibility. Some technology differentiation would also be expected.

Another essential element in IDT is TV authoring software, required for interactive content. As with Middleware no single standard exists. Currently, middleware vendors produce much of this software to ensure compatibility with their own platforms.

Alpha would be expected to constitute organisations with functionalities in at least all the preceding five segments. But this limits the role and competences to technical aspects of technology integration. To develop a product concept acceptable across wide international markets, the collaboration would be expected to influence and work closely with standard setting institutions. It would be expected to include research institutes with rich expertise and access to new knowledge. Even more importantly, for the collaborative to achieve commercial success, it would be expected to include contribution from one or more organisations with strong business and marketing skills to establish user preferences and define the complexities of shared revenues. Alpha's starting conditions represented these characteristics.

The discussion now turns to product concepts on offer in the international market. It should help the reader get a sense of Alpha's technological fit with external developments. The section concludes with issues still faced by the industry. This was considered important in determining if Alpha had similar views and how it addressed them.

4.6 MAIN AREAS OF TECHNOLOGICAL DEVELOPMENTS IN INTERACTIVITY

Various 'added value' services are being offered using an existing TV set (Allen, 2001). Since 2000 the following product categories have grown significantly. This may give clues to the applications considered by Alpha and their consistency with the market place:

i) Electronic Program Guides (EPGs) are electronic versions of traditional TV magazines such as RadioTimes, with detailed programme listings. Information is further organised thematically for speed and easy access: news & documentaries, kids programs, music, movies and times of viewing etc. Gemstar-TV Guide is the market leader.

ii) Video-on-demand (VOD): is an offering of movies as an alternative to video rentals. Offered at various times of the day enables impulsive purchase and consumption.

iii) Synchronised applications e.g. interactive news, weather, educational documentaries

iv) Sports offerings e.g. football, horse racing, golf. BSkyB offers a great deal of premier league football at premium pricing

v) 3D games and game shows where consumers can play along

Of these five applications, the most popular in terms of organisational investments seem to be EPG and sports offerings. In essence, it is not just the TV channel that is valuable, but every programme on that channel generates value. The aim is to encourage as much paid interactivity per programme as possible (Whittingham, 2000). It would be interesting to see if Alpha considered any of these applications during its early discussions.

4.7 INDUSTRY DEVELOPMENT AND ISSUES CURRENTLY FACED

The European television industry is undergoing remarkable change. Mandated by the 1996 Telecommunications Act, the UK has pushed for analogue replacement with digital technology. This has encouraged some operators to develop the market. BSkyB's investment been remarkable; reality shows such as 'Big Brother' and 'Survivor' have attracted millions of interactive voters. The cost of integrated digital devices however still remains prohibitive, raising government concern for achieving its targeted digital switch between 2006 and 2010. Recent reports suggest that inclusion of digital devices into TV sets may become mandated (Itvt 4.31 of 13/3/2002). Despite some frantic investment activity by a few telecoms, cable, satellite and software companies the industry is developing in a fragmented way, offering niche products (Swedlow, 2001; Foliomag, 2001). This disjointed development is leading to technological packages consisting proprietary technologies with limited scope for interchange. Given the proprietary nature of technologies and complexity of interaction, two major issues face the industry and its future development. These issues are consistent with EU's concerns and its reason for constructing the Alpha collaboration:

i) Lack of robust Business Models

Although IDT is believed to generate revenues, strengthen brands and customer loyalty (www.itvt.com), there is a basic uncertainty about its value proposition for constituent firms. Previously each sector's value chain was fairly linear; business models were clear about who sold what to whom, at what price. IDT represents a complex picture of inter-firm inter-dependencies, confusion over how each firm carves out an economic share (Mueller, 1999). New business models have to reflect the complex revenue sharing arrangement amongst content producers, STB suppliers, Middleware software providers, network providers, ISPs, advertisers, and so on. This lack of clarity has deterred investors from committing funds to the technology raising concerns over IDT's sustainability. A concern reflected in comments made by an IDT executive:

> *'...don't get creative with IDT products until you get creative with IDT business models'* (www.Itvt.com/evrev11202js.html).

Business modelling in addition to technology integration was expected to be an important concern for Alpha.

ii) Adoption of Common Standards and Generic Technologies

Costs of producing content are high. For revenue maximisation content has to be accessible to a wide range of consumers and integrated in a form that allows transmission across heterogeneous networks without any compatibility issues.

Whilst no single technology has attained worldwide acceptance, European and US industry players and regulators seem to be working towards development and agreement of generic standards; particularly for programme content to cross various platforms. If an organisation is to develop multi-media content once, but broadcast it without further manipulation, it can only do this cost effectively

by using common standards. In Europe, the EU has encouraged collaborative consortia to adopt and influence common standards (Mueller, 1999; SPIG, 1999). Some of the larger consortia sponsored by the EU were highlighted in Chapter 1. The EU sponsored collaboration Alpha, had the common standards as one of its starting objectives.

The following IDT related standards would be expected to be important considerations for Alpha in keeping with market developments.

i) For broadcast of Digital signals 3 competing standards have emerged:

- DVB standard is embraced by 31 countries including UK and most Europeans
- ATSC adopted by US and Taiwan, just recently by South Korea[21]
- ARIB adopted by Japan

DVB seems by far the most popular and would be expected to be included in Alpha given its wide European constituency. Given the inclusion of a South Korean partner in Alpha it should be interesting to see how consensus is reached or how competing standards are accommodated.

ii) For transmission of a digital signal MPEG is perhaps the single area where there is substantial global accord, and therefore expected to be included in Alpha.

iii) ATVEF-specified protocols for interactive content. HTML based protocols are universally accepted, but XML, a more recent development is likely to carry over into IDT. It is supported by TV Anytime Forum and therefore expected to be a standard included in Alpha.

iv) Application programming interface (API) included in STB or integral TV sets is being specified DVB, as DVB-MHP, which is set to emerge as an open European standard

How complex revenue sharing is enacted and which standards are included in the development have process implications. A collaboration planning to integrate diverse technologies in IDT would be expected to address the two important issues of business models and emerging standards during the course of its technological development.

4.8 TECHNOLOGICAL DEVELOPMENTS AND CONTEMPORARY IDT PRODUCT OFFERINGS

Since the 1980s, the EU has sponsored a large number of technological collaborations to enhance European competitiveness. Whilst many have been in the Computer and Telecoms industries, they have also included agriculture, automobile and biotechnology industries (Evan & Olk, 1990). Within the Information Industry, the analysis showed that the EU had sponsored various prior and

[21] S Korea has tested both ATSC & DVB standards, finding DVB far more superior in quality of delivery. However the government is unlikely to alter its commitment to ATSC because its leading CE company LG uses ATSC technology extensively in its electronic products

concurrent collaborations similar to Alpha in the IDT sector[22]. The research also found that the EU sponsored a further collaboration on Alpha's completion (See Chapter 8 & 9) consisting of some current members combined with others who owned specific technologies.

An important question might be: was there any non-EU sponsored IDT technological development activity underway in the commercial environment. If so, how did it compare with what Alpha was trying to do? The developments and product offerings are reviewed here. This review was guided by the following concerns:

i) To identify IDT applications of particular interest in the market and their relative success to help contextualise the empirical findings
ii) Identify organisations or industry segments widely engaged in technology efforts, to compare those with Alpha
iii) Identify any successful business models to compare Alpha's achievements
iv) To determine organisational engagements with emerging technology standards to compare Alpha's commitments to particular standards and the impact on integration

The large number of IDT initiatives reported by the industrial business magazines suggested that technology integration seemed broadly feasible. This was consistent with the empirical findings. Yet it seemed that the process dynamics of integration was poorly understood. There was very little information regarding technology integration failures and reasons why those failures might have occurred. Six important conclusions were drawn from a picture of fragmented IDT development, each summarised here with some illustrative examples, quoted from the business literature. They were selected as representative from hundreds of similar developments, involving many new and existing firms:

1. Novel IDT concepts are being developed successfully through collaborative technology transfer amongst diverse partners from various nation states. Alpha's constituency and broad technological objectives seemed consistent with those seen here. The following examples also illustrate the organisational and technological complexities of the collaborations.

Lucent, nCUBE, NDS, Orca Interactive and PaceMicro have teamed up to offer an IDT system that integrates respective technologies. The system will support broadcast video, VOD, DVR, and encryption-based content protection over STBs for cable and telecoms operators. Lucent is providing encoding technology; LINKRunner is to provide video gateways and network management software; nCUBE is contributing its n4 streaming media server and its nABLE multi-network management platform. NDS's Open VideoGuard content protection software will provide encryption and security offerings, while its XTV digital video recorder technology will support the client-side PVR control applications. Orca's RiGHTv Core system will provide the STB. Support for architectures will give operators flexibility to decide how they want to deliver content (Itvt 3.87 of 20/9/2001)

[22] Over Alpha's lifetime a concurrent project was exploring security issues relating to the integrated technologies. The concurrent BASE collaboration's technology was to be integrated by Alpha (Chapter 8 & 9)

EnReach (Middleware provider), NTT-ME (WakWak Station BB STB maker), Rikei (Broadband operator), and Toyo (VOD content) formed an alliance to provide IDT applications to hospitality and multiple dwelling unit markets. The partners will develop services for the Japanese market (Itvt 3.73 of 18/7/2001)

2. Larger industry players are working with firms from the same segment that offer competing technologies, probably to ensure inclusion in technology that becomes an industry standard. For instance, Philips, a European multinational device maker is developing STBs with competing partners. Some of the partners in Alpha too were collaborating in other parallel collaborations.

Philips the maker of STBs is to make boxes for TiVO (Itvt 3.63)

AOLTW and Philips collaborate to co-market services (content and technologies). This collaboration will lead to alliances on IDT products as well (Itvt 3.72 of 13/7/2001)

Philips and Microsoft announced availability of their new STB combining Microsoft TV platform with Philip's Nexperia digital video platform and its CryptoWorks conditional access system (Itvt 3.87 of 20/9/2001)

3. Countries as yet uncommitted to specific standards may be influenced by organisational participation in international collaborations and standards adopted by those collaborations. The empirical findings discussed in Chapters 8 & 9 illustrate the case of the non-European partner C in Alpha.

Liberty Media recently acquired 6 German cable companies pending regulatory approval, set to become Germany's largest cable player, says it plans to purchase Germany's 3rd largest cable operator TeleColombus. The US Company has declared its refusal to adopt MHP which could mean that programming from German broadcasters standardised on MHP would not be available on its cable networks (Itvt 3.98 of 27/10/2001)

Taiwan formally selected the DVB standard for digital terrestrial broadcast. South Korea, Canada and the US are now the only countries to have adopted the rival ATSC standard (Itvt 3.97 of 24/10/2001)

4. Some areas of interactivity have attracted greater interest from industry players, such as interactive sports offerings. They might give clues to the appropriateness of technological choices made by Alpha.

BBC Sport has teamed up with BBC New Media, using OpenTV and NDS technologies, broadcasting via satellite using Sky broadcasting, have developed an interactive element to its annual tennis tournament at Wimbledon. The interactivity enables a viewer to choose amongst various live video streams of different matches and enables selection of latest scores and background information on players whilst watching a current match on screen (Itvt 3.72)

Four Australian companies have teamed to bring viewers the country's first interactive broadcast of a major sporting event. Optus (integrated communications provider), Seven Network (national broadcasting network), Pineapplehead (sport graphics and statistics company), and ICE Interactive (IDT services company) tested an interactive application during the broadcast of Rugby's Bledisloe cup (Itvt 3.84 of 6/9/2001)

5. Other than entertainment, developments are also underway for public services. UK Government has been particularly interested in its potential for casting of votes and submission of Inland Revenue tax returns. This too was thought to be important in giving clues to Alpha's development choices.

A trial program in healthcare was launched in the Midlands, called 'Living Health'. Using Telewest's cable platform it features 24hour NHS access. Developed by a variety of collaborating partners – Smashed Atom, Opta, Medic Direct, Medic Logic, iMPower, viewers through TV sets can look up and book medical services and contact a nurse at any time (Itvt)

A week before the General Election in May 2001, ITVDigital launched applications across Telewest and ntl (both using Liberate middleware) offering information about electoral candidates in local areas, news, guides to important issues in constituencies, and information on how to vote. During the actual day of voting, viewers were able to access election progress information (Itvt 3.62)

6. Although business models such as BSkyB's subscription based offering are beginning to mature, economics of most initiatives illustrated above are unclear. This was consistent with the empirical findings (see Chapters 8 & 9). It would seem that a great deal of technological participation is undertaken in the belief that business models and revenues will become clear at a later stage. Whilst this strategy might be viable for larger organisations, smaller organisations with limited resources are unlikely to engage under these conditions. Their strategic intent may be to learn new knowledge and utilise these engagements for access to organisational networks. The empirical findings show that Alpha generated future collaboration for partners who were interested in making the linkages.

4.9 SUMMARY OF THE REVIEW

This review was undertaken on the premise that social processes are deeply embedded in the contexts that produce them and are in turn produced by them. Multiple levels of context were conceptualised in the belief that numerous related processes would impact the collaborative technological transfer process and that asymmetries of those levels might lead to different momentums and speeds of change (Pettigrew, 1997). A detailed understanding of multiple levels of industry context was expected to help situate Alpha's developments against those emerging in the market; understand the reasons for Alpha's conception and its intended goals; to help interpret the contextualised organisational actions and behaviours. In essence, it helped provide an understanding of the likely industry influences on partner organisations and the collective entity.

Consistent with Alpha, the review illustrated the various dimensions of organisational complexity:

- Multiple organisations contributing interdependent technologies
- Relative organisational sizes and technological heritages with potential to both constrain and facilitate the social knowledge creation process

- Diversity of sectoral technologies and associated standards required organisations to make important choices that might introduce tensions and conflicts
- National heritages and differences in market conditions might affect choices individual organisations make
- Organisational cultures and work practices might introduce process issues in social knowledge creation

The heterogeneity of the setting was likely to bring different organisational competences, expectations, motivations, decision-making processes and levels of commitments. Process issues associated with the complexity dimensions were discussed in Chapter 3. Each of these dimensions was expected to complicate the collaborative technology transfer process and its performance outcome. The research concern was not to track the dimensions over the course of the transfer but to be sensitive to their starting conditions and evolving influences. Technological evolution meant that knowledge integration was unlikely to be a simple process of fitting together of knowledge pieces. A great deal of social and collective envisioning, experimentation and interaction would have to take place (Tsoukas, 1996). Alpha's goals and tasks would have to be adjusted to the changing landscape yet it was not known how the heterogeneous organisations would make these learning adjustments. Furthermore, development of international standards and their different adoptions by nation states was likely to generate tensions in choices the social entity would have to make.

The higher complexity and the impact of context on technology transfer process is perhaps better represented by Pettigrew's river stream metaphor, '*... we are studying some feature of organisational life not as if it represents one stream in one terrain but more like a river basin where there may be several streams all flowing into one another, dependent on one another for their life force and shaping and being shaped by varieties of terrain each constraining and enabling in different intensities and ways*' (Pettigrew, 1997:340).

Consistent with the basis given for Alpha's conception, the review found important industry concerns about lack of business models. Despite a growing number of complex collaborations and technological success stories, little was known about process issues that might have contributed to those outcomes. Interestingly, collaborative product concepts illustrated in the preceding section gave little indication of how revenues were generated for the engaged constituencies. Alpha clearly provided a unique opportunity to study the emergence and development of these issues. The empirical findings (Chapters 8 & 9) showed that Alpha too, was unable to develop any novel business models despite successfully integrating some technologies with narrowed scope. The empirical findings also illustrated the immaturity of the technological standards that had a limiting effect on the extent of technology integration.

4.10 Concluding Remarks

This chapter has fulfilled its objective of reviewing multiple industry contextual levels. It has demonstrated that the specific IDT setting represents an interesting opportunity to study the dynamics of social technology transfer and integration. The contextual review was undertaken in the belief that social processes are deeply embedded in the contexts that produce them and are produced by them (Pettigrew, 1997). Multiple levels were expected to contribute numerous process complexities with implications for process outcome. The rich understanding helps situate Alpha and the fit of its goals with market developments. Interpretation of empirical process findings were made with this background of understanding.

Contextualised process research contrasts sharply with research based on large scale quantitative methods. Construction of Alpha's contextual richness would not have been possible without use of a qualitative, interpretative case study design. The intensive contextual engagement also helps illustrate the limited number of cases that might be studied at a given time. This has implications for academic work that seeks to understand change process in organisational life.

The next chapter describes the dynamic process theoretical framework and discusses the reasons for its selection to the exclusion of other process theories.

SECTION II

RESEARCH DESIGN & METHODOLOGY

CHAPTER 5
THEORETICAL FRAMEWORK AND PROPOSITIONS

5.0 INTRODUCTION

A rigorous piece of theoretically-informed research would be expected to declare the theory it has employed. The purpose of this chapter is twofold: first, to discuss the selected process theory of learning and mutual adjustments (LaMA) (Doz, 1996); second, to develop two dynamic propositions grounded in the theory and the reviewed literature. The propositions served to operationalise the theory to determine how well the specific collaborative technology transfer process and its outcomes were explained by it, if at all. Finally, the empirical research contribution is discussed.

Before elaborating the theory, the chapter begins with a brief look at the reasons for choosing the dynamic LaMA theory, as a theory of particular value in this setting. Research objectives and their underlying assumptions are then discussed. It was argued in Chapters 1 and 2 that much of the existing empirical study of technology transfer, in the field of strategic management, views transfer process in relatively linear terms. There has been a greater concern to understand transfer outcomes, linked to certain transfer dimensions, as if they were variables with fixed characteristics. Human action or emergent process that contributes to outcome development has largely been ignored. There is a dearth of processual study with an interest in temporal development and change, and how that change links with organisational outcomes. The key research concern in this thesis was to track the transfer structure, individual and social actions / interactions, and how they mutually constituted to shape the transfer outcome.

Collaborations are said to avoid unnecessary dominations and to encourage knowledge integration (Mintzberg, Dougherty, Jorgensen, & Westley, 1996). They are believed to be highly complex and prone to learning[23] difficulties. Weaknesses of linear approach to study of technology transfer are well known (see Chapter 2) and can be briefly summarised here.

Complex collaborative technology transfers were not expected to traverse a pre-determined path. If that was the case, then knowledge would be objective and wholly known and definable at the outset; and transfer conditions would remain constant over time. In this research, transfer conditions were not viewed to operate as if in a controlled environment. Contextual unpredictability and change was highly likely to influence and shift the task needs over time. This was expected to affect individual and collective expectations, decisions and actions. The key process consideration was the nature of human actors as sources of *irrationality*: their *motivations*, *understandings*,

[23] The concept of learning is discussed later in this chapter

interpretations and changing expectations. Moreover, performance outcome was unlikely to hold a single objective reality shared by the multiple stakeholders. Changing views about likely project outcome and its organisational impacts was likely to influence ongoing organisational commitments. In essence, the central research concern was to understand a form of collective social behaviour; expected to be unpredictable and to shape the transfer process outcome.

The research setting of Alpha was introduced in Chapter 1; it's technological and business goals were discussed in Chapter 4. Alpha's higher level complexity was considered to arise from various complicating dimensions discussed in Chapter 3. To recapitulate: given the diverse technological heritages, for technological interdependence there was expected to be problems of understanding each other's technologies. The diverse country origins were expected to contribute cultural differences and work practice influences (Hofstede, 1980). Differences in organisational forms: commercial / non-commercial, small / large organisations were likely to create work tensions and conflicts from differing incentives, motivations to participate and learning. Incentives to participate for a commercial organisation might be markedly different to those of a research organisation (Rogers, Carayannis, Kurihara, & Allbritton, 1998).

This research was based on the premise that for a collective process of technology transfer to be effective, it would have to go through cycles of social learning and mutual adjustments (See section 5.3 for the definition of learning and mutual adjustments). Knowledge was not viewed as entirely objective or pre-defined; rather, a great deal of knowledge was expected to be processual and situated (Tsoukas, 2002). Organisations would have to engage in envisioning how the technologies might be integrated. Consistent with the processual view of strategy (discussed in Chapter 1), organisations were not expected to know for certain, all future events. As joint work began, understanding of various aspects of the task and learning about its feasibility would develop. This may lead to changed expectations; organisations may decide to reduce participation or commitment. Changes in internal circumstances of organisations might also have a process impact. To effectively integrate the defined IDT technological concept, the entire collaborative entity would have to act in a unified, interconnected manner. It would have to be responsive and adaptive to emerging issues by making mutual adjustments. Divergent decisions taken by individual organisations were likely to shape those of others, singly or jointly.

From a limited number of process theories, an *a priori* process theory of LaMA was selected in the belief that it provided a general theory of social development and change (Poole, Van de Ven, Dooley, & Holmes, 2000). The social network perspective that might be considered relevant in a complex collaboration was not chosen (Powell, 1998). This decision was justified in Chapter 3. As a theory of change and development, the theory of LaMA was believed to be superior. It had the ability to provide a better understanding of the collaborative structure, the unfolding actions, and the various learning influences on the shaping of the evolving structure. Initial conditions were not

viewed as static and efficient i.e. whether they allowed collaborative technology transfer to be successful. Rather, they were viewed in dynamic learning terms i.e. whether they allowed partners to learn about how to make the collaboration effective and whether they provided the conditions for improvements and learning adjustments. The research innovation was its deployment in a higher complexity transfer that had not been done before.

Scholars have argued that theories of organisational change are limited to action or structure, stability or change, external or internal causality; this partial concern can render them incomplete (Van de Ven & Poole, 1988). LaMA theory was believed to overcome many of these imbalances in that transfer action and collaborative structure could be trailed; group stability as well as change was explainable; external and internal influences on individual and social levels could be captured. The theory incorporated mechanisms and explanations for continuous and discontinuous process development. In fact the theory was believed to meet the four requirements set out by Van de Ven & Poole (1988) for a dynamic change theory:

i) *A part-whole relationship between structure and action is a basic requirement of any process theory of organisational change.* Individual organisational learning cycles within the collective structure and their co-influences were managed well by LaMA Theory. The nature of social learning and change in initial conditions provided a basis for following the relationship between the two aspects.

ii) *Sources of change are identified and explained from both within the social structure and outside the structure.* Internal and external contextual influences on individual and the collective organisation could be considered in light of dialectical contradictions and tensions in the evolving structure and social actions. This contrasts starkly with linear process models that assume that process temporality is immaterial.

iii) *It is able to explain both stability and change.* Stability here reflected social change actions in the form of mutual adjustments that led to unity, consensus, or social order. Any tensions, conflict, pluralism and disruption reflected an inability to make social adjustments, which would eventually lead to instability.

iv) *Time is included as a key historical accounting system.* The path of actions as reactions of some past event could be captured. In other words, actions were not viewed as isolated occurrences. They were connected and influenced by time, intimately linked to what had preceded them in time and space.

It was thought that putting an already well developed theory to work in a new and markedly different setting, which confirmed or refuted the likely process outcome, would help enrich it. It would

generate a theoretical research contribution. It is of note that other scholars have used the same theory to produce incremental theoretical advances (Arino & de la Torre, 1998; Larsson, Bengtsson, Henriksson, & Sparks, 1998), but limited to simpler settings (see Chapter 2). It is also worth reiterating that this research was primarily theory-driven, with an added exploratory element for theory enrichment.

5.1 Research Objectives and Research Contribution

A dynamic process question requires a process theory that is non-linear in nature. Here the most important assumption was that organisations are characterised by dynamic complexity that renders models with simple cause-effect relationships unrepresentative. Although different researchers may focus on different aspects of a process theory (Langley, 1999), the broad concern of any process theory is to find if a typical sequence or pattern exists over time; to determine why it may exist and to explain the mechanisms and consequences of the patterning sequence in the phenomenon being studied (Abbott, 1990). In a highly simplistic dichotomy, the process sequence may be determined deductively by comparing an existing model that specifies the order of events; or inductively derived as a narrative model from the data. In this study the former deductive approach was adopted in the belief that its application in a single study would help accumulate further knowledge (Johnson, Melin, & Whittington, 2003; Pettigrew, 1997).

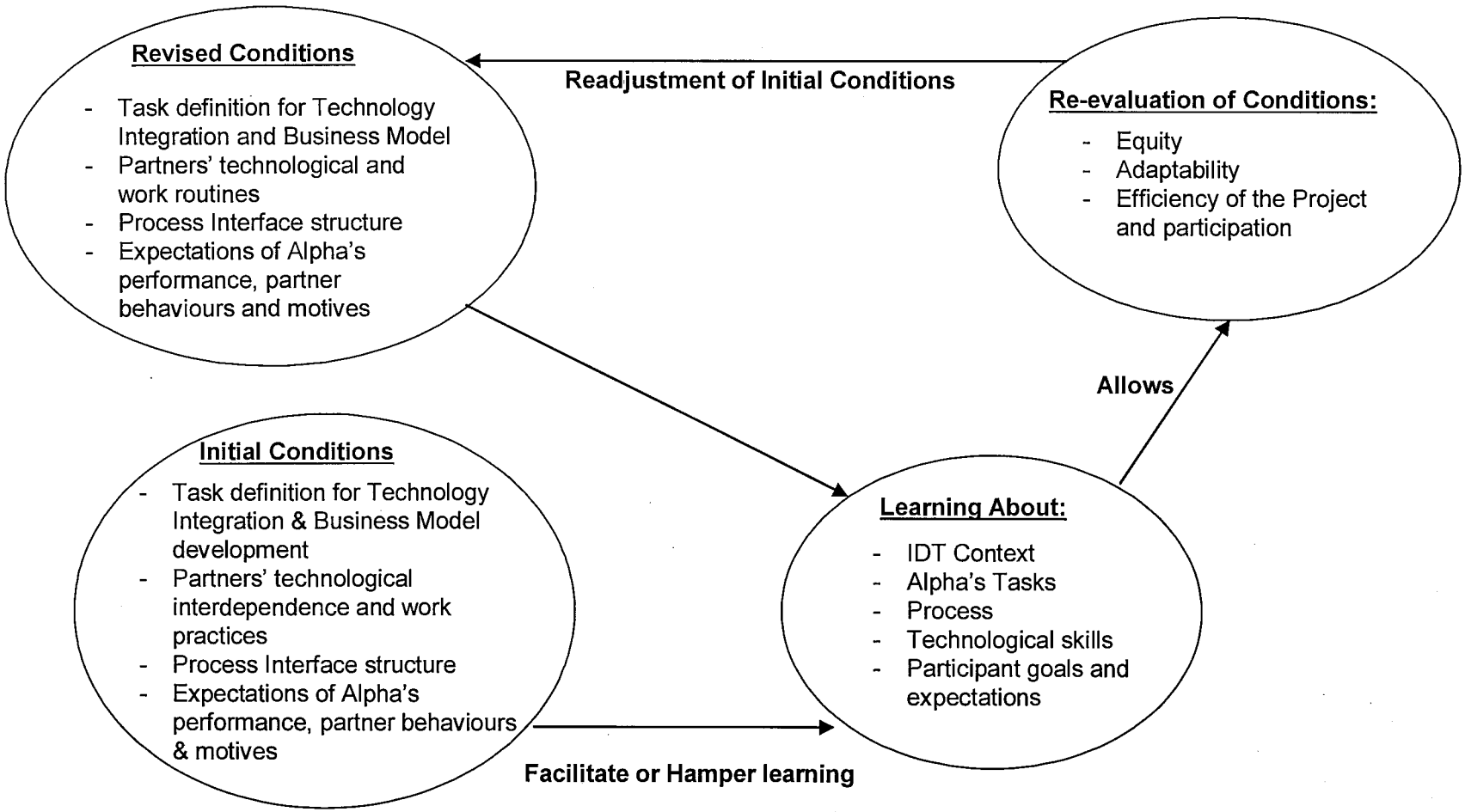
In essence, the research objective was to determine if the LaMA theory would explain how the process of collaborative technology transfer and integration developed over the 24 month duration; and how it led to particular change outcomes. By applying it in this high complexity setting, the intention was to enrich the theory. The theory was originally derived empirically from a simple dyadic setting and tested in four projects. The projects were all dyadic collaborative technology transfers in 3 different industry settings – pharmaceutical, aerospace and computers. It had yet to be applied in higher complexity settings.

5.2 Process Theory Framework & its relationship with the Research Problem

Diagram 5.1 represents the *a priori* process theoretical framework used in this study. In essence, the framework represents a patterned sequence consisting of cycles of structural adjustments. Their mechanisms are explained by an empirically derived, theory of LaMA (Doz, 1996). Their consequence can be failure or success, depending on the quality of learning evaluations and adjustments that are made, individually and collectively, and their impacts on the coherence of the social entity. Broadly, the positive and negative feedback loops show that social reality consists of circles of causality.

Before exploring the elements of this theoretical framework and the concept of learning, it is worth pointing out that this framework was believed to be particularly relevant to the study of Alpha in a

DIAGRAM 5.1: PROCESS THEORY OF LEARNING & MUTUAL ADJUSTMENTS (LAMA) (Doz, 1996)



number of important ways. It dealt with not just the initial structural conditions constituting: the starting knowledge, participants and their technological histories but also how knowledge changed over time, and how changes in expectations and relationships developed. Initial conditions were not viewed as static but in dynamic learning terms. It also provided important insights into how changes in context affected organisational actions and process adjustments. Essentially, it dealt with what work needed to be done, how it would be done and by whom. An important assumption was that social adjustments would be necessary as a response to emerging changes in any of the starting conditions. The framework might also be viewed as an opportunity to study content, process and context (Pettigrew, 1997). Given that actions can give clues to people's understandings or intentions, emerging organisational understandings and expectations could be tracked, both individually and collectively.

The framework was a product of an empirical study of new business and product development cases, where new opportunities were pursued under significant market and technical uncertainties. These conditions only became resolved over time. This mirrored Alpha's situation particularly well in that: technology standards were still evolving, consumer preferences were beginning to become established and concepts developed by competitors were gaining visibility (Swedlow, 2001). Based on industry sectors that organisations belonged to, inferences could be made regarding their motivations to participate (discussed in Chapter 4). By contextualising the research and capturing the various influences, it contrasted with a study that might focus entirely on project activity isolated from its surrounding. Essentially, action embedded in its context was captured and studied longitudinally (Pettigrew, 1992).

Knowledge creation and transfer occurs through learning actions (Inkpen, 1996). Actions were considered to be enactments of individual and organisational understandings and motivations. They gave clues to events or conditions that might have triggered them. By following how organisations interpreted, defined and redefined themselves in the tasks, expectations and commitments to the collective project, the model enabled the tracking of the process dynamics and its outcome. There now follows a brief discussion about the concept of learning.

5.3 CONCEPT OF LEARNING

Learning is an important concept in strategic management for organisations to achieve sustainable competitive advantage (Teece, Pisano, & Shuen, 1997; Senge, 1990). The concept has been used widely and with many underlying meanings. Clarification is thus needed regarding its use in this research. It should be noted that this discussion does not pretend to represent an exhaustive review of the various learning literatures[24]. The aim of this brief discussion was to discuss how its use in this thesis fits with some of the wider debates.

[24] For a review the reader is referred to the works of Romme & Dillen (1997) and Easterby-Smith, Crossan, & Nicolini (2000)

The variety of perspectives has generated vast amounts of literatures on learning. They span fields such as: innovation study of new product development; use by economists in study of production efficiency; in the management field as accumulation of learning experience or the learning curve. Organisation theorists have sought to define and explain differing levels or learning intensities (Argyris & Schon, 1978)[25]. Indeed learning is a complex concept because different perspectives have an implicit view of it either as process, an outcome or both.

In considering where and how learning takes place, the key debates that were considered relevant to this research were as follows:

i) Whether learning is at individual or organisational level: the implicit focus is intra-organisational learning
ii) Whether learning is at group level: here the learning focus may be reoriented to external inter-organisational levels
iii) Whether learning is cognitive or behavioural: splits learning into two steps of understanding and action

The concept of learning in this research touched on all the debates listed above. The process theory and the interpretative research methodology were believed to be consistent with the way in which the concept was viewed and used.

The common dictionary refers to learning as acquisition of knowledge or skills. This widely used perspective implies a split between an individual as possessor, and knowledge as possession. This positivistic attitude neglects the impact of time and the process of human interpretation and knowledge enactment. More processually orientated writers argue that collaborative technology transfer is a complex, dynamic, and social process (Kogut & Zander, 1993). And that learning plays a significant role for transfer of existing knowledge and creation of new knowledge (Teece et al., 1997). In other words, in a collaborative IDT project, knowledge was not a given in a pre-defined sense. It was expected to rely on individual and social learning about various technologies, business environments and their ability to carry out interdependent tasks. New insights would develop, which would lead to different options. Knowledge would have different meanings in different contextual conditions. It reflected the situated and enacted nature of knowledge (Tsoukas, 2002). The collaborative entity was therefore perceived not as a stable structure with fixed boundaries that remained constant over time. Instead, it was more a fluid, mutually reconstituting structure that would have to be responsive and adaptive to changing conditions if it were to be effective.

[25] Argyris' 3 levels of learning - single loop, double loop and deuteric learning whilst conceptually neat is a challenge to study. For no process can claim to operate under a single level of learning at any given time

The concept of organisational learning has been in use since the 1960s but research on learning organisations gained impetus following the work of Senge (1990). Senge gave a normative account of what an organisation would need for it to be known as a learning organisation. For learning effectiveness, managers would need to create environments where shared visions and team working were engendered (Romme & Dillen, 1997). Other writers provide a more descriptive account of learning (Kim, 1993; Levinthal & March, 1993).

Starting with the first of the three debates listed above, the organisational learning literature holds two polar views of learning: whether it is an individual activity (Simon, 1991), or whether it occurs at an organisational level (Kim, 1993; Fiol & Lyles, 1985). The latter, organisational level learning view considers it to be more than the sum of individual learning. At any given time, an organisation accumulates knowledge that exceeds its current stock of individual knowledge. Organisations accumulate knowledge from prior historical activities and organisational individuals. This in turn influences the quality of individual learning in that organisation. It clearly has a path dependent nature to it. In this regard, Fiol & Lyles (1985) describe organisational learning as development of insights, knowledge and association between past actions, the effectiveness of these actions and future actions. This notion of accumulated path dependent learning has also been referred as organisational absorptive capacity (Cohen & Levinthal, 1990), discussed in Chapter 2. For instance, organisations that engaged in previous collaborations were said to have greater absorptive capacity than those that did not (Kanter, 1994). This might apply to various organisations engaged in Alpha that had collaborated before.

The notion of organisational learning was considered particularly important in this research because it assumed that sector-specific organisations had honed their knowledge bases. They had accumulated learning about their markets, customers, technologies and institutions. Organisations from other sectors would not easily grasp, understand or replicate this knowledge. Participating individuals as organisational representatives were expected to bring this broader organisational knowledge to the social learning context.

This preceding individual/organisational learning debate has probably had a greater focus on intra-organisational learning and knowledge creation. An external shift can be made by extending the organisational learning view to social networks (Powell, 1998), where learning occurs at inter-organisational, group level. Here for instance, learning and knowledge from current collaborations can be accumulated internally by organisations. This learning is put to organisational benefit by undertaking other collaborations. Positive experience, satisfaction with the knowledge gained and development of trust can drive future collaborations, often with the same partners (Gulati, 1999). Group level learning was considered particularly relevant in this research at Alpha's collective level, and also within the structures that emerged over the course of the project. The learning in these

structures reflects the learning characteristics of Communities of Practice (Lave & Wenger, 1991), discussed in detail in Section III.

The social constructionist perspective that represents Communities of Practice (Lave & Wenger, 1991; Brown & Duguid, 1991) challenges the traditional idea that learning occurs either at individual or organisational systems. It starts with the assumption that learning occurs and knowledge is created through dialogue and interactive social processes. It substitutes the traditional representation of learners as individuals with learners as social beings; understanding and learning is constructed from social interaction within specific socio-cultural settings. Knowledge as 'possession' transitions to knowledge that is enacted and 'practice-based'. This processual view was reflected in the view adopted in this research where learners as social beings, interacted to enact and produce knowledge. Knowledge contributions greatly depended on organisational and technological heritages.

The third debate listed above was the cognition - behaviour learning split. This was considered particularly relevant in this research. Cognition, as the first step in learning represents the development of understanding of a situation and an ability to conceptualise that experience and its consequence; the second step refers to the ability to articulate and action that understanding. Fiol & Lyles (1985) argue that the two steps represent different phenomena. It is vital to appreciate the difference between the two steps because one is not reflective of the other. Change in cognition or understanding is a pre-requisite for change in behaviour or adaptation. Learning in the process LaMA theoretical framework included this cognitive and behavioural split along various situated learning dimensions. Learning occurred at the levels of individual and organisations (as organisational representatives of specific technological knowledge), as well as the social group (as a collaborative structure). Cognitive learning refers to partners' abilities to recognise and understand emerging information. This information together with their experiences helps work out the potential impacts on the project. Behavioural learning refers to partners' ability or intention to put the understood information into action. Effective cognitive learning is not sufficient for effective behavioural learning to occur. There has to be an intention and the necessary capacity to learn (Hamel, 1991).

Learning in this collaborative technology transfer did not refer to mere acquisition of technical skill to integrate knowledge. It included the social ability to interact with and adjust to partners from different technology domains such as telecommunications network providers, software authoring tools providers, consumer electronics manufacturers and so forth. It included individual and social learning about emerging technology standards for the social group to make choices about the specific technology standards to use. The learning readjustments clearly had implications for the entire social entity and for individual organisations. The theory also captured the motivational dimension by including negative learning adjustment cycles. A negative learning adjustment may

occur as follows: emerging information, its consequence and necessary actions may be understood but partners may choose not to act because of changed priorities or commitments.

The discussion now moves to the theoretical framework.

5.4 THE LaMA FRAMEWORK AND ITS ELEMENTS

It must be remembered that variables in a positivistic sense were not the centrepiece of this theoretical framework. Intermediate change outcomes might be viewed as 'dependent' variables (Pettigrew, 1997) only in so far as they provide the ability to connect a narrative process analysis with them. This contrasts sharply with statistical correlation of independent variables with an outcome. Recall from Chapter 4, the two main goals of Alpha: to define novel business models and to create integrated technology. The performance outcomes of these two goals were processually linked to the transfer process and represented the 'objects' of study. The outcome developments are discussed in Chapters 8 and 9.

Using a number of concepts discussed below, the focus of the LaMA theoretical framework was the progression of technology transfer by following the actions and changes made by the social entity and its individual participants; the nature and sequence of this progression that led to the development of particular change outcomes. Generative mechanisms for the sequenced pattern were explained as a narrative, using a dynamic process theory.

In this social science theory, human nature was viewed as non-mechanistic. Organisations were expected to recognise and understand emerging issues based on often competing and sometimes conflicting frames of meanings. Based on those understandings they were expected to make judgements about what they wanted to do and the likely consequence of those actions or even inactions. Their preferred action amongst alternatives may not always be for the collective good. These actions and interactions might also reflect a balance between individual organisational versus collective gain. The framework takes a holistic approach by encompassing the 'what' and the 'how' of the collaborative work. It also takes account of organisations' changing contextual conditions and expectations. The framework consists of three conceptual elements, namely: Initial conditions, Learning dimensions and Evaluative adjustments. Each element is now discussed:

5.4.1 INITIAL CONDITIONS

The theory argues that initial conditions determine whether and how learning takes place between collaborating partners. The conditions are important because they have an enduring effect on the process. The transfer does not unfold independently of the initial conditions but is influenced by them. In other words, there is path dependence (Teece et al., 1997). In facilitating or hampering the transfer process, initial conditions are significant in defining whether the outcome is likely to be successful or not.

Initial conditions are represented by:

Firstly, definition of organisational tasks: what work has to be done for new knowledge creation. For instance, a broadcast content producer would have to work closely with the organisation that incorporates interactivity enhancements. In the process, both partners would learn something about the other's technology. They would form a view of how a smooth integration might be achieved, which would not be remote from activities of other organisations. The enhanced content would have to technically be capable of transmission across various distribution networks, and receivable by a consumer's digital device. Given the extent of IDT's technological organisational interdependence, the tasks would have to be carried out in collaboration with the entire group.

Secondly, normal organisational work practices are determined by their national, industry and organisational contexts. These work practices may constrain social working. Tensions may arise because of differences in learning speed or flexibility in decision-making and problem-solving. Those with prior experience of joint working may be familiar with others' work styles. Those without any prior experience might require a great deal more time to get to know each others' work practices and adjust their own style.

Thirdly, the defined process interface for collective work. This interface may facilitate or hinder the process depending on the interaction or communication intensity that a task or situation requires. As the process unfolds, partners may find that the initial interface design of remote electronic work, communication and problem-solving is not responsive enough especially given the relatively short duration and timelines of the work. Moreover, organisational participants had other organisational commitments and priorities at the same time. Their time was not entirely dedicated to working on Alpha. Interface adjustments would be required to achieve common and timely understanding.

Lastly a series of expectations of the collective goal, motives for organisational participations and the likely individual goals, their expected behaviours. In other words each organisation held a set of expectations about the overall project, its own and others' organisational contributions and benefits. Participation intensity would reflect the relative commitments.

How some of these initial conditions are set may influence the following learning steps. So for instance, from the empirical findings it would seem that Alpha's initial conditions were highly conducive to social adjustment and change for one of the intermediate change outcomes but much less so for the other. How and why this occurred is discussed in Chapters 8 and 9.

5.4.2 Learning along Various Dimensions

The theory states that a technology transfer progresses neither as planned nor does it evolve independent of its initial conditions. The nature of initial conditions is either highly inertial or

generative in fostering learning and adaptation over time. As organisations engage in joint working, the conditions facilitate or hamper the learning, either cognitively and / or behaviourally. This occurs along a number of 'learning' dimensions: the environment, the task, process interface, skills and expectations of collective goals. For instance, learning about the environment might lead to goal adjustments; learning about tasks might lead to conclusions that the necessary knowledge and skills are lacking. To achieve a successful performance outcome, partners would have to make mutual adjustments to one or more of the learning dimensions, both individually and socially.

5.4.3 Re-evaluations and Adjustments to Initial Conditions

As learning occurs along the various dimensions, periodic re-evaluations are undertaken at individual organisation level or by the collective group. They monitor the project for its efficiency. They also monitor each other for adaptability and degree of knowledge contribution. Efficiency refers to an organisational assessment of the value of collaborative participation; equity refers to the inter-organisational perceptions of amount of actual participation and contributions that each has made; adaptability refers to the willingness and partners' ability to adjust to changing conditions. When organisations assess others' contributions and efforts towards achievement of a social goal, it may trigger a process of re-evaluating their own efforts. These periodic re-evaluations lead to readjustment of the starting conditions in a positive or negative direction.

Learning re-evaluation and readjustment is clearly a two-step exercise, similar to that argued by Fiol & Lyles (1985). The first step consists of individual or joint ability to recognise and understand the emerging conditions; assessing the likely implications and changes that might be needed. The second step represents the response action to this emergent understanding in order to effect a re-adjustment. A negative adjustment in the second step may simply constitute a partner's inability or intention not to modify its behaviour to make the change. Organisational intentions and expectations may change or be reset: an example might be where Partner *X* finds that one or more of the other collaborating partners were simultaneously working with *X*'s competitors and that this might limit *X*' in the future. *X*'s reduced participation therefore would not represent an inability to learn about the actions needed for effective performance.

Failed or less successful collaborations tend to be highly inertial. This is a result of poor or little learning, or due to divergence between understanding (cognitive) and behavioural learning and frustrated expectations. Successful collaborations by contrast are highly evolutionary as they progress through a sequence of highly interactive cycles of learning, re-evaluation and readjustments. There is an ongoing process of mutual reconstitution. As understanding of what has to be done or how it has to be done develops, success depends on partners' abilities to socially adjust the starting conditions. As adjustments are made and partners become more trusting of each other, greater and more irreversible commitments are made, all of which positively impact the

transfer performance outcome. The empirical findings showed these deepening commitments by a small number of organisations.

The conceptions of cycles of evaluation and adjustment do not mean a synchronous or simultaneous act by individual organisations or the collective social entity. Evaluative cycles occur separately and collectively. They do not have a fixed duration or frequency. Decisions regarding what might be best for the collective project are reached jointly and separately; some partners may well wish to disengage based on their evaluative assessments. The sequence of the theoretical pattern suggests that learning must precede evaluation, which in turn must precede adjustment. In this empirical study, any deviation in the ordering of this sequence would have to be explained by inductive reasoning. Chapters 9 and 10 explain the anomalous empirical findings in this sequence.

5.4.4 CRITICAL SUCCESS FACTORS IN THE LEARNING DIMENSIONS:

The theory argues that in a mutually interdependent relationship, the following conditions and learning processes are particularly relevant for a more successful outcome development. Before considering these conditions, it is worth reminding the reader what was meant by success. In Chapter 2 it was stated that a processual view of success was plural. Whilst it was acknowledged that no single success measure can satisfy the multiple stakeholder views, meaningful process explanations would be helped if an anchor was defined. In Alpha, performance success was taken to mean EU's evaluation of the two starting goals and its assessment of the final outcomes. These two intermediate outcomes as anchors helped link the process development. They also helped uncover some divergent views of success. It is of note that an organisation's disengagement from the project did not necessarily represent failure for that partner. It probably reflected a strategic decision not to continue based on its emerging circumstances and understandings.

Collective success emerges when the learning dimensions satisfy the following conditions:

ENVIRONMENT:

The learning influences of the environment help create success if the conditions foster convergence of purpose and intensive cooperation amongst the partners. It is only through shared premises and joint sense making that sustained social action take place. This would mean that if IDT's future was viewed by one or two partners as highly unpromising they might decide to reduce their participation or disengage. If their unique technologies were critical to the collective project then there would be a significant process impact on the remaining constituency. Environmental conditions might also relate to market developments in emerging technological standards and how different partners conceived their relative positions.

TASK:

When partners bring highly different skills and technologies, if tasks are initially ill-defined then major information and knowledge asymmetry ensues. It leads to difficulties in learning and knowledge transfer. If individual organisational tasks are undertaken isolated from the rest of the group, without due consideration to the task interdependencies of others then success is highly unlikely. For a more positive outcome, the highly interdependent technological tasks required partners to take account of future process consequences of their current actions. This greater task interdependence and greater engagement was particularly evident in the more successful knowledge creation in the technology integration module (Chapters 8 & 9).

PROCESS INTERFACE:

As interactions intensify and partners discover each other's work practices, technologies are combined and incongruities are overcome. Communication is encouraged, which leads to increased communication frequency. This results in higher levels of trust, which fuels even greater openness, honesty in problem solving and decision-making and increased commitments. These deepening process interface changes were seen in the more successful technology module but not in the business model module.

SKILLS:

Skill learning facilitates cooperation: Doz (1996) found that where there seemed very low skill learning, it raised doubts about collaborative effectiveness and suspicions of partners' real motives. Questions surfaced in partners' minds, such as: was a partner there just to acquire new skills rather than share with the rest of the membership. Interestingly, by contrast very high skill learning provoked an opposite concern: that a partner may set up as a potential competitor. In Alpha, a great deal of skill learning occurred within the emerging structures in the technology integration module, but there was little evidence of any competitive concerns.

GOALS:

Partners' individual and collective social behaviours give clues about their motives beyond those explicitly declared and shared. They may reveal hidden agendas. Regular evaluation of efforts made by different partners gave powerful clues to their commitments at the time. In the technology module for instance it was found that Partner D failed to contribute or participate soon after the first socialisation meeting (see Chapter 8); the apparent change probably reflected a readjustment in its expectations of benefit accrued from Alpha's.

Given this process theory, the process findings in the literature and the assumptions discussed at the start of this chapter, what might one expect in this higher complexity collaborative project? In order to deal with this question, two dynamic process propositions were derived grounded in the theory and the literature.

5.5 Discussion and Development of Dynamic Theoretical Propositions

Two alternative dynamic theoretical propositions are first given, followed by a brief review of the themes that helped underpin the arguments in their construction. The development of the propositions was guided by the following question:

If the aims of the high complexity collaborative technology transfer project Alpha were to develop novel business models, which would help drive the development of integrated technologies, then knowledge contributions from the entire social entity would be necessary. They would be necessary throughout the process. To integrate such a wide ranging interdependent knowledge what process outcomes might be expected? It was thought that two process and outcome alternatives were likely. Both propositions had two central themes: i) quality of learning responses to emerging conditions and ii) consistency of unified action that would determine the pattern of process development and its performance effectiveness:

Proposition 1:

For the development of a successful collaborative technology transfer outcome, the initial conditions would facilitate highly dynamic cycles of learning and mutual adjustments within a unified and collective entity. The sequence of cycles of learning would be expected to consist of: cognitive learning followed by re-evaluation of project conditions, followed by both individual and social actions to adjust the initial conditions. In this high complexity setting, the complementary technologies would be expected to be contributed by the entire membership in a mutually reinforcing way.

Proposition 2:

For the development of an unsuccessful performance outcome, initial conditions would hinder cycles of learning and mutual adjustments along one or more of the learning dimensions. It might be reflected in the disengagement of one or more partners from the social technology transfer process.

The following understandings contributed to their construction:

Social interactions and learning processes do not occur in a vacuum. They take place against a background of competing interests, expectations, understandings and patterns of beliefs. Consistent with the processual view of strategy the highly structured design of Alpha was not expected to follow a predefined linear path. Change adjustments to its specified milestones and work tasks would be expected in response to learning. Similar to the dyadic collaborations studied by Doz, emergent contextual changes might require realignment of tasks, and related decisions and actions. Technological uncertainties in the newly emerging IDT sector meant that all knowledge could not be known or specified at the outset. This knowledge was expected to be continuously

emerging in nature. Its enactment was likely to change with changing conditions (Tsoukas, 2002). For instance, the telecoms sector underwent a major economic crisis that coincided with Alpha's timeline (Swedlow, 2001). Organisations in that technology domain would have joined the collaboration under significantly different business conditions than those experienced. This might have influenced their expectations and participation over time. Alpha was therefore viewed as a highly dynamic and emergent social process, with an unpredictable development outcome. For it to be successful, its initial conditions would have to be mutually adjusted over time.

According to Ring & Van de Ven (1994), collaborations are socially contrived mechanisms for collective action. The collaborative groups are created to achieve a mutual goal. If there was no mutuality, they would not be coherent groups. They argue that collaborations are continually shaped and restructured as a result of actions and symbolic interpretations of its members. Their interdependence means that an event that affects one affects them all. Based on dyadic collaborative technology transfer, the theory states that for complementary technologies there has to be mutual learning adjustments, otherwise the transfer fails. In other words, if one of the two partners in the dyadic relationship failed to learn and adjust, then failure was likely to ensue. Alpha's highly complex and multiple organisation composition would be expected to expose at least one partner's failure to make learning adjustments - intentionally or otherwise. Given the highly interdependent and unique nature of technologies, they would not be easily substitutable by others. Any learning divergence would be expected to have a negative impact on the process outcome. Clearly, every organisation had to see a strategic logic and convergence of purpose throughout the transfer process for it to be effective (Doz, 1988).

Discussion in Chapters 3 & 4 introduced the dimensions of complexity. They were considered important contributors of difficulties in the social knowledge transfer process.

Given the diverse and novel nature of technologies being integrated, and given there was little prior experience of this particular integrative task, organisations might find that what was first thought technically feasible was actually much more difficult. Unforeseen obstacles might require additional resources or different knowledge expertise. They may lead to changed expectations and project participation. For a successful process outcome to develop, positive learning adjustments in the level of effort and resource contributions would be necessary. This type of adjustment was seen in the technology module by a number of partners (see Chapters 8 and 9).

The fact that the majority of collaborative knowledge creation activity was to take place from geographically dispersed sites (dispersed in time and space), difficulties were highly likely. Misunderstandings were expected during the process of daily problem-solving and decision-making. Although project review and technical working meetings were planned on a quarterly basis, it was thought that for a relatively short duration project, waiting for a 3 month face-to-face meeting

to resolve specific problems might have a significant process impact. Initial interface conditions would have to change to help overcome any process difficulties.

Organisations are heterogeneous with respect to their distinct knowledge architectures (Rebentisch & Ferretti, 1995), their diverse customers and technology base, their national and organisational contexts. This was likely to contribute to process difficulties and mutual understanding. The nature of knowledge held by organisations from different industry sectors was likely to be so specific and tacit that it was unlikely to be easily communicated without verbal and face-to-face contact. Even Browning, Beyer, & Shelter (1995) found that partners from the same industry sector and national contexts developed organisation specific language that had to be overcome through other means. Misunderstandings were likely to be compounded further by national, cultural and language differences. These diversities can lead to different styles for problem solving, decision-making, interacting or even methods of knowledge transmission (Lam, 1997). When performance, particularly in a short duration project was dependent upon timely knowledge contributions from each and every partner, differences in speeds of learning were expected to significantly impact the course and outcome. Partners were expected to be constrained by national contexts in the way technologies were developing and being adopted as international standards. The technology module illustrated that despite widespread European adoption of a particular technological standard, it had not been adopted by Partner C's nation state. C overcame this dilemma by significantly increasing its resources to develop a parallel integration that included the more widely adopted technology with one accepted in its national context.

5.6 CONCLUDING REMARKS

As this research is theory driven, this chapter has fulfilled an important role of presenting a process theory. The theory of LaMA was discussed with reasons for its selection. Two dynamic process propositions were derived. They served to help answer the central research question about the problem of higher complexity technology transfer and to determine if the theory corroborated the empirical findings. The logic supporting this was that if the propositions were validated by the empirical evidence then the theory would have explained how the transfer took place in this high complexity IDT collaboration. It would also have made a theoretical contribution by extending the theory to this complex, high complexity setting. If on the other hand, the empirical evidence revealed a different pattern or sequence than that maintained by the theory then the theory would have failed to explain the transfer process in this particular research setting. The research task would be to then explain the observed divergence.

The next chapter deals with the research design and methodology.

CHAPTER 6
METHODOLOGY AND RESEARCH DESIGN

6.0 INTRODUCTION

In the previous chapter, the *a priori* dynamic process theory of LaMA (Doz, 1996) adopted in this research was discussed. Two dynamic propositions were developed with a key concern to determine their empirical validity. The application of the theory in a higher complexity setting, allowed an exploratory element to be built into the research design. The highly persuasive reasons for the relevance of this particular theory in Alpha were offered; in particular, the important empirical contributions the research was expected to make.

All empirical research has an implicit, if not, an explicit research design. A research design represents the logical sequence that connects the empirical data to the research study's initial research question and eventually to its conclusions (Yin, 1994). A social science researcher faces various options and alternatives and has to make strategic decisions about which to select. Each selection has a set of assumptions about the social world being investigated and its inevitable advantages and disadvantages (Denscombe, 2000; Bogdan & Taylor, 1975; May, 1997). Of the two[26] principal research paradigms in social science research, termed 'quantitative' and 'qualitative' approaches, qualitative approach was adopted here.

Although the two paradigms are not mutually exclusive, each has its own ontological and epistemological assumptions that influence the research methodology. At a highly simplistic level, the two paradigms may be differentiated according to the degree of quantification used in its analysis. At a deeper level however, each has philosophical differences regarding the nature of reality; how that reality is grasped, and influences of space and time on it. Quantitative research assumes a rational and objective reality that separates the observer from the observed. Qualitative research on the other hand represents a mixture of the rational, intuitive and unexpected; the researcher's personal experiences are often key events to be understood and taken into account as data. Unlike quantitative research, understanding the impact of context is a key research concern (Van Maanen, 1979).

The purpose of this chapter is to present the research design and methodology that was believed to best capture the essence of the dynamic technology transfer process question and discuss why this particular design was constructed. By making explicit the range of guiding assumptions that shaped

[26] The two broad paradigms also have other labels. Quantitative paradigm is often referred as positivistic, scientific or post-positivistic and is modelled on natural sciences. Qualitative paradigm is also termed interpretative, naturalistic, social constructivist

the conduct of this research, the intention was to outline its distinctive advantages and help overcome criticisms of a qualitative (Yin, 1994), processual (Pettigrew, 1997; Johnson, Melin, & Whittington, 2003), and single case study research design (Mintzberg, 1979; Yin, 1994; Eisenhardt, 1991).

This chapter starts with a brief introduction to the broad qualitative approach, followed by a discussion of the particular processual approach selected (Pettigrew, 1997; Langley, 1999). Clarification of the processual approach is particularly critical because scholars have argued that most social science research methods are not particularly well suited to execute research on change and development (Poole, Van de Ven, Dooley, & Holmes, 2000). They rightly argue that dynamic process theories are adequately assessed only if research is directed at action; when there is good access to process detail and influences on the developing entity can be studied.

These concerns are included in the five key assumptions that operate in process research that are espoused by Pettigrew (1997), defined as follows:

i) Embeddedness: means the study of change within interconnected levels
ii) Temporal interconnectedness: locating change in past, present and anticipated future; predetermined timetables or ordered stages are not an assumption, but rather that of uncertain streams of events
iii) Exploring context in action: they are interwoven when human beings make their own history
iv) Cause of change is neither linear nor singular: organisational change has multiple and interacting causes
v) Complexity reduction: allows linking of process to organisational outcomes

By specifying the processual method selected in this research the aim was to demonstrate its ability to broadly achieve the foregoing assumptions.

Two further strategic choices were made and are discussed here:

i) Research strategy of a Single Case Study (Yin, 1984)
ii) Research method or technique using documentary evidence as an exclusive source of data generation

Reasons are given for making specific selections from available choices, and associated strengths and weaknesses. The chapter ends with an introduction to the goal of process analysis in this research and the planned process analytical approach. In a nutshell, this chapter deals with 'how' the research was conducted. The next chapter deals with how the data was actually analysed.

6.1 DOMINANT APPROACH TO RESEARCH IN STRATEGIC MANAGEMENT

This research is firmly placed in the 'processual camp' of strategic management pioneered by renowned scholars (Pettigrew, 1992; Mintzberg & McHugh, 1985), and utilises a well developed dynamic process theory LaMA, developed by a respected strategy scholar (Doz, 1996).

Whilst discussed earlier, it is worth reiterating that a central concern of empirical research in the field of strategic management dominated by industrial economists has been to understand the structure-conduct-performance relationship (Porter, 1980). To examine these relationships, research has relied extensively on cross-sectional methods that assume that model parameters are stable across organisations and over time. Yet, many theoretical constructs used in strategic management have clear organisational and time-specific components e.g. organisational knowledge (Nonaka, 1994; Kogut & Zander, 1992). Although this positivistic line of study has offered important insights into organisational competitiveness, process research has the ability to provide deeper insights into organisational outcome development over time (Pettigrew, 1997). These insights can be used by managers to influence future organisational processes. Process research captures the social or human element to process; how limits of rationality and agency influence organisational processes. Process research draws on sociology and history, and whilst it has grown in interest in the strategy field (Ferlie, 2002), there remains a call for more research using dynamic approaches (Barnett & Burgelman, 1996; Van de Ven, 1992).

Conventional form of strategic management research was rejected here on the basis that it would provide limited insights into understanding how intra-collaborative technology transfer occurred; particularly when the research concern was to study the co-influences of various dimensions including context on actions in the process. Quantitative approach would have limited the use of eclectic data gathering method to study micro processes.

6.2 THE BROAD APPROACH OF RESEARCH METHOD

The first major research design choice faced was whether the research was quantitative or qualitative in style. The two paradigms introduced above, do represent distinctive philosophies and research methods but are not mutually exclusive (Van Maanen, 1979); in fact they can be complementary, by providing different kinds of data bearing on the same phenomenon (Jick, 1979). The advantage of combining quantitative with qualitative data is to achieve triangulation or external validity (Ferlie, 2002). This research however relied entirely on rich and thick qualitative data.

As the objective was to gain a detailed understanding of a dynamic transfer process in a single setting, time and context were highly important. A cross-sectional, quantitative methodology would not have fulfilled this objective. Therefore, a broad qualitative research approach was adopted to capture a deeper and richer understanding of process. The research was largely deductive in style that explored the validity of an *a priori* theoretical model; but the design flexibly incorporated an

exploratory or inductive element. An entirely inductive or grounded theory approach (Glaser & Strauss, 1967), whilst considered highly interesting was rejected on the basis that location and interrogation of a single case study in an existing theoretical framework would contribute to greater knowledge accumulation; it would be less open to criticism (Pettigrew, 1997; Johnson et al., 2003).

There is a misconception in social science research that qualitative research somehow implies an inductive logic. Induction is used to develop theory from data (Glaser & Strauss, 1967). Sensitised by the theoretical framework of LaMA and the IDT industry context, two alternative theoretical propositions were developed for deductive testing. Deduction here does not imply positivism as represented by Auguste Comte. In that sense there would be little regard for subjective or irrational states (Bogdan & Taylor, 1975). Instead, it reflects the researcher's starting theory that guides the search for themes in the data (Miles & Huberman, 1984). Indeed, this qualitative-deductive approach is not novel. It has been adopted in other process studies: application of an internal corporate venturing process model (Garud & Van de Ven, 1992); trial and error learning model (Van de Ven & Polley, 1992); utilisation of three alternative models to best explain the Cuban Missile Crisis (Allison, 1971).

This research was qualitative and interpretative on the basis that rich explanations of how a collaborative transfer took place leading to certain performance outcomes would have to take account of the surrounding context (Pettigrew, 1997). It would benefit from inclusion of actions, even absence of actions, for actions convey meanings and intentions. Include also, decisions and behaviours and resulting consequences as data. So in the reading of data, one could either literally interpret what was there or interpretatively construct what the data represented (Miles & Huberman, 1984; Silverman, 2001). Qualitative researchers claim to know relatively little about what a given piece of observed behaviour represents until understanding of where the behaviour occurs has been developed (Van Maanen, 1979). Importantly, if the so called 'facts' do not occupy an objective reality then the interpreter of data relies on his own frames of reference to reach conclusions or construct explanations of what may or may not be occurring.

For instance, It was thought that understanding market developments might help explain why certain participants acted in the way they did rather than what they might have set out to do. For example, knowing that the telecommunications sector was undergoing a worldwide economic crisis over Alpha's timeframe might explain some divergences in organisational participation from this sector.

In carrying out interpretative research, the researcher's role is not entirely independent of the research process. There is no such thing as total detachment as viewed in positivistic research. The subject matter is not independent of the researcher's thoughts, values and expectations of that matter. Even if detachment is claimed during data examination, the reality is that what is seen or

how it is seen is a function of what is expected or has been experienced before. My prior management experience of organisational processes, human interactions and dysfunctions, albeit in an entirely different context might sensitise me to see things in a certain way.

Critics of qualitative research would argue that this value-laden analysis or subjectivity leads to bias or poorly objective results. It could be argued against this position that much of the so-called, rational positivistic research is not entirely value-free either. Even scientists observe 'facts' using conceptual lenses and theories (Silverman, 2001). What is critical in interpretative research is the concept of reflexivity or mindfulness of one's underlying practice of theorising (Weick, 1999). By retaining a critical distance, emerging explanations have to be repeatedly challenged and assessed. Reflexive explanations can emerge as sudden intuitions; they may be triggered by unrelated events in unstructured ways and may develop over a period of time. Alternative arguments have to be considered before drawing conclusions about what might be suggested by the data. Due to access constraints, emerging explanations could not be validated by project participants. As the only judge of meaning, the concern was to ensure that I adopted a critical distance and repeatedly questioned emerging explanations. The strengths and weakness of this approach are discussed later in this chapter.

6.3 PROCESS STUDY

To test the two dynamic process propositions, a major task was to design the study so that it was processual in character. The development of a collaborative technology transfer had to be followed in a longitudinal manner, over a two year timeframe. Capturing this dynamic quality had implications for both data generation and analysis, discussed later in this chapter. First, the meaning of process study is discussed.

Pettigrew (1992) is a pioneer of the theory of method in process research. Process research can be defined as the dynamic study of behaviours in organisations, with a focus on core themes of organisational context, activities and actions that unfold over time (McNulty & Ferlie, 2002). What differentiates process from variance studies is that process research does not focus on a few independent variables. It is more holistic in nature. It does not seek to trace input/output relationships, trends or correlations on a cross-sectional basis. Instead it seeks to capture interactions, complexity, rich and thick detail and context to help explain how particular outcomes develop (Pettigrew, 1997). Importantly, it is based on the assertion that societies or organisations have deep recurrent underlying patterns that can be identified and explained (Ferlie, 2002; McNulty & Ferlie, 2002). Being narrative in style, it does not necessarily involve statistical analyses.

By way of contrast however, scholars have combined quantitative analyses with narrative explanation. One particular school of process research (the Minnesota Innovation studies) has combined the two styles in an attempt to enhance rigour and wider generalisability (Garud & Van de

Ven, 1992; Van de Ven & Polley, 1992). Unfortunately, generalisability here is gained at the loss of process detail and richness. This work is discussed in more detail below, in the context of Langley's (1999) analysis of different process approaches. The problem with this quantification approach is that rich qualitative data is standardised by collapsing it into binary codes. Although temporality is retained, the loss of richness to build a coherent historical narrative was deemed to be inconsistent with the needs of this research.

Only through longitudinal design can the dynamic nature of a phenomenon be studied, especially under conditions of strong path dependence (Pettigrew, 1997). Longitudinal construction can be made either prospectively or retrospectively (Leonard-Barton, 1990). Both approaches have advantages and disadvantages. The intention here was to construct a retrospective picture. It would enable a search for patterns of events and help find explanations for development of organisational performance outcomes. The benefit of a retrospective construction is that it helps focus on what is being studied. It is favoured by management scholars for its strong outcome or performance focus (Pettigrew, 1997), and orientation to study of strategic decisions. Process approach builds on ethnographic method (the study of process in its own right) and displays a longitudinal and contextual characteristic (McNulty & Ferlie, 2002). Gathering a rich, longitudinal process detail provided an opportunity to explain performance outcome divergences. In this way, an inductive or exploratory element was incorporated into the research.

6.3.1 Approach for Representing and Making Sense of Process Data

In process study the level and units of analysis are complex and ambiguous, especially when compared with traditional variance models. For, what is analysed may include individual or collective actions, events, decisions and occurrences that span multiple levels of an entity. In a complex collaboration it may include social interactions amongst individuals engaged in collaborative activity, or at participant organisation level. How this process data is represented and made sense of may be tackled in a number of different ways. It is worth reviewing here some of the methods found in the literature and how the method selected in this thesis fits with them.

Langley (1999) presents a broad review of key process studies. They are categorised according to what is termed 'sense-making' strategies adopted by their authors, and associated strengths and weaknesses. Seven broad sense-making strategies are identified. Each tries to deal with the overwhelming nature of borderless, dynamic and multiple level process data by fixing on some anchor point. Three strategies representative of this spectrum are briefly discussed here to illustrate the advantages of the approaches.

The three strategies span a conceptual spectrum, one end of which can be viewed as coarse-grained quantification analysis, the polar opposite a fine-grained narrative analysis. The trade offs

appear to be the desire for simple and generalisable results, or highly accurate and detailed; essentially a tension between depth (for process detail) and breadth (number of cases studied).
The fine-grained, narrative analytical approach (Pettigrew, 1997) involves constructing a detailed story from raw data. It uses time as a key anchor point to find meanings and construct process explanations and has potential for high accuracy. Whilst thick detail and richness is retained, conceptual simplicity is lost. It has been used mainly to extract theory from the ground up, and works best when dealing with a contained number of cases (McNulty & Ferlie, 2002). Narratives are analytical descriptions that reflect not just a chronology but concepts that guide understanding and in the end theory (Pentland, 1999).

According to Pentland (1999) the key properties that operate in a narrative approach are:

- Sequence in time
- Focal actors or narratives about someone or something through a narrative voice
- Evaluative frame of reference: i.e. implicit or explicit standards against which actions can be judged
- Other indicators of content and context that add to the reader's understanding of the chronology

The research findings presented in Chapters 8 and 9 help illustrate these properties: a two year chronology; researcher's narrative voice; analysis of context influences (Chapter 4) that provides the frame of reference.

At the other extreme, the coarse-grained or quantification approach used in Minnesota Innovation studies (Van de Ven & Poole, 1989) builds on the quantitative sociological tradition (Abbott, 1992). An initial mass of rich qualitative data is condensed into events. Using simple binary codes they are coded according to a set of predefined categories, into a quantitative database. Advanced statistical techniques including regression and stochastic modelling are used for data analysis; inter-rater reliability checks are also conducted. This approach has generally been theory driven, deductive in style representing a narrative positivism.

Single case studies have been studied using both fine-grained narrative and coarse-grained quantification approaches (Pettigrew, 1985; Garud & Van de Ven, 1992). The latter approach needs many similar events for statistical testing. A great deal of data is interpreted and collapsed into simple yes/no or 1/0 binary codes. E.g. if learning occurred, not how or why it might or might not have occurred. There are problems with this approach in that whilst conceptual simplicity and generalisable results are produced, contextual richness is lost and it fails to capture an organisational gestalt (McNulty & Ferlie, 2002). Whilst such methods may appear accurate at a superficial level, they lack the internal validity that a narrative approach can provide.

In between these two extremes, sits an approach termed 'temporal bracketing' exemplified by Doz's (1996) study. Here, the time scale is broken into successive phases or blocks of periods. They have no real theoretical significance but are connected sequentially to help structure a mass of shapeless data into digestible chunks for event description. It is not supposed that a block synchronises with the one earlier. Other than convenience, this conceptual structuring provides a useful tool to construct comparative units of analysis, to replicate theoretical ideas, especially when a theory involves feedback mechanisms and mutual adjustments. This sort of replication is particularly useful in single cases (Yin, 1994).

The quantification approach was rejected outright given its reductionism that replaces actors and their interactions with passive occurrences. For reasons discussed earlier, a narrative approach that extended beyond description seemed the most attractive. Given the substantial and complex nature of Alpha, a combined narrative and temporal bracketing approach was adopted. The narrative was structured into two brackets or process modules: Business Model module and Technology Integration module. This allowed module developments to be compared, constituting an internal replication within a single case. The differential development is described and explained in Chapters 8 and 9 respectively.

6.4 RESEARCH STRATEGY

In addition to selecting an approach that represents process data, a key decision in a research design is the research 'strategy' (Yin, 1994). To a certain extent what we want to say about the phenomenon being researched and how we want to present it, dictates the most appropriate strategy (Leonard-Barton, 1990). As the research objective was to describe and explain the collaborative technology transfer process in a high complexity setting, linked to performance outcomes, the research strategy adopted was a single longitudinal case study.

Case studies are preferred when 'how' or 'why' questions are posed, when there is little control over events and when the focus is on a contemporary phenomenon within some real life context (Yin, 1984). A case study can capture the complexity and detailed interactions within its context (Stake, 1995). This choice was governed by the belief that its ability to deal with a variety of evidence would allow a more nuanced and behavioural forms of evidence to be interrogated. Furthermore, attention was focused on relationships and processes within a complex social system rather than just outcomes of those processes (Denscombe, 2000). Relationships and processes within social systems tend to be interconnected. To understand one thing required understanding many more, especially how they are linked. It also allows for contradictions to be considered, thereby deepening the scope for a richer picture to be built.

Single case study design can be highly risky too (Yin, 1994). It is often used in exploratory research followed by a wider survey once initial results are obtained. A poor case study has no story but lots

of un-theorised and un-analytic description. This weakness was avoided in this research by starting with a process theory.

A single case study as opposed to a comparative case study design (Eisenhardt, 1991) was chosen because of the unique nature of Alpha, its higher complexity and the particularly interesting industry context. A single good case can illuminate the workings of a social system in a way that a series of morphological statements could not hope to achieve (McNulty & Ferlie, 2002); particularly given the internal replication built into the single case here. Criticisms and weaknesses of a single case study are discussed later in this chapter.

6.4.1 Alternative Research Strategies

Other than case study approach, when asking a 'how' question, two alternative strategies are available: experiment and survey (Yin, 1994). Although no single research strategy is unilaterally superior, the particular research context and the specific question posed led to the belief that neither of these two approaches offered a more superior method to study the process.

Experimentation is useful when the researcher has control over events being studied, when conditions can be held constant to focus on particular relationships. An experiment deliberately divorces the phenomenon from its context by isolating a few variables and holding others constant (Yin, 1994). In Alpha there was neither the means nor intent to hold any conditions constant; the very essence of the study was to look at process complexities and co-influences of various dimensions in their natural setting.

A survey approach tries to deal with both context and complexity, but its ability to deal with context is extremely limited (Yin, 1994). Surveys can be adopted in process study as interviews or questionnaires to gather data. A dynamic picture can be constructed by asking respondents to recall what happened over time or by running interviews or questionnaires at various time intervals. Panels of data are then linked to construct a longitudinal picture. This probably represents a highly efficient approach when multiple cases containing large numbers of participants are involved. Its drawback can arise from an unwillingness of respondents to provide data necessary to construct a meaningful process picture. When they do, they may ignore events they consider irrelevant; events that happened in the past may be forgotten leading to a fairly incomplete picture.

6.5 Research Methods for Generation of Case Study Data

The decision to use case study approach is a strategic decision which relates to the scale and scope of an investigation. In principle at least, it does not dictate the method(s) that must be used (Denscombe, 2000). Case studies can be constructed in many ways (Stake, 1995). Data can be generated through observation of the collaborative technology transfer project (in the form of participant or non participant); participants can be asked about their experiences and views of the

collaborative transfer (as interviews or questionnaires) or by examining documents generated over the course of the collaboration (written formally, informally, directly and indirectly). None are mutually exclusive. Entire studies can be done using a single method. They may be combined to generate a richer mass of data. The strength of case study approach is that multiple methods or even multiple sources within a single method can be used to generate data in a complementary way (Yin, 1994).

6.5.1 DOCUMENTARY EVIDENCE AS THE KEY DATA SOURCE

Documents can be used as a source of data as an alternative to questionnaires, interviews or observations (Denscombe, 2000). For this research, documentary evidence: formal and informal, from multiple sources, produced for different purposes and audiences, was chosen as the exclusive data generation method. It was supplemented by an interview with the EU Office. Predominant use of documents with supplementary interview is not a novel method. It has been applied in strategy research previously in the study of strategy formation in an adhocracy (Mintzberg & McHugh, 1985). Doz (1996) used documentary evidence to construct a background understanding and then sought various interviews for further insights. The Prahalad & Doz (1987) study of strategy formation in Multinationals used extensive archival evidence to cover time periods when interviews were not possible.

Before looking at the rationale for not using alternative methods for data generation, the advantages, disadvantages and reasons for using documents as the main method are first discussed.

Although sociologists such as Marx and Durkheim have used documentary evidence as their key method for theorising, on the whole it has been neglected in social science enquiry, particularly in the British and American traditions (Murphy, Dingwall, Greatbatch, Parker, & Watson, 1998). The concern being that the flimsy nature of words is less reliable in empirical work. In many process studies including Doz (1996), documentary evidence is often used to gather historical and informal information as background to supplement interviews. The underlying assumption is that documents are not rich enough. Exclusive use of documents has been justified before: to overcome 'reporting bias' (Das & Van de Ven, 2000) or as 'unobtrusive method' (Webb, Campbell, Schwartz, & Sechrest, 1966). Lee (1999) maintains their use may become more frequent in the future, as use of electronic communication increases.

Studies of international relations and political behaviour rely heavily on documents as primary source of evidence; from these national behaviours and intentions are inferred (North, Holsti, Zaninovich, & Zinnes, 1963). Research in areas such as philosophy, social theory, law and history also rely heavily, if not exclusively on documents (Denscombe, 2000). Text constitutes a reality that

can be deconstructed through textual analysis into multiple meanings (Ferlie & Mark, 2001). Therefore, documents must not be viewed as a rigid form of evidence.

Different documents have different properties (see also Chapter 7). For instance,

- Board meeting minutes (like Alpha's monthly management reports) are produced for external presentation of organisational life. They may reflect slightly different internal realities
- Emails, doodles, marginal notes however are informal and much less laundered. They would be expected to reflect a more accurate reality

Documentary method was chosen because Alpha had generated a huge amount of real-time documentation. It consisted of formal and informal accounts for external reporting and internal communication. Since project participants were not co-located to carry of technological activities, geographical differences in space and time were overcome by utilising emails for day-to-day communication. Emails were distributed using different lists: to all participants or groups of participants depending on tasks defined. Emails were also used to provide project updates. It was thought that use of this more informal method was likely to create conditions for more open and candid expressions of opinions and thoughts.

Widespread introduction of email technology for organisational communications represents an important development in social science research. Email as data source is non reactive and has an informal characteristic which has potential for good quality and reliable data. There seems limited research on email as a methodological technique. Cramton (2001) studied the use of emails in dispersed teams, and found that difficulties were encountered in achieving mutual knowledge; misunderstandings developed quickly amongst team members. The aim here was not to evaluate effectiveness of email communication. The quality of emails gathered from Alpha reinforced the view that it was an invaluable method for generating good quality research data. Most emails gathered were addressed to specific individuals and were subjects of particular problems or concerns. They contained implicit assumptions about recipients' knowledge or views they might hold. They also gave an opportunity for others to engage in discussion and contribution. Their richness was expected to provide a means for uncovering different intentions and changing organisational expectations.

An advantage of using documents either as unofficial or informal accounts is that they offer an opportunity to study aspects of social life that would otherwise be inaccessible (Webb & Weick, 1979). Although external reports imply a formal obligation to give full and accurate account of events, documents produced for external audiences can be exercises in impression management (Ferlie, 2002). Consequently, they have to be read with healthy caution. Informal documents on the other hand can provide some really useful insights; with a potential to reveal front and back stage

behaviours. Multiple sources of documents can therefore provide an alternative and a powerful means of triangulation. This approach has been used in process study using various public databases and press reports (Garud, Jain, & Kumaraswamy, 2002).

Documents in this research were used in the same spirit as historians to gather facts, find clues and to help explain why certain things happened during the collaborative project. What added to their reliability was that during their generation, writers of the materials did not expect them to be subject of research, constituting a form of naturally occurring data.

6.5.2 Other Methods of Data Generation Considered

Direct observation can provide really useful insights that would otherwise not be captured in written or spoken word. But it can be disadvantaged by artificial behaviour if participants know they are the objects of research. A downside is the time required to be in the field. This technique in combination with documentary evidence has been used in process research (Garud & Van de Ven, 1992).

The research challenge here was that the collaborative team was carrying out day to day technological activities from 12 dispersed sites. Each partner was assigned specific tasks that had to be worked on individually or jointly with others. Because of the dispersed interface, majority of social technological activity occurred through remote interactions. This time and space dispersion was not conducive to observation. Moreover, participants performed project tasks in addition to normal organisational duties. This limited their availability to be interviewed.

The collaborative team met once a quarter at different locations in Europe to update each other, to share knowledge, to problem solve and achieve a common understanding of project direction. I became aware of Alpha during early 2001 - the project's second of two years. At first it seemed that observation of quarterly meetings might provide important insights into issues, choices and how they are executed. It was abandoned after consideration on the basis that even if full access was gained, attendance might be constrained by limited research funding. The richness of the real-time generated documents was considered superior and adequate.

Structured or semi-structured questionnaires are a good instrument when a large number of participants are to be interrogated or a number of specific and superficial issues are under investigation. This technique was considered weak in its limited ability for a rich detailed picture to be constructed. Moreover, participants were unlikely to provide a series of responses to help create a dynamic picture. But as a research method, its use in process research is not uncommon. For instance, a longitudinal study of organisational change in 100 organisations used this technique in the form of 2 surveys over 2 years supplemented by four interviews at six monthly intervals (Glick, Huber, Miller, Doty, & Sutcliffe, 1990); the researchers acknowledged the trade off of depth of detail for greater generalisability.

Interviews, either as formal or informal instruments are an excellent source of data. They can be highly complementary to other methods. A lot of social science research relies on this as the main means of data generation. It provides data which might otherwise be unobservable, and helps generate multiple realities. To construct a balanced picture however, good access at different organisational levels is required. Its main criticisms are data reliability: respondents may put up a façade; they may say what they think the researcher wants to hear or what shows them in good light; their recollections of past events may be poor, biased or they may make rationalisations of what happened and why it happened. Interviews are often limited to accessible and cooperative respondents, often far removed from the problem being studied (Webb & Weick, 1979). They observe that the limit of this technique of self-report is regularly specified, yet researchers press ahead and maintain that the method is good enough. He is a strong proponent of documentary evidence as an unobtrusive method for generating good quality data.

Although interviews with Alpha participants as organisational representatives might have been useful, access was difficult. It was thought that the nature of the documents provided a more powerful, reliable and sufficient evidence. Reliability was enhanced by Alpha's high reliance on documents to maintain internal information symmetry. Once data analysis commenced, the sponsor would be interviewed to elicit explanations of specific events. A face to face interview with the officer was carried out after Alpha's completion, which helped clarify some documentary findings; discussed in Chapter 7.

6.5.3 TYPES OF DOCUMENTS FROM THE RESEARCH SITE

A detailed document list is provided in the next chapter with a discussion on how they were used in the analysis. The following section summarises the types of documents used.

Majority of documents were confidential and internal to Alpha. Some formal reports were held in the public domain, as web pages or reports. The types of documents collected were: a highly detailed technical work plan with specific roles and responsibilities, 24 monthly management reports, minutes of 7 quarterly strategy review and steering committee meetings, minutes of 8 technical meetings and other subgroup meetings, 5 major project deliverables, a number of workshop presentations, about 400 day-to-day e-mails for debate, problem solving, information exchange etc.; other published materials such as contracts of engagement and basis for sharing intellectual property, audit reports, conference presentations and individual partner press releases. Evolutionary record of many documents as they became updated and reshaped was also available. Emails sent via a general distribution list were gathered; they did not constitute a complete set of project emails. The sample was not considered to be distorted in anyway for reasons discussed in Chapter 7.

Yin (1994) has argued that extensive use of documentary evidence is relevant especially when an exemplary project such as a research effort is studied. He refers to Moore & Yin's (1983) study that examined various R&D projects. For each project, proposals, interim reports, working papers, manuscripts and reprints, correspondence between researchers and sponsors, agendas and summaries of advisory committee meetings were collected. These documents were used in conjunction with some interviews and observations to explain change. In a similar vein, the intention here was to study changes in evolving documents but this plan was abandoned for reasons discussed in Chapter 7.

6.5.4 Strengths and Weaknesses of Documentary Method in this Setting

The strength of documentary method was contributed by: its highly reliable nature, a high degree of completeness, and a real-time record of project activities. Its unsolicited nature minimised reporting bias or informant oversight. Because the documents were produced for reasons other than this research, they constituted 'naturally occurring' data, made even stronger by the unobtrusive nature of their sourcing. With almost full access to the documents, it provided a stable means for repeated interrogation and data review. By keeping an open mind, repeated exploration can throw up unexpected clues or serendipitous findings, which might otherwise be missed (Miles, 1979). Many project deliverables here could be viewed as physical artefacts; their technical merits were the focus of external audit. External audit reports might be considered highly objective and impartial. They provide a strong means for comparing against internally written reports. Webb et al. (1966) identify two major sources of bias in archival records: selective deposit and selective survival. Although selective deposit may be associated with formal documents like monthly management reports, it is less likely with technical meeting minutes or email communications. Selective survival was not considered a problem here because of the relative completeness of the documentary repository.

Despite using a single method, the availability of many types and sources of documents provided a unique means for data validation. It also provided the opportunity to reveal any front and back stage behaviours discussed earlier.

Critics could argue that the major weaknesses of documentary evidence as an exclusive means of data generation is that it misses the opportunity to find out participants' own accounts of events; especially as there was no means for feeding back early results for respondent validation. Reliance on documentary analysis results in majority of interpretations being those of the researcher, as primary judge of meaning of that data. One can contest this by arguing that for generations, historians and archaeologists have found meanings and constructed explanations from documents and artefacts without direct inputs from individuals that were the subject of their analyses. This approach is not considered inferior in any way. Gersick (1988) observes that the advantage of a single, patient judge of meaning is that data can be analysed consistently. It yields understanding of a whole event. But it will always be one side of a trade off in a study such as this.

Having dealt with limitations of the method of data generation, the strength and weakness of the case study approach are now discussed.

6.6 STRENGTH AND WEAKNESS OF A SINGLE CASE STUDY APPROACH

Although concerns about quality might be raised in any research strategy, qualitative research especially as a single case study attracts a great deal of criticism (Yin, 1984). In the strategic management field there has been a preponderance of large scale survey research on the basis that it somehow represents stronger research; the field has been dominated by the positivistic rational school which represents a different research paradigm.

A single case study is strong in its internal validity or accuracy with which it can deal with subtleties and intricacies of complex social situations. It has the ability to be highly relevant to managerial practice (McNulty & Ferlie, 2002). Its major weakness or criticism is its lack of generalisability and apparent rigor. Each of these issues is elaborated below.

6.6.1 INTERNAL VALIDITY AND RELEVANCE TO PRACTICE

It was discussed earlier that case study approach benefits greatly from its ability to deal with multiple sources of evidence, thereby improving internal validity. Validity was tackled by collecting different kinds and sources of documents that bore on the same phenomenon, for corroboration. When data from a source suggested possible explanation of an event, it was crosschecked using data from another source. It assured the process of closely tying up data and findings. Given the variety of documents there was ample opportunity for this type of corroboration and building process explanations.

With respect to its relevance to other situations, by uncovering specific events, issues or themes, case study has tremendous capacity to help practitioners deal with similar problems in different settings (Ferlie, 2002). In fact, Goffman's single case study of a mental institution has served to provide themes applicable in other institutional settings. The empirical findings (Section III) of emergence of learning communities as a means for reduction of task complexity and enabler of mutual learning adjustments may be a theme that practitioners can apply in other settings.

6.6.2 EXTERNAL VALIDITY OR GENERALISABILITY

External validity relates to the problem of generalisation to other populations (Webb et al., 1966). Whilst a case study approach is strong in its internal validity, a major issue against it is that it might establish the existence of a phenomenon, but unlike conclusions from statistical analyses, it does not provide the kind of evidence generalisable to a population. What this means is that findings from this study of a single, higher complexity setting in IDT, could not be generalised to a population of collaborative technology transfer settings, whether in the same or other industry.

To overcome this lack of representativeness, scholars recommend selecting multiple cases based on theoretical similarity or difference (Eisenhardt, 1991; Leonard-Barton, 1990; Pettigrew, Ferlie, & McKee, 1992; Yin, 1994). The argument being that multiple cases provide a more powerful means for replication and comparative testing. Eisenhardt (1991) suggests 4 to 10 cases as a more rigorous design, adopted in other organisational process studies (McNulty & Ferlie, 2002).

Many classic single cases are based on the principle of replication within a single case: the use of various gangs in Whyte's street corner society; or various divisions in the same organisation (Pettigrew, 1985). Internal replication can clearly be achieved in a number of creative ways and a great deal of insight can be derived from this comparison. In a single process study of the integration of a new hospital leader, internal replication was achieved using two conceptual domains: process of integration with physicians and administrative personnel (Denis, Langley, & Pineault, 2000). This manner of replication was utilised in this research and is illustrated in Chapters 8 and 9.

Mintzberg (1979) argues that the numbers debate obscures an important point: not whether two cases are better than one but rather how much more new information is likely to be provided by incremental cases. Proponents of a single case argue that much can be learnt that is general from a single case. This is on the basis that in most cases, certain activities, problems or responses are likely to recur repeatedly, making it possible to draw 'naturalistic' (Stake, 1995) or conceptual (Goffman, 1961) generalisations. Goffman's concept of institutions whilst studied and derived from mental hospitals was applicable to other institutions, like prisons and schools. Here, each case has many similarities and yet is unique in many other ways; it is up to the researcher or practitioner to make the conceptual connections. Doz (1988) single case found cultural differences between a large bureaucratic and a small innovative organisation, yet this theme carries over in many different contexts.

Mintzberg (1979) passionately argues that the field of organisational theory has been so obsessed with rigor (not that case studies cannot be rigorous too) and external validity, that it has lost the opportunity to gain valuable insights from single cases. He argues that there is nothing wrong with a single case and that too many research results have been significant in a statistical sense. He wonders whether it is better to have statistical significance or more valid data that explains relationships, behaviours, and processes. The deep probing of a single case does not seek predictive laws; it intends to identify low level tendencies or patterns (Ferlie, 2002).

Mintzberg & McHugh (1985) acknowledged the rather extreme nature of the single case of strategy formation in an adhocracy. Yet they argued that one must not dismiss the likelihood that their findings could not be generalised to other organisations. They suggested that their single case had uncovered behaviours, which could be found in 'muted form in all kinds of organisations'.

Nonetheless the important point in this thesis was that research findings would be conceptually generalised to the LaMA theory.

In summary, the research concern was not to determine universally generalisable principles to all technology transfers, but to make analytical generalisation. A previously well developed theory was used as a template against which empirical results were interrogated. The intention was to generalise to an empirical literature given that the model had only been applied in simpler, dyadic collaborations. It was also argued that using a particular single case was quite appropriate given its higher complexity. These differences were likely to generate greater insights into the process impacts of complexity and applicability of the theory.

6.6.3 Lack of Rigour

Lack of rigour is another criticism of case study research; blamed for non-methodical data collection and data handling. The concern is that this haphazardness introduces bias from both researcher and respondent. Misjudgements or exaggerations of single events may be made, just because that specific data happened to be available or some unconscious anchoring occurs (Yin, 1994).

This criticism was overcome by approaching the entire set of documents in a systematic manner (Chapter 7). Document files were created; a chronological database of events was produced cross-referenced to the documents. Essentially, an audit trail was constructed, which could be used by another researcher to verify what and how the data management was done.

6.7 Method of Analysis of Process Data

The overall analytical goal of this research was to uncover and compare the chronology and pattern of collaborative transfer to determine how effectively the dynamic process theory explained the process development and its outcome. Data analysis represents the technique used to make sense of the mass of textual data (Miles & Huberman, 1984). It is used to determine if theoretical concepts can be linked to the data and whether the empirical evidence validates the theory.

To capture the dynamic nature of a process setting, data has to be obtained from the processes where development and change takes place (Poole et al., 2000). Identification of events from the text forms the starting point of data analysis. Meaningful interpretation of temporal development could only be done once a chronology of critical events was constructed. Events were not found through simple keyword searches. Their conceptual nature meant that they were not some uniform concrete objects waiting to be collected. Events were either a string of words or the result of an interpretation uncovered from a mass of unstructured words. Events might be identified at various levels in a case: subgroup of activities or at one or more participant organisations. They may draw on relationships, thoughts and may spread out over time and space; their temporal embeddedness may vary in duration, precision and relevance (Langley, 1999). They may differ in the range of

actors involved (a single individual or a group of individuals) and the context they span (Poole et al., 2000).

This approach clearly was more complex than determining relationships between standardised variables isolated from contextual co-influences. Analytical complexity was further complicated by the nature of the data gathered. Documents did not direct the researcher to the most relevant data. As a contrast, interviews or questionnaires do allow respondents to identify critical events, or at least give important clues to where to look for them.

6.7.1 Definition of Level and Unit of Analysis

Any rigorous piece of social science research would be expected to define its level and units of analysis. This helps demonstrate consistency between the research question and how it is researched. As a broad definition, the level of analysis in this research was Alpha, the collaborative technology transfer project. Units of analysis refer to events: ranging from a critical action, a singular or collective decision, a meeting, an interaction, or a change in specified concepts. Events may be directly observable, such as an interaction or a meeting. They may be conceptualised by giving meaning to some text. They may span a range of macro to micro levels. For example, events may be at industry or firm level; within the project they may be at the level of individual actions or at a collective group level.

The following section discusses the action plan constructed to carry out process analysis. The actual analytical process and its emergent nature are discussed in Chapter 7.

6.7.2 Planned Steps for Process Analysis

Before reading the empirical data there had to be a clear definition of what constituted an event in the context of what was being researched. This was particularly important because one could not study everything. A category system was constructed to link data with theory. The *a priori* theoretical framework drove the category development for operationalising the theoretical concepts (discussed in Chapter 5): Initial Conditions: tasks, skills, process and goals; changes in initial conditions and learning.

The following steps were expected to systematically operationalise the process analysis (Poole et al., 2000). The actual analysis did not progress in a pre-defined, linear fashion and is the subject of discussion and reflection later.

The systematic plan aimed to ensure that:

i. A clear set of concepts or analytical categories were generated from the theory. They described the objects of study: Four Initial Conditions, and their progression, tracked over time. This would provide the context for operating the next step.

ii. Identification and systematic recording of events when changes in concepts were observed. The concept change record included what happened, who/what was involved or affected and when it occurred. Change in concept over time represented empirical observations.

No universal standard defines the number of events that must be recorded in a process study. Van de Ven & Polley (1992) recorded 325 events over a 5 year time period; Garud & Van de Ven (1992) recorded 719 events over a 12 year time period, and Arino & de la Torre (1998) study of alliance failure, recorded a mere 14 events over a 4 year period. All these studies were single case studies. Doz (1996) study does not specify the number of events other than to say that a handful of critical events were selected from a mass of events to make sense of what changed and explain why it changed. What seems important is not the number of events but their quality and ability to explain the developmental path.

iii. Devise a method to represent the events into process patterns. Once events were logged, they would be coded to represent change in one or more of the four initial conditions; change arising from one or more learning dimensions, whether it was a result of cognitive or behavioural learning readjustment. By arranging events chronologically, critical events would be selected to explain when and how re-evaluations occurred; and if and how initial conditions changed. Essentially, it would result in a display of temporal relatedness and patterning.

6.7.3 Decision Not to Use a Computer Software Package to Assist with Data Analysis

This section briefly discusses why a qualitative computer software package was not used to help with data management and analysis.

Although quantitative research can generate masses of data, there is usually a systematic process for reducing the data into 'variables' of interest. Qualitative research too can generate large volumes of data, but cannot easily be reduced to a handful of variables (Miles, 1979). In fact, data from this single technology transfer project and its related industry context bears testimony to that (see Table 7.1). A number of software packages are available to assist with qualitative data management and analysis (Weitzman & Miles, 1995). Software packages can be effective tools for managing a voluminous dataset. But a great deal of caution is advised in their use. The concern is that they can distance researchers from the data. Researchers can become engrossed in data organisation and coding instead of immersing in the data to uncover key themes.

As Alpha was expected to generate a mass of documents, a software package seemed an appropriate tool for data management and analysis. During the second year of study a considerable amount of time was spent considering this resource. The eclectic data, of the order of 4000 pages, was held in original format either as Word documents on-line with embedded tables or graphics, or

as Adobe® files, web pages and emails stored on the local academic network. It was thought that for a package to be particularly useful it would have to satisfy five criteria:

i) Able to import and store entire text in original format for repeated access
ii) Code and retrieve data linked to its original document
iii) Allow memos or notes to be linked to the documents
iv) Search and map events along a time horizon
v) Offer flexibility to analyse the data without being tied to a specific computer

NVivo® is a software package designed and marketed as a theory building package that can be easily adapted for use with a starting theoretical framework. At first, NVivo seemed to satisfy the above criteria. Data coding and retrieval was managed rather well. Codes were retained in the text for repeated referral to full text if necessary. After some familiarisation, important weaknesses were uncovered that was likely to cause practical issues. Whilst many difficulties might have been overcome it was decided not to use either NVivo or any other software package. Instead, data analysis and coding would be done manually, supported by Microsoft Word and Access packages and supplemented by the age-old method of wall display, to track critical events over Alpha's lifetime (Miles & Huberman, 1984). The following observations led to the decision not to use NVivo in particular:

a) It was particularly well designed for organising cross sectional data when the objective was to look for common and consistent themes. This research was concerned with both the unusual and the particular. Management and tracking of data on a non cross-sectional basis seemed complicated

b) It seemed unable to import text from documents containing tables or graphics. Whilst this might have been overcome by external linking of files, access to these files when working from a remote site would be problematic. In importing email documents, details containing the subject of communication would be lost

c) Although apparently developed to deal with large volumes of data, it was suggested that the system might struggle with my dataset. An alternative version was offered from the Australian Technical Department, but this version did not have overlapping features as the widely used version. Further training time and effort was needed. An important concern was that the local UK support staff had little experience of it

d) It was not robust enough to handle discrete files which could be worked on from different sites. Anecdotes were given of researchers losing entire day's analysis when they had worked on different computers. This was considered an unacceptable risk

e) There was uncertainty whether events/codes could be temporally mapped

f) Whilst UK technical support was highly competent in dealing with a number of emerging queries, many had to be referred to the Australian company head office. There was concern that time zone differences might affect support responsiveness. A significant concern was that the specialist nature of the package would limit the ability to utilise any on-site university IT support

6.8 CONCLUDING REMARKS

If a research design represents the logical sequence that connects the empirical data to the study's initial research question (Yin, 1994), then this chapter has fulfilled its role of elaborating this sequence. It has presented the research design and methodology that was believed to best capture the processual nature of this particular study. The study design consisted of a qualitative, processual (Pettigrew, 1997); and single case study (Mintzberg, 1979; Yin, 1994). In carving out this final design it has examined the various alternatives faced and the reasons for making particular design choices. This has helped outline the distinctive advantages offered by this research. A particularly creative design feature is the combined fine-grained process analysis with single case study and incorporation of two internal micro-cases as replicative units of analysis. It has defended the use of the single case study method on the basis that little was known about how collaborative technology transfer develops in a higher complexity setting. It has maintained that whilst single cases are not generalisable to a wider population, they can offer important lessons which might be applied in other settings. The aim of course was to make theoretical generalisations.

By making the guiding assumptions in the conduct of this research explicit, the many criticisms aimed at this type of research have been countered. In essence, it has allowed the research to be considered rigorous under its own terms.

The next chapter describes and discusses the actual conduct of process analysis and document organisation.

CHAPTER 7

DATA COLLECTION & DATA ANALYSIS PROCEDURE

DATA GENERATION, MANAGEMENT & REDUCTION

7.0 INTRODUCTION

The previous chapter described the qualitative research design and introduced the concept of process data. It dealt with how process data differs from data generally collected in quantitative research as 'homogeneous' variables. It discussed the documentary method as a sole technique for data collection and process analysis, and introduced the messy and emergent character of process research (Langley, 1999).

The purpose of this chapter is to build on the research methodology and describe how the actual analytical process unfolded; how documentary evidence was collected and analysed. The term analysis here refers to the process of iterative focusing on chunks of text to help make sense of occurrences in the research setting (Miles & Huberman, 1984). Unlike a linearity and rationality that might be conveyed in the planning of a research design and analysis, the many twists and turns encountered over the course of this analysis demonstrated its emergent nature. It illustrated the researcher's engagement with textual data to uncover the likely meanings and assumptions contained in that text. Interpretations were based on researcher's understanding of the nature of the setting, expectations, prior experiences and theoretical perspectives. It may be likened to a process of reading between the lines and continuous self-questioning of what those meanings represented. Strauss & Corbin (1998) refer to analysis as interplay between researcher and data. The view being, that facts do not exist as some objective things independent of the researcher but are constructed and influenced by the researcher and his experiences. They are experienced in space and time and it is this that distinguishes qualitative interpretative research from positivistic research. The two paradigms were contrasted in the previous chapter.

The chapter starts with the steps taken to generate the research data. It details various document sources, characterised by the variety of producers, purposes and intended audiences. The diverse documents served not only as sources of empirical data for Alpha but also helped provide some background of understanding to enable empirical analysis to be conducted. The management and temporal organisation of this data is discussed, followed by the procedure for its reduction and process analysis (Miles & Huberman, 1984). This procedure does not represent an analytical approach that might be adopted in quantitative research nor does it signify data coding as a highly structured and shredded form (Poole, Van de Ven, Dooley, & Holmes, 2000). The experiences are reflected upon in Chapter 11.

Specification of the analytical procedure helps the reader understand how documentary evidence was gathered and used as a resource to generate process explanations. More importantly, it helps overcome some criticisms directed at qualitative research. It is often considered unsystematic and haphazard, particularly by investigators from the quantitative paradigm. To overcome this criticism, researchers are advised to construct an audit trail as a sign of scrupulous practice (Yin, 1994). The step by step procedure described here, despite its emergent nature should go a long way towards dispelling this misconception. The procedure aims to be transparent, to allow another researcher to retrace the journey through the data. It has to be noted however that this in no way suggests that another researcher would necessarily identify or 'see' the same events or indeed reach the same explanatory conclusions. The reason being that in sharp contrast to the view held in natural sciences, facts are not independent of the observer; they do not have an external reality of their own. It has already been argued that interpretation of qualitative data is shaped by the researcher's frame of reference, insights and intuitions.

In observing a process one cannot explain everything. There has to be a mechanism for reduction of process complexity (Pettigrew, 1997). Following some data reduction, two 'central' objects were identified. Their development led to two differentiated change outcomes: i) Development of novel Business Models achieved a Weaker Success outcome, whereas ii) Integration of Technologies across diverse platforms: broadcast, internet, and telecommunications was relatively more successful. The two central objects were chosen on the basis that they represented Alpha's two main starting goals. They provided the opportunity to apply the theory of LaMA to understand how social action took place in this higher complexity setting to lead to these outcomes.

The two 'bracketed' objects (Langley, 1999) were considered modular but also intricately interlinked. Chapter 8 provides a more detailed account of the goals and the significance of their outcomes. Here it is sufficient to say that they were tracked as two separate bracketed processes in order to constitute replicable comparative units of analysis, providing a form of internal replication (Langley, 1999; Denis, Langley, & Pineault, 2000). The concept of replicative units of analysis was discussed in Chapter 6. The central objects provided the focus to: construct a fine-grained process analysis; to build explanations of how the technology transfer evolved compared to initial plans; what explanations could be derived for any divergences; and how the *a priori* theory performed in explaining the process and outcomes development.

7.1 METHOD OF DATA GENERATION AND SOURCES OF DOCUMENTS

5 main document sources are now discussed, illustrating the degree of completeness and highly reliable nature of data gathered. Data gathering occurred over 18 months commencing February 2001. The first 9 months of collection overlapped the latter half of Alpha's actual collaborative work, and continued beyond its finish (December 2001) to July 2002.

The documents represented both formal and informal accounts of technology transfer. They were intended for different purposes and audiences, and produced by individual project actors or as joint efforts involving two or more partners. For reason of their multi-source, they were considered highly powerful in uncovering key events as problems, decisions, achievements etc. They were also thought to help explain how divergences from starting conditions emerged and what adjustments took place. It was thought that they would help reveal events influenced by one or more complexity dimensions discussed in Chapter 3.

Informal accounts were assumed to be more powerful than formal evidence on the basis that spontaneous production reflected the veracity and a reliable account of what the participants thought and how they behaved. It is worth noting that formal accounts when compared with informal documents provided deep insights into how and why different stories might have been constructed. The five document sources can be grouped with distinct characteristics as follows:

i) COLLABORATIVE PROJECT WEBSITE:

A password protected internal website existed to enable and required partners to post copies of: internal documents, presentations at external and internal events, formal monthly management reports, and minutes of working or technical meetings, conference or trade show attendances. The website did not contain a log or copies of email communications. The purpose of this document bank was to keep partners informed of technological development at all times.

Many documents were duplicates of emailed documents distributed to initiate debate and discussion. At each quarterly team meeting, one participant was responsible for recording minutes of the meeting. He was responsible for receiving and acting on comments on their accuracy, prior to posting on the website.

Monthly management reports represented external formal documents submitted to the funding body. Each partner was required to send an update of prior month's activity to the coordinator. The coordinator summarised the month's cumulated achievements, in particular highlighting any resource or activity deviations that might impact the final outcome. Production of these documents enabled an implicit chronology to be traced from emails which notified the partners of website postings.

The website also contained a content list with: headings of document types (e.g. monthly reports, technical meetings, deliverables, etc.), dates generated and a date that the list was last updated. This formed the biggest source for document collection and represented a very rich, real-time data constructed for purposes other than this research. A particular advantage afforded by this unobtrusive method was the ability to repeatedly read and interrogate the documents, to construct

meanings and explanations of what happened and why it might have happened (Webb, Campbell, Schwartz, & Sechrest, 1966).

If data is generated from interviews there is an implicit focus on the research subject and themes. Respondents can point to events or incidents most critical to the subject's development albeit from individual view points. Pointers also on both the relevant and the less so, which helps the researcher decide what may safely be ignored. By way of contrast, the documents generated during the normal course of Alpha provided few clues as to which documents might be more relevant. For this reason, all documents available on the website during February 2001 were printed. At this stage Alpha had been in existence 14 months; documents were still being generated. Files that were too large to print, or were in colour PowerPoint slides or audiovisuals were downloaded onto a PC. Although Alpha officially came to an end on 30th December 2001, the website continued to be updated for a further six months when technological adjustments and records were submitted to the funding body. Further set of documents were printed off from updates posted on the 7th May 2002 and 13th June 2002.

In the same manner as Moore & Yin's (1983) use of documents, it was thought that updates could be analysed to help locate reasons for change and likely impacts on project conditions. For instance, it was thought that organisational preferences for particular technologies or different organisational influences in certain technological tasks might be revealed. But it soon became clear that this task would be difficult. A great deal of updated material was highly technical in nature. Without the necessary technical knowledge, little opportunity existed to make real sense of subtle changes. Interpretation and understanding of changes would have required technical assistance from perhaps some participants. It was therefore decided that only final versions of documents would be included in the evidence file.

ii) INDIVIDUAL PARTNER WEBSITES:

Starting March 2001, organisational websites were browsed for reference to Alpha. When found (for Partners[27] H, J, L, G only), text was printed. It was thought that this might give clues to the organisation's importance placed to it and its expectations of it. Failure to publicise the collaboration was not assumed to signify a lesser value to that organisation.

iii) INTERNAL PROJECT COMMUNICATIONS:

Other than quarterly 'get together' at technical or review meetings, emails represented the mainstay of interaction, communication and technological activity. Knowledge transfer and technological development was largely facilitated by the digital nature of technologies being developed: files were exchanged by email for progressive integration. This would not have been possible if traditional, physical technology were the mainstay of technology development (Tidd, Bessant, & Pavitt, 1997).

[27] See Chapter 8 for Partner coding and their industry sectors

Emails distributed to the whole constituency were accessed and stored in an electronic folder. The in-built chronology and subject headers were considered valuable process data. At a superficial level, emails could be analysed quantitatively to determine the relative frequency of intensity of participation or organisational communications. Whilst a highly simplistic 'quantitative' analysis was undertaken, it was difficult to determine if any meaningful conclusions could be drawn because of two issues: i) their content and ii) the degree of completeness as a true reflection of all email communications in Alpha. Of the 493 emails collected for the 24 month period, a frequency analysis by individual organisations found Partner C sent 4 emails compared to 115 sent by Partner L.

If one assumes that a greater communication frequency is associated with greater participation or deeper commitment, then C might be considered far less participative or committed than L. Other documents revealed the inaccuracy of drawing this conclusion. In actual fact, C made immense adjustments by increasing its resource three-fold, demonstrating a high motivation and commitment to technology integration. Chapter 8 illustrates C's introduction of a particular technology which was otherwise outside Alpha's scope. The content of L's emails on the other hand showed a great deal of coordinative and administrative communication consistent with its project coordinator role.

Moreover, interdependent technological tasks were organised into small teams or modules over time (Chapter 8). Those working more closely on specific activities probably exchanged emails directly or may even have interacted telephonically. Details of these communications were unavailable. Generally however, the final results of sub-activities were always documented and posted on the website. Often, if two or more partners had been tackling a difficult technology issue, they opened it up for discussion on the general mailing list. This indicated that other communications did take place.

iv) INDUSTRY CONTEXTUAL DATA:

An electronic folder was used to store newsletters received from an IDT website called Itvt, subscribed from June 2001. This was a US based industry magazine generated weekly or sometimes bi-weekly, with international circulation. It reported on analyses of latest industry developments; reviewed technological developments as far a field as Australia, China, and Scandinavia. It seemed a current, credibly reported and widely read news source in the IDT sector. Industry reports from Keynote and Mintel were collected for a broad review of the IDT industry. These documents provided a great deal of contextual understanding of Alpha. Some specific technology developments drawn from these documents were presented in Chapter 4.

v) THE EU OFFICE:

In July 2002, seven months after Alpha's completion, a 2 hour face to face interview was carried out with the EU Officer in Brussels. The purpose of the interview was twofold: to update the officer of this empirical research and to gain an understanding of EU's view of Alpha's progress and its

assessment of the final outcomes. Interview notes were written up and stored in the document files. Supplementary documents provided by the EU officer relating specifically to Alpha and more generally to links with other collaborations were also gathered. This single interview helped clarify EU's conception of success and its basis for assessment of the final project outcomes.

Although some documents provided more detailed understanding of the technology transfer process, no single document type would have been sufficient to construct a rich account of the entire longitudinal process. There was recursive learning from the project documents. The contextual data helped provide an understanding of the project data but also became more meaningful as project goals were better understood.

7.2 Data Management and Organisation

Documents were managed in paper and electronic files. Documents printed from the website were segregated according to the content list type e.g. monthly reports, project deliverables, minutes of technical working meetings etc. Bound spiral document files were created which generated 13 sequentially numbered, physical files of varying sizes. For ease of reference, each document was given a distinguishing code on the front page, e.g. Monthly Management Report for Month 1 was assigned code MM01, Month 2 assigned MM02 and so on. A document catalogue was generated detailing the number of pages in each file, shown in Table 7.1. Remaining miscellany was filed in a separate ring binder. Table 7.1 lists the document categories and their source. 'Events' generated from particular documents are also listed.

It was discussed in Chapter 6 that events are theoretical constructs not observed directly but inferred from changes in concepts, ideas, people, actions, and so on. They represent the data substance for process research (Van de Ven & Poole, 1989; Poole et al., 2000). The method of event generation is discussed later. Of the 720 events identified, 103 were generated from emails, the remaining from other documents.

7.3 Analysis and Data Reduction

A highly detailed document (DOW) describing Alpha's objectives and reasons for conception, was read first of all. It defined organisational roles and technology contributions, and represented Alpha's initial assumptions and conditions. From these initial conditions, theoretical concepts of project goals, tasks, skills and process were constructed and changes tracked over time. Process of change would be explained from inferences drawn from observed actions and decisions. As there was no means for inter-rater validation, repeated self questioning was undertaken on an ongoing basis. Questions such as, how could I be sure that what I inferred was correct?

Over time, I became more confident in what I was 'seeing' and believed that a fair and balanced picture was constructed. Next, project documents were read with the aim of looking for events that

TABLE 7.1 CATALOGUES OF DOCUMENTS COLLECTED FOR EMPIRICAL ANALYSIS

FILE #	TITLE	PAGES	SOURCE	USE
	Index to Content 31/10/01; 17/12/01; 7/5/02; 13/6/02	22	Project Website, emails	General organisation of project documents
1	Monthly meeting reports & Project Coordination Committee meeting minutes	159	Project Website	Context & events 2-404
2	Workplan and Contact details	87	Project Website	Context
3	Legal Matters – signatories and IPR definition	38	Project Website	Context
4	Project start up Jan 2000 – roles, expectations, project structure	47	Project Website	Events 1
5	Several Reports – Working & Technical meeting minutes and presentations	248	Project Website	Events 408-539
6	Deliverables Part 1	159	Project Website	Events 540-555
7	Deliverables Part 2	235	Project Website	Context
8	Project Review 2000 and Final Report 2001	336	Project Website	Context
9	Various Data – DOW, cost reimbursement, EC letters of contract and signatories	136	Project Website	Context
10	IST Concertation/Clustering; IBC 2001 proposal	80	Project Website	Context & events 405-407
11	Final Reports – Self assessment		Project Website	Context & events
12	First intermediate report on assessment	140	Project Website	Events 556-618
13	Final Report Apr 2002 version	59	Project Website	Context
14	Technical Audit Report dated 21st Dec 2001	4	Hard copy from partner	'outcomes' as central subjects to be followed
	Interview with EU Office	6	Interview notes	Context & 'outcome'
	IST 2000 clustering information	148	Hard copy from EU office	Project Context
	ACTS booklet	151	Hard copy from EU office 4/7/02	Project Context
	e-Europe 2005: An information society for all	22	Hard copy from EU office	Context
	Partner Organisation Press announcements	4	Company Websites	Project Context
	Description of Work (DOW) circulated November 1999	65	From partner	Project Context
H: drive	Intra-Project emails	~ 400	Project participants	Events 619-720
H: drive	Weekly [Itvt] industry newsletters	~ 200 emails	Subscribed emails	Context

might indicate changes in initial project conditions[28]. As most documents had an associated chronology, the choice faced was whether to read different document types for a particular time period e.g. formal and informal documents for Month 1, then Month 2, etc., or to read an entire series of a document type for the 24 months. The latter option was selected as it seemed to provide a more coherent emerging process picture. Different patterns observed in different documents could be compared.

Documents were read in the following order:

Given that the DOW was highly technical, it was thought that emails would be a more useful starting point. The discourse contained in them was expected to be less technical in detail. Identifying key themes or discussion topics might help target certain document types or events. It was also thought that the email chronology would provide an organised way of identifying the development of key events: how some events arose and linked to other events for a prospective, longitudinal project construction. It was also thought that communication frequency would give clues to partner commitments, expectations and intensity of participation.

Although reading of emails identified some interesting interactions, problem-solving episodes and changes in partners' tasks and goals, it became apparent that context had to be understood first: understanding the specific project and its fit with the broader external context. Relationships and linkages of events could only usefully be made once this understanding was gained. In other words, to identify events, a degree of raw interpretation had to be engaged in. Unlike interview text where data may result from targeted questions, documents gave few clues to specific textual elements. It also seemed premature to code the text using the concepts without really understanding how the events would be ordered.

It is of note that my role in Alpha was highly peripheral. During January 2001, just over half way through Alpha's development, I was asked by a partner organisation to assist with analysis of the converging Information Industry. My remit was to review and summarise the general industry background, but not that of the specific IDT sector. I was required to conduct a search of information industry reports (Keynote, Mintel and Internet search of business magazines); review the changing roles of industry players and future relationship structures. Drivers for industry convergence were identified and the likely implications for incumbent firms. A truncated version was incorporated in the discussion presented in Chapter 4.

[28] Alpha's Initial Conditions were as:
Context where technology integration seemed feasible but no robust integrated system existed and project provided the opportunity to show it could be done;
Task to integrate the diverse technologies using open standards and develop business models that could create value for all partners;
Skill – partner mix brought the necessary competencies for the project goal to be achieved;
Process – technological integration could be carried out from remote sites supplemented by quarterly working and review meetings

The broad industry analysis suggested Alpha's interesting characteristic. It had potential for contribution to the field of strategic management. Reading of emails indicated a need to first understand the specific IDT context and the relevance of Alpha. For this, subscription to a sector specific weekly electronic newsletter was made from June 2001. It provided up-to date developments in this sector, including: international technological developments, new product ideas, market issues and specific organisational engagements in global markets. Large and small organisations involved in IDT activities from countries as far apart as Australia, Sweden and China were reported on. A rich mass of data was gathered on other complex collaborative integrations within the same sector. Some examples were given in Chapter 4.

A considerable time was spent understanding the IDT industry and its distinctive terminologies. A thorough re-reading of Alpha's entire work plan began to provide a broad picture of what was being attempted; the goals being pursued, and how Alpha fitted with other product developments in the industry. The document pointed to the important reasons for Alpha's conception. It detailed the roles and competences of its constituency. Produced by the EU, it formed the basis upon which partners agreed to participate and share proprietary technologies. Reading this document concurrently with industry newsletters helped identify key drivers for Alpha and its consistency with IDT market reports[29]. In summary the document told me why Alpha was conceived, what its objectives were and how its outcome was to be assessed. Once this broad understanding was gained, I could read other project documents to see meaning in what it contained.

The next set of documents to be read was the formal Monthly Management Reports. They represented external project reports for updating the EU of progress and any resource or technical issues. It was assumed that their construction may not truly represent the reality within the collaboration. They might reflect a 'reality' Alpha wished to portray. Despite this assumption, the documents were used to identify issues presumed to be important to participants or report recipients. They might illuminate issues discussed in other documents but omitted here. These documents also contained rich information about statements of organisational participations in specific technological activity, meeting attendances, reasons for non-attendance, relative contributions, etc. Inferences could be made of likely consequences.

From January 2002, 24 chronologically organised monthly reports were read repeatedly at least three times. In isolation, an individual report said very little; but in reading the series, a picture began to emerge of continuities, discontinuities, and some dysfunctionalities. Events were identified relating to change in initial conditions: tasks, roles, process, and goals. The intention was to identify chunks of relevant text and tag or code it to theoretical concepts at the same time. This was premature given that observation precedes understanding; recognising an important moment

[29] A lack of demonstrable integrated technological concepts clearly associated with novel business models was leading to little interest from investors

(seeing) precedes encoding it (seeing it as something), which in turn precedes interpretation (Boyatzis, 1998). A greater understanding had to be gained before meaningful conceptual coding could be done. I was also aware that large amounts of seemingly relevant text had already been identified. There had to be some way in which it could be reduced into critical events. Consideration was given to organising the process into three phases: a start, middle and an end. This was thought inappropriate because of the modular and sequential organisation of project tasks.

Instead of conceptual coding, chunks of text or events were logged into a Microsoft Access Database which generated sequential event numbers. For each event, document source and date were recorded e.g. MMR01 signified Monthly Management Report of Month 1 or Jan 2000. It is worth remarking that this date did not always represent the exact day when an event occurred. It helped place the event within a window of a month. Event numbers generated by the database were recorded in the margin next to the relevant text. This created a permanent record and an ability to revisit the text if needed. Just the one set of documents had generated over 200 'events'; it was still unclear how these would be reduced into critical events. The events were at various hierarchical levels: a mix of macro and micro-events. My document reading was guided by an image of building a picture of how technologies were transferred and integrated, what adjustments were made to starting conditions and how all this led to the actual outcome i.e. a prospective process construction. Although no conceptual coding was explicitly done yet, it is acknowledged that event generation in itself implied a degree of implicit reference or connections to theoretical concepts. These subjective judgments of why events might be critical or how they may be relevant were inevitably based on the reading of the context and other experiences.

At this point, I stopped identifying chunks of textual data. Instead, I read the entire set of gathered documents. The reason for this was to get a broad sense of what they contained. It might give clues to making the analytical task less unwieldy. It was also recognised that the mass of documents was not guaranteed to uncover anything meaningful. With hindsight, this general reading should have been done at the start of the analysis. This extensive reading and re-reading helped move beyond a superficial understanding of text; underlying meanings became clearer (Lee, 1999). Now it was also obvious what Pettigrew (1997) meant about linking outcome to process and starting conditions. Pettigrew advocates retrospective construction to help focus what to study; I had pictured a prospective construction. When data is approached in this way, one falls into the trap of following everything. It results in an overwhelming mass of data without a real focus on what is being explained.

After reading some highly technical reports and minutes of technical meetings, I came across an 'audit' report that assessed and summarised Alpha's achievement at the end of its two year life. It represented an independent assessment of Alpha on behalf of the EU. This document proved really helpful because it provided an evaluation of Alpha's progress and its achievements. From this

evaluation two outcomes were selected on the basis that they represented important collaborative activities with differential degrees of success. They could be used as central subjects or hooks on which events could be linked. In this way a retrospective process picture could be constructed. The outcomes also helped refine the two dynamic process propositions. The two outcomes were: Development of novel Business models and Technological Integration across diverse platforms. The former was assessed as relatively weak success whereas the latter was considered more successful.

In July 2002, the EU officer responsible for Alpha and its final assessment was interviewed. The interview revealed that the EU considered Alpha to be highly successful despite Alpha's failure to produce a positive outcome for its key goal of business model. It provided a 'theme' to help explain the change in this view of success.

Events or incidents were recorded if they were thought important, or may be relevant to the process later on. By going through the entire series of monthly reports a broad picture began to emerge as to what was being created technologically, when and by whom. Next, minutes of project coordination committee were read and events were identified and logged. This was followed by the reading of minutes of technical meetings, workshop presentations, then deliverables and finally audit reports. Minutes of meetings and workshops revealed instances when certain decisions were not disclosed in formal reports. One such theme is discussed in Chapter 8. The document reading became more strategic in terms of what was considered important and hence logged. I found myself not just looking for what had changed in Alpha and how, but also asking why this might have happened. I had to stop reading the text a number of times to return to the research question to remind myself of what I wanted to know.

Over the course of my reading I came across a number of 'verifications' or restatements of events I had identified in other documents. For instance, a monthly report stated that three partners had presented an aspect of the integrated technology at a conference. I found specific references to it: either as slide presentations at project technical meetings or contained in emails from partners who had received feedback from external organisations. This kind of event verification represented a form of triangulation or internal validity, within a single documentary method.

7.3.1 Iterative Stages of Data Reduction

A total of 617 events were logged into Microsoft Access database, then sorted chronologically into a Microsoft Word document with headings: event number, text, source and date, generating a 41 page document. A similar database of text was developed for 103 events from the 493 emails. The two database files were combined and sorted to develop an integrated chronology of 720 events. This chronology of events was read and re-read. A list of memos (questions, thoughts, likely explanations, and linkages with contextual data) was created for consideration in building process

explanations. This also led to further categorisation of the events. The 720 events were sorted into 4 broad categories: two relating to the central subjects discussed earlier, one relating to EU's perception of outcome success and one relating to specific changes in partner roles and tasks that could be linked to one or both outcomes. With specific questions in mind, the re-reading of the chronology of events helped narrow down and identify critical events. These events were significant in the process development of the two outcomes. The iterative event reduction (720 to 412 to 235) produced the following spread across the categories:

- Business models & choice of application – 76 events reduced to 46
- Technology integration – 262 events reduced to 150
- Specific changes in roles, tasks, and expectations – 61 events reduced to 30
- EU's perception of outcome – 13 events reduced to 9

Further iterative reduction of events led to the construction of a narrative chronology (Chapter 8). 5 events were used to link theoretical concepts in a fine-grained process analysis of the Business Model Module and 12 events were used in the Technology integration module (see Chapter 9).

7.4 Concluding Remarks

Process data is said to be messy, unwieldy and difficult to manage. This chapter has illustrated this unwieldy character and probably explains why the approach is used so infrequently. This contrasts sharply with the research paradigm that uses standardised de-contextualised data. The process of identifying events, which were the substance of process research, was discussed. In particular this chapter has demonstrated the emergent nature of the research design and process of document analysis. It has shown that the detailed research design presented in the previous chapter was not a result of some linear and rational construction. The interaction of the researcher with the data and the research process played an important role in the iterative shaping of it. It has discussed and shown the benefits of retrospective linking of outcome to process development for its ability to delimit what was being studied. Alpha's two central subjects of study emerged from the textual analysis. The rich and detailed nature of documentary evidence has shown that using this technique to the exclusion of others did not disadvantage the research. In fact the fine-grained process data could otherwise not have been generated. The in-built chronology in the documents lent itself well to process study which had sought to take account of time and space. Qualitative case study research is often criticised for lack of research rigour. By detailing the organisation and management of the documentary evidence, this criticism was considered to have been overcome.

The next chapter provides a narrative description of development of the two differentiated process outcomes.

SECTION III

EMPIRICAL FINDINGS

CHAPTER 8

RESEARCH SETTING AND PROCESS FINDINGS
A DESCRIPTIVE ACCOUNT

8.0 INTRODUCTION

The aim of this research was to link Alpha's process of collaborative technology transfer to its actual process outcomes. To do this, Alpha's starting goals were first uncovered and compared with actual outcomes for similarities and differences. The development of the actual outcomes then constituted the 'objects' of study (Pettigrew, 1997). Critical change events were uncovered to help construct the dynamics of what happened and how divergent outcomes developed. This chapter provides a descriptive process chronology of the findings. The next chapter builds on this by constructing a fine-grained process analysis of differential outcome developments. The purpose and method of finely-grained process analysis are discussed in the next chapter.

This chapter serves an important role of uncovering the 'objects' of study and provides an analytical description of the empirical process chronology. In other words, it sets out 'what' happened and how it evolved. The process is constructed as narrative (Langley, 1999) from textual excerpts (proprietary technologies are either given a pseudonym or blanked out in the excerpts). Narrative serves both as descriptive chronology and incorporates an analytical element that highlights causal linkages or generative mechanisms in the development process (Pettigrew, 1992; Pentland, 1999). A broad description of Alpha and its organisation is given, following a brief background to the EU policy context and in its role as Alpha's sponsor.

Textual interpretation was informed by contextual and project understanding, and ongoing process of reflexivity; a recurring reflection, questioning the impact of oneself on the 'seeing', and challenging the interpretations (Weick, 1999). Some theoretical concepts introduced in Chapter 5 are built into the description. The research findings are organised and described in the form of two interdependent goals, constituting the objects of study:

i) Design of novel Business Models and
ii) Development and Integration of generic and application-specific Technologies.

They are conceptualised as two temporal brackets of differing durations and they also represent units or micro cases for internal replication (Langley, 1999). The ability of internal replication to strengthen single case study was discussed in Chapter 6 (Yin, 1994).

The EU deemed the overall project outcome as relatively successful[30]: stated in the audit report and confirmed in interview. Yet, the two outcomes that contributed to the overall project performance showed differentiated success: one relatively weak, the other much stronger. The stronger outcome seemed to develop through emergence of organisational learning clusters. The two clusters did not include the entire constituency. These distinct groups achieved effective integration by adjusting its technological scope. The work of the two groups was separate yet within the bounds of the overall single social entity. The interdependent nature of Alpha's two goals and their relative developments would be expected to constrain the overall performance. But in its assessment of the broad outcome, EU's success criterion was based on a different order of goal priorities. These priorities apparently had a better fit with its broad policy agenda rather than that specified for Alpha at the start. The implication of this apparent discrepant performance expectation is discussed in Chapter 11.

The different degrees of success provide interesting comparators with respect to the feedback theory of LaMA. They also showed how actions in one period might affect change in a later period; how minor early events may have major impact later in the process: path dependence where the past shapes the emerging future (Pettigrew, 1992; Teece, Pisano, & Shuen, 1997). Compared to a great deal of research that views outcome as a dichotomy between success and failure, this analysis illustrates its partial nature. This dynamism is hard to capture in linear process models. The apparent change in EU's goal priority and basis of assessing success illustrates the problem of viewing an outcome in singular terms. Moreover, this assessment was based on just one stakeholder's viewpoint amongst many others. Alpha's complex social system consisted of a multitude of stakeholders that was expected to generate multiple views of success: at project, organisational and individual levels. Although the analysis was principally aimed at project level, the processual research design enabled the linking of different realities and ambiguities if identified and thought relevant.

The chapter starts with a brief background to the EU policy context followed by Apha's conception and the rationale for its creation. This rationale was consistent with the IDT industry development with respect to technologies and economic goals (Chapter 4). Organisations are introduced with roles and tasks they were expected to fulfil. Organisational backgrounds and prior collaborations amongst constituent members are detailed. Organisational structure is outlined and its starting objectives are discussed in relation to the IDT market. This serves to provide an understanding of the relevance and significance of Alpha's set objectives and broadly represents Alpha's starting conditions. Temporal development of the two goals is then described; a narrative is built around the dynamics of key events believed to have contributed to the evolution of the two differential outcomes. The implications for the rest of the project activity are discussed. The reader is expected to have gained a broad contextual understanding from Chapter 4 in order to make sense of some industry-specific terminology used in this discussion.

[30] No patent submission arose from Alpha's collective activity. Separate patent applications were submitted by 2 partners in US and Korean markets; various academic publications and conference presentations were made by 5 partners; a further collaboration commencing 2002 that included some Alpha partners was approved for EU sponsorship

8.1 Background to the EU Policy Context

Since the 1980s, the EU has provided significant support to research in science and technology in the form of sponsorship of a large number of cooperative consortia. These consortia have consisted of large and SME industry firms and research / academic centres, from different nation states. They have occurred in a number of industries but the Information Industry has had by far the greatest input (Ham, Linden & Appleyard, 1998). The EU's key objective has been to reduce fragmentation of European research and enhance Europe-wide industry competitiveness. It sees itself as a medium through which organisations can communicate more effectively and improve the coordination of their research efforts. It considers this kind of work to stimulate innovation and improve the use and transfer of research results into commercial technologies. In the absence of adequate coordination, networking and cooperation the research efforts can suffer (www.europa.eu.int/comm/research).

The budget devoted by the EU to European research has been substantial. For instance, for the period spanning 1998 to 2002 it was set at around €15 billion: an average €3 billion per annum. (Alpha's €5 million budget represented a tiny amount of its total budget but was nevertheless considered important to study). From 2007, its annual budget is expected to rise to a staggering amount of around €10 billion. Despite the scale of sponsorship it considers its innovation performance to be relatively weak when compared with the US and Japan (www.europa.eu.int). One of the main tools used to measure this performance is the R&D expenditure, expressed as a percentage of GDP. Compared to almost 3% GDP spent by US and Japan, EU has remained below 2%. The EU considers performance improvement as a function of increasing it's spending in the coming years.

If the overall expenditure is the key measure of performance success rather than the particular collaborative goal, then this has important implications. It has implications for how decisions might be taken to sponsor particular R&D projects amongst alternatives; the criteria used to assess their performance and organisational engagements in those arrangements. These implications are discussed in Chapter 11.

8.2 Case Study of Alpha

During late 1999[31] Alpha, an EU sponsored collaborative consortium was formed, with a budget of €5 million. This equated to a total resource commitment of almost 20 FTE persons, deployed for 24 months, from January 2000 to December 2001. Alpha was conceived in the belief that whilst technology integration across the three industry sectors was theoretically feasible, no single organisation could achieve integration alone. Moreover, no collaboration had as yet demonstrated a robust product concept. Without proof of concept that easily merged with existing technologies, there remained little investor interest to develop the industry sector. This had contributed to fragmented IDT development and was consistent with market reports at the time (Swedlow, 2001). Alpha's conception was consistent with EU's role of promoting industry

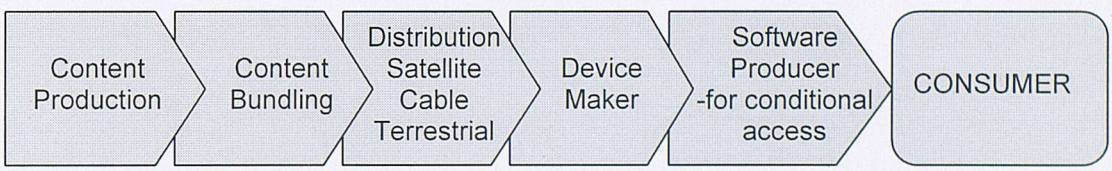
[31] Coincided with the peak of the Internet boom and auction of 3G licenses in the telecoms sector; by the end of 2000 the internet 'bubble' had burst and telecoms sector was experiencing major economic crisis

competitiveness by influencing European technology standards. Common standards could be developed only if organisations were prepared to work together. EU saw its role as a facilitating medium for this.

To safeguard against any future dispute over intellectual property rights of contributed or jointly created technologies, Alpha was constructed within a highly detailed legal framework. It specified: organisational resource commitments and broad technology contributions; structure and plan of formal project meetings and responsibilities of host organisations; project duration and timeframe; exploitation rules for partners to use the newly created knowledge. In other words, a formal arrangement was in place to supplement an informal social contract.

Technology integration was to span a spectrum of: content production through packaging, distribution to receipt by consumer for interactive manipulation (Diagram 8.1). The IDT technological value chain was discussed in Chapter 4. The knowledge attributed to each segment was neither entirely separate nor totally tangible. Integration of the disparate knowledge was a highly complex process that would have to be enacted through human social interaction. Instead of a simple mechanical joining together of technologies, interactions would include making knowledge linkages, refinement and conceptual re-envisioning; consistent with the processual enactment of knowledge (Tsoukas, 1996).

DIAGRAM 8.1 THE IDT VALUE CHAIN



An important requirement was the need to easily incorporate new technologies with existing infrastructures and consumer technologies, i.e. to maximise consumer uptake, new technology had to be compatible with conventional TV and its associated infrastructures. If consumers had to invest in entirely new equipment then the take up might be significantly slower.

Each organisation would bring unique industry-specific knowledge, skill and experience to the collaboration; technological complementarities and interdependencies were key assumptions. Organisational selection (by the EU) was made on the basis that

> '*...knowledge and skills are absolutely complementary and cannot be found within one single European nation. For the project to succeed, trans-European cooperation is a prerequisite. The project's intention to promote technological specifications in a worldwide domain makes inclusion of US and South East Asian partners all the more important'.*

The 12 organisations are introduced in Table 8.1, then summarised in Table 8.2 for ease of reference. To retain anonymity and confidentiality they are coded; their prior collaborative experience is detailed in Table 8.3. Countries of origin and industry domains illustrate Alpha's national, organisational and technological diversity: potential difficulties from diverse work-

related values and organisational practices (Hofstede, 1980), and differences in sector-specific technological knowledge (Prahalad & Hamel, 1990), and associated language, technical jargon

TABLE 8.1 INTRODUCING PARTNER ORGANISATIONS

Partner A: Telecoms operator based in France. It was involved in over 100 other EU funded collaborative research projects involving numerous partners including universities and manufacturers from all over Europe. The key representative was a telecommunications engineer with a central role in the AIC standardisation group that was considered highly relevant to IDT.

Partner B: a Dutch multimillion-dollar broadcaster, content producer and supplier of TV, film and video facilities. It provided technological services to various European countries. The key representatives were technologists experienced in content production and technology bundling.

Partner C: South Korea government funded R&D institute involved in developing new technologies for transfer to local country manufacturers for commercialisation. It had access to a broad range of technologies including rich content. Its nationally approved technology standard (ATSC) was rejected by European countries in favour of DVB standard; DVB was considered superior with respect to its interoperability across various distribution platforms. C had by far the largest number of individuals assigned to Alpha who all had technical and engineering skills.

Partner D: US based multibillion dollar global company that provided software technologies for 'doing business in the network age'. The key individuals had a broad business and technical experience. D was to contribute an important and highly significant technology that enabled generic integration of interactivity applications. Its role was to help refine the generic technology to facilitate smooth synchronisation of other Alpha components.

Partner E: Dutch R&D Institute that provided support to its companies and their international partners in the development and introduction of new products and services based on multimedia technology, satellite communications and internet services. The key representatives had technical and engineering backgrounds and had been exposed to prior EU projects.

Partner F: Belgium based subsidiary of a Japanese multinational electronics products and entertainment company. The key representatives had computing and engineering experience with a business development role. It was expected to contribute technologies related to its existing products and content for interactivity.

Partner G: Italian telecoms operator. The individuals assigned to Alpha were all computer scientists with prior experience of other EU projects. One member was a key player in AIC and had conceived Alpha. It was expected to contribute technologies related to its distribution network.

Partner H: a small, public listed technology Israeli firm. It developed software and hardware technology. The representatives had computer science, marketing and business development experience. They were involved in development of MPEG standards and had participated in other EU projects.

Partner I: a non-profit, national German research institute. It had considerable experience in applications development; had collaborated with a number of partners from industry and science in the past and had worked on several EU funded projects in telecommunications and multimedia applications. The key representatives were all computer scientists.

Partner J: German global telecoms operator. It had considerable experience in MPEG4 technology and 3D[32] functionality that was expected to help integrate Alpha's 3D content. The two key individuals were electronic engineers with experience of new product development. They played an active role in a number of standardisation bodies directly relevant to Alpha.

Partner K: a British university representing two departments responsible for technical input, business analysis and industry strategy. A number of individuals were assigned from both departments with a wealth of experience in the structure of competitive strategy and production in network industries and in artificial intelligence technology. Some individuals had prior experience of EU projects. K's key role was to lead the development of business models and carry out an economic analysis of the interactivity concept.

Partner L: Netherlands based multinational business and consumer electronic products maker. It was to contribute expertise gained from other EU projects with respect to user interfaces and for improvement in the generic technology provided by partner D. It also served a role of project coordinator / project manager. The key individuals had experience in science of human behaviour and computer science.

[32] three dimensional

and images (Browning, Beyer, & Shelter, 1995). These complexity dimensions were expected to impact the technology transfer process (discussed in Chapter 3). Partners' prior collaborative engagements either with Alpha or other partners was expected to have a positive impact on learning and process adjustment.

TABLE 8.2 SUMMARIES OF PARTNER ORGANISATIONS

Partner Code	Country	Industry Sector	Individual/Organisational Expectations presented to Alpha members at the Project Start Up Meeting in January 2000
A	France	Telecoms Operator	Development of business models in the domain involving telecommunication operators in the food chain; development and validation of tools that realise this business model (complete chain production/delivery/consumption validation); development of applications and trials to validate them with real users
B	Netherlands	Content provider	Find out what Alpha will mean for consumers and broadcasters
C	South Korea	Govt funded research institute, broadcasting and technology development	We will conduct the realisation of a demonstrator based on terrestrial ATSC[33] environment
D	US	Multinational Technology developer and service provider	Feedback from the TV industry on the java technology in general and java platform in particular
E	Netherlands	Service provider and platform developer	Expect the project to provide valuable knowledge and experience in creating 'cross-media' services. Especially the ways in which 'new' content and interaction can be linked and added to existing services is important to us
F	Belgium	Multinational Electronics and Entertainment products	*IN ATTENDANCE BUT NO EXPECTATIONS PRESENTED*
G	Italy	Telecoms operator	Increased use of telecoms infrastructure for audio-visual content downloading and streaming - clear definition of business models and feedback for the users are essential for the definition of the industrial strategy of a telecoms operator
H	Israel	Quoted technology firm, Technology developer	Explore new horizons of research; benefit from multi-disciplinary and multi-cultural cooperation; establishing strategic alignments
I	Germany	Govt funded research institute and application developer	Different background of partners will allow to provide a comprehensive environment to create, test and deliver interactive broadband/internet applications with new possibilities for end-users. Expected results would improve the excellence of [Partner I] through publications, workshops and conferences and will enable it to use these results as a basis for further industrial and research project acquisition [70% of its total budget depended on this type of funding]
J	Germany	Telecoms operator	Interested in the definition and verification of new scenarios and business models in the area of IDT; expect a demonstrator to be built at our labs that demonstrates the technical feasibility of the developed scenarios and business models

[33] A technology rejected by Europe, adopted by a handful of other countries (See Chapter 4)

K	UK	Academic Centre	To further enhance our reputation as leading innovators in communications field and industry business. To position ourselves as active participants and drivers of standardisation bodies
L	Netherlands	Multinational Business & Consumer Electronics Producer	New interaction possibilities for end-users; enhanced user interfaces; improved java virtual machine

Partner G, an Italian telecoms operator was the main conceiver of Alpha and responsible for defining its objectives. G also had an important role in an International Standards Body. From its prior network, G was supported by K and C in making a case for this collaboration and for securing EU sponsorship funding.

Many organisations within this collaborative set had prior experience of joint working as shown in Table 8.3, even if specific individuals had not. This type of repeated organisational collaboration illustrated the use of networks and utilisation of prior organisational and individual ties (Gulati, 1998; Powell, Koput, & Smith-Doerr, 1996). These organisations seemed to have built up a relatively high degree of common understanding and trust and clearly wanted to work together. Instead of face-to-face interaction, project communication and interaction was predominantly electronic; this virtual interface was expected to lead to some misunderstandings.

TABLE 8.3 PRIOR COLLABORATIONS OF PARTNERS

Partner	Prior Collaborative activities of some of the Alpha members either independently, or through EU funded collaboratives or various Standardisation bodies
A	Was involved in >100 other EU funded projects with numerous partners including universities and manufacturers from all over Europe. It had worked with K, G and J previously Representative on AIC body that included Partner G
B	It had worked with L on other EU sponsored collaborations It was currently working on a parallel project (see L)
C	It had worked previously with G independent of any EU projects It supported G in the conception of Alpha
D	There was no information regarding prior collaboration; as a non-EU country member it was unlikely to have participated before
E	Had been involved in a number of other EU collaborations
F	There was no information regarding its prior collaboration
G	Had worked with C previously Had collaborated on various other EU projects including those with K, A and J
H	Participated in other EU projects Member of the MPEG standards group
I	Collaborated on various EU projects Participant of a number of standardisation bodies
J	J had collaborated with K, G and A in other EU collaborations J was also participating in a parallel project [BASE] which was to contribute technologies to Apha
K	K had collaborated with G, A and J in other EU collaborations Had supported G in conception of Alpha
L	L had collaborated in numerous EU projects and had worked with B previously; *It was involved in a parallel project to Alpha that aimed to demonstrate the storage capability of STB included L, an Italian firm, a UK broadcasting corporation, two Scandinavian Mobile telecoms equipment makers, B and a Slovenian University*

On average each organisation assigned two to three individuals to Alpha. To retain confidentiality and anonymity, the text is not attributed to specific individuals in this empirical analysis. No organisation planned to allocate full time persons to work on Alpha; nor was a separate buffered organisation (Thompson, 1967) created for technological integration. Hence, project tasks were carried out in addition to normal organisational roles and were likely to present conflicts on individuals' times. This had process implications.

This sort of interface arrangement is not conducive to sustained interaction or socialisation (Zander & Kogut, 1995) for effective knowledge creation (Nonaka, 1994). Its structure had potential to impede knowledge transfer. But the intensity of engagement with project tasks had potential for uncovering organisational commitments to Alpha. Many participants were key players in project relevant standards bodies[34]. Email from Partner A on 29.3.00:

> *'I have taken this opportunity to comment on AIC / Alpha relationship...they have a very close history. To build Alpha we took AIC general ideas and expanded on them, we took the most active partners at that time and completed a meaningful project, self contained. .... AIC is one international platform where we can amplify the result of Alpha (document a proper specification for this kind of applications since we want to have an open solution to that problem, test conformance with other industrial partners, influence other standardisation body, market our solutions....) this was also one of the selling argument to the Commission..'*

They all seemed to be highly agreed on the logic of the collaborative objective. They seemed to perform a dual role of: unique organisational knowledge contribution and representing at the standardisation bodies. It enabled these bodies to be influenced for specific standards adoption.

The 12 organisations can be grouped into 6 broad knowledge competence categories (Table 8.4). These competences were considered highly important by designers of Alpha for it to achieve its goals. Partners that belonged to the same knowledge category were not necessarily direct competitors. In some cases they belonged to different industry segments e.g. L was a Consumer Electronics company whereas K was an academic research centre; others had competences that straddled two or more categories. L was also the project coordinator. No single organisation was considered more important or dominant than any another. Given the assumption of multi-organisational technological interdependence, no single technology was considered more powerful than another. This was an important collaborative condition for avoidance of unnecessary compromises and dominations (Mintzberg, Dougherty, Jorgensen, & Westley, 1996). Difference in organisational resources and level of EU funding was dependent upon the size of tasks undertaken.

In terms of coordinative and project management duties, the overall leadership role in this complex, constructed organisation was provided by L. The collaborative constituency had to raise issues of project or individual partner performance at project steering and coordination meetings. Any changes had to be sanctioned by these instruments. For effective technological integration, all partners were required to participate for the entire 24 months' duration. No single

[34] Bodies included AIC, MPEG, W3C, DVB, IETF

organisation was expected to have a short-lived presence. The analysis showed that the process of integration was not simply a one-off event of organisational contribution. It was constituted an ongoing process of technology refinement through engagement, re-conceptualisation and trial and error learning. This suggested that organisational failure or its technology to stay the entire project duration was likely to have a negative impact on Alpha's overall performance.

TABLE 8.4 KNOWLEDGE CATEGORIES AND PARTNER ORGANISATIONS

Knowledge Competence	Partners
Business Strategy & User Requirements	K, L
Content Provision & Application development	B, C, I
Technology and System development	C, D, F, H, L
Service Provision and System Integration	E, G, I
Network Provision and Operation	A, G, J
Testing and Validation of Integrated Concept	E, G, L

Alpha's broad objective was to develop an integrated IDT product prototype. This concept's technical ability would be exhibited by the use of 'interesting' interactivity applications, selected on the basis of their commercial attractiveness. Component technologies would be based on emerging standards; the final concept would be user tested to gather feedback on ease of use, concept attractiveness and interesting content. This would provide clues to its potential for commercial exploitation. This suggests that organisational expectations at the outset were not just to integrate technologies for proof of technical feasibility but that there was an important market orientation also.

The open standards requirement was necessary because traditionally each sector had developed its own standard for production and transmission. For effective and good quality synchronisation, new content had to be compatible within a hybrid network of telecoms, Internet and broadcast. Failure to achieve compatibility had important implications. Content would have to be produced in various versions to accommodate different networks. Demonstration of economic value for all participant organisations across the value chain was expected to promote commercial interest in the concept:

> '*...although the project has a research orientation, a set of activities is defined that analyses the commercialisation of the product. Such analysis includes market analysis, solution pricing according to competition, business plan of commercial exploitation….*'

> '*...the idea is that all participants of the value chain should be able to profit from these extensions...*'

A thick and detailed document called Description of Work (DOW) formed the basis for organisations' common understanding of Alpha's objectives and tasks. It also formalised their contractual obligations regarding technology contribution. It stated what had to be done, by when, by which organisation and resources they had committed to contribute. Importantly however, it did not state how the knowledge integration would be done. This conferred flexibility

to the process of knowledge transfer and integration. It also reflects the fact that knowledge was emergent and had to be socially enacted.

Structuring of project tasks helped reduce technological complexity. Organisations were arranged into teams or work-packages on the basis of their apparent knowledge endowments. Each team was assigned specific tasks to contribute towards the final goal. This would suggest that if task roles were determined by unique organisational technologies, then they were unlikely to be fulfilled or substituted by others. Organisational engagement varied over time but continued throughout the project. Whichever integrated technology was conceptualised, all organisations were expected to contribute to it. The findings showed that as technological integration progressed, some partners clustered into smaller, highly interactive groups to focus on specific technological integration. This clustering seemed to create the conditions for a more effective knowledge creation process, discussed in greater detail in Chapters 9 and 10.

Alpha was rolled out as four highly interdependent, sequential and parallel work-packages. Each work-package had a set of milestones and a leader. Depending on their technology, organisations were assigned to one or more work packages. The four work packages had the following task:

i) To define novel business models and choose applications
ii) Develop a technology platform
iii) Develop applications and integrate with technology platform
iv) Validate and test the integration

Work-package leaders undertook to co-ordinate each of the four task deliverables. Leader roles were allotted to partners believed to have expertise in the key task of a particular work-package.

To simplify the process research analysis the packages were collapsed into two modules or temporal brackets (Langley, 1999): a) Business Model Module that defined business models and selected the applications and b) Technology Module that consisted of development of a generic technology platform, development and integration of applications and their validation. The benefits of this modular analysis were discussed in Chapter 6.

Organisational expectations were declared at the outset by representatives attending the Project Start Up meeting. These declarations were made during the formal group presentations (see Table 8.2). Reflecting the seemingly still developing IDT industry sector, some partners seemed more concerned about strategic learning: interested to develop a wider understanding of IDT[35]; others were clearly more focused on Alpha's specific technology integration[36].

[35] Partner B's interest to find out what Alpha would mean for consumers and broadcasters
[36] Partner C's interest in the realisation of a specific technology

Majority of the daily work was to be carried out from geographically dispersed sites, with communications conducted via email. Although not formally stated, English was the main language of communication. Given the differences in time zones and national languages there was undoubtedly a potential for misunderstandings in carrying out the interdependent tasks. Quarterly meetings lasting two to three days were scheduled over the 24 month duration; all organisations were expected to attend. Meetings would enable socialisation[37], a face-to-face progress review, technical discussion and problem-solving. It also allowed partners to develop a mutual understanding of what progress had been made collectively and individually. This broadly represented the process interface for project tasks. There was clearly a greater reliance on electronic communication for interaction, which was expected to have process implications.

Alpha was expected to borrow technologies developed by other EU projects, in a complex web of collaborations. Some Alpha partners might also be participants in other collaborations that would allow their technologies to be borrowed. Contributing collaborations in turn were expected to benefit from Alpha's development through royalty payments or through commercial application:

> *'As the BASE[38] player is expected to be made available according to the open source paradigm the BASE project itself believes that a prospective commercial exploitation of the Alpha solution supported by one of the business models studied by the project can bring direct revenues to the BASE consortium'.*

This reflected EU's desire to create a network of consortia that progressively developed new technologies. It helped influence the development of the industry by definition, refinement and adoption of common standards. It also gave clues to why the EU might have assessed the overall project performance in the way that it did. Alpha's success was attributed to the number of linkages with other EU sponsored collaborations. The following extract also illustrates the potential for tension between organisational expectations and those of the EU:

> *'...[EU's] audit summary report was in most parts positive. The project members agree with most of the comments. Some controversy was caused by the comment: we expect important contribution to standards..... The argument against it is that we are not supposed to contribute to standards but to use them...'*

The following section discusses Alpha's starting objectives, assessment criteria set by the EU and observed final process outcomes.

8.3 ALPHA'S GOALS

Alpha's goals and their priority order were documented and defined as follows:

i) Define business models in a form easily exploited commercially and responsive to changing environments

ii) Technically specify and integrate a robust system that is evaluated by users

iii) Borrow existing technologies and contribute to adaptations of international technological standards

[37] Other than the Project Start up meeting, this was the key mechanism for socialisation, commented on also by the EU officer

[38] Pseudonym for a technology generated by another EU consortium

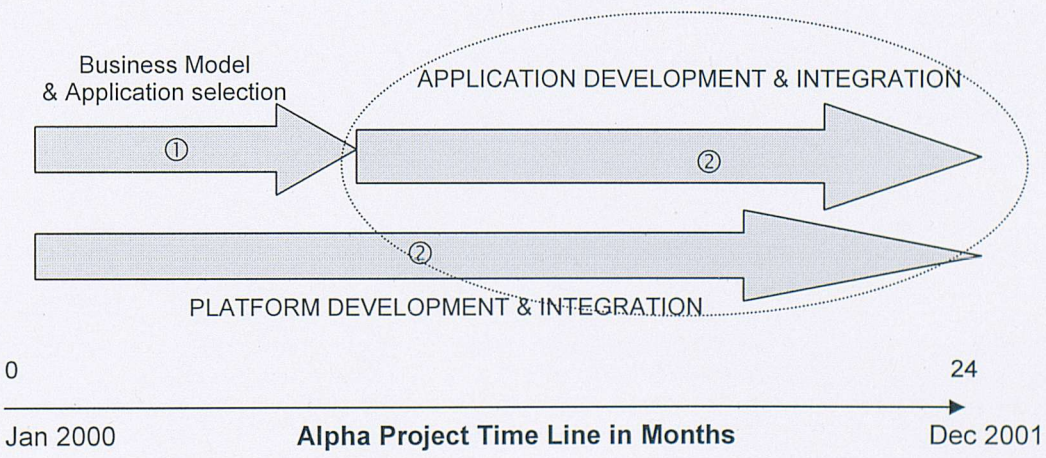
It was assumed that by engaging in the consortium, all organisations had subscribed to these goals. This was particularly so, given that commercial organisations were contributing and sharing the project costs with the EU.

The first major milestone was set at month 6 (June 2000). During this period business models would be defined and 'interesting' applications would be selected. The second goal consisted of two components: i) development of a general technology platform, which would be carried out from months 0 to 22, and ii) application development, which required the integration of the applications from the prior stage with the platform from the latter stage. This would occur between months 6 to 22. Validation and technology testing would commence in month 15 through to the end of the project at month 24.

The technology development timeframes illustrate parallel and sequential activities discussed earlier (Diagram 8.2). Parallel, because the business model module and platform development would commence at month 0 but each would proceed for different durations; sequential, because the output of the business model module would feed into the technology module for application development and integration. Decisions taken in one module would influence or constrain what happened later in another module, illustrating path dependence. In other words, the applications and business models chosen early in the process would determine the later development and final integration into the technological platform; and ongoing testing and validation would help refine the technology. Path dependence meant that early decisions influences later actions, the activities were not isolated from each other.

Other than the 2 or 3 organisations not involved early in the business model module, all organisations were expected to participate in both modules. The timeframes and composition of the two modules (① and ②) are depicted in Diagram 8.2, below to illustrate further the sequential and parallel relationships.

DIAGRAM 8.2 TIME LINE OF THE TWO PROCESS MODULES



EU's stated evaluation criteria mirrored the stated goals, detailed here:

i) Relevance of the business models: ease of learning, use and adaptability; measure of attractiveness of applications based on commercial interest by organisations within and without the consortium

ii) Success of the system prototype based on user tests and feedback

iii) Use of open technologies and relevance of contribution to standards development measured by adoption in open international standardisation body and further usage by actors outside the consortium

The evaluation criteria represented the measures that would be used to assess goal achievements at the end of the two year timeframe. The audit and EU's assessment of the final outcome illustrates the partial and plural nature of performance outcomes and indeterminate view of success, which was consistent with the processual view of strategy. The outcomes were assessed as follows:

i) The overall significant project success was attributed to networking (*significant contribution to other EU projects)* and contribution to standardisation activities

ii) Business models development had achieved relatively weak level of success - '*business scenarios had only partly been covered and the corresponding commercial requirements...*'

iii) The technological prototype had achieved a higher degree of success even though - *'prototype showed less ambitious performance than planned [far from commercialisation] and user tests'.*

This assessment shows that the overall performance was judged as largely successful; a 'significant contribution' had been made with respect to input into other EU projects and standardisation activity. Yet, the first goal of business model development had not achieved a convincing success. The second goal achieved a higher degree of success, albeit through adjustment of technological scope driven by contextual constraints. Interestingly, one of the resultant integrated technologies was granted funding for a further two-year collaborative development, commencing January 2002. This follow-on collaboration constituted four[39] Alpha partners (L, B, K and I) and six other external organisations, of which one had supplied an important technology to Alpha. This is a further illustration of EU's desire to promote networks for continued efforts to develop technological enhancements. It is of note that understanding this level of outcome detail and its significance could only be captured using a fine grained process method.

It would seem that Alpha's intra-collaborative activity was of lesser concern for the EU than its inter-collaborations with other EU projects:

> '*....the project leadership was particularly impressive in bringing and managing a very diverse team together on human aspects, not necessarily technically competent... particularly impressed with the ability to bring together other projects, network of projects and technologies...*'

[39] This is an example of a learning sub-group and its future collaborative potential

It exemplifies EU's developmental objective to build networks of collaborations and organisational linkages compared to a concern for the specific project outcome. The business model aspect of a technology development would be expected to be of strategic interest to any commercial organisation concerned with justifying its investment efforts; yet the EU seemed to have a fairly relaxed attitude to it. It also was remarkably unperturbed about the level or intensity of organisational engagements and contributions. According to the EU officer, the collaborative contained inbuilt process efficiency: organisational inequities or non-contributions were always addressed effectively. Disengaged partners were sure to be excluded from future collaborations as others were unlikely to entertain free-riders. Presumably, learning assessments and evaluations of each other were relevant to both the immediate project and to any future collaborative work.

8.4 Temporal Development of the Two Process Modules

The dynamic development of the two goals is now described enriched by some theoretical concepts: quality of learning along different dimensions - task, process, skill, context and goal.

Alpha's highest priority objective to develop flexible business models was not realised convincingly; nor was the economic value of the integrated technology for the entire constituency. Presumably, investor interest in the integrated concept was therefore likely to be limited: recall this as a key concern in Alpha's conception. Given that technological integration was considered more successful, if Alpha's sole aim had been to integrate technology then project performance could indeed have been considered relatively successful. From a commercial perspective, technological integration told an incomplete story; technology integration needed to be in the context of economic relevance to commercial and user communities[40], otherwise it might be viewed as an impulsive development by enthusiastic technologists. Interestingly the outcome was not inconsistent with that seen in other technology developments in the market place (discussed in Chapter 4).

The inconsistency in outcome development and performance of the two modules is also interesting. The fact that one module was significantly more successful than another equally important one, allows conditions to be analysed separately and in relation to each other. It also illustrates the emergent nature of technology transfer; how cognitions, actions, contextual factors influence the development process; how the quality of learning blocks or facilitates the different process developments. In describing the process leading up to the first observed outcome, some key events are traced that tell the story of the developing trajectory.

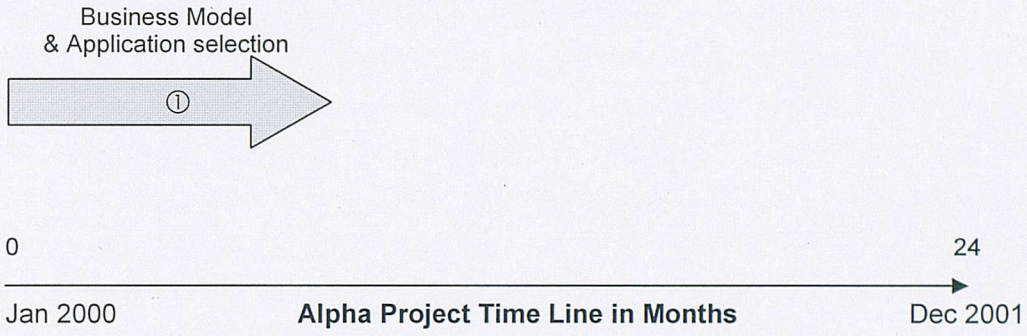
8.5 Business Model Module

Work in the business model module was to take 6 months, from January 2000 to June 2000 (Diagram 8.3). The key task was to define innovative business models that would influence the selection of up to 3 applications. (A business model can be viewed as the economic architecture

[40] An IDT executive was quoted saying at a conference during October 2001: 'don't get creative with IDT products until you get creative with IDT business models' (www.itvt.com)

of a business system. It defines inputs and related costs; outputs and their value. An organisation would be expected to undertake a cost/benefit analysis for technological investment. This would help determine if an investment was worth making). An application serves at least two purposes: i) illustrates a system's technical ability to deliver concept to the user; ii) illustrates the perceived value it holds for user and organisation. Consider the Doz (1988) technology integration study between Alza and CibaGeigy. The collaboration's application choice was a skin delivery device for controlled drug release. Ability to integrate the patch and the drug demonstrated its technological feasibility to users. The particular drug incorporated into the patch created a therapeutic advantage, which led to its clinical attractiveness and economic value.

DIAGRAM 8.3 TIME LINE OF THE BUSINESS MODEL MODULE



Output of this module would determine application-specific technology development and integration of the next module.

Two applications called Omega[41] (a children's story-telling) and Phi[42] (a tele-shopping) were selected. Phi was selected at a fairly late stage of the module and drew limited discussion from most participants. Omega was championed by B and supported by L. B, a content owner and content provider seemed to have a great degree of influence and control over the content it provided, and thereby the associated applications that could be selected. Very little market analysis was carried out for application selection that might be considered rigorous. Recall, the applications discussed in Chapter 4 that seemed commercially popular.

The process description illustrates cycles of blocked learning, constraints of access to content and module domination by some key technologies; all these conditions contributed to the development of a weaker performance outcome.

This module was led by K closely assisted by L. K was deemed to have the necessary knowledge and skill in business analysis and economic modelling of new business concepts. K would guide the collaboration to make strategic decisions about selecting the most attractive

[41] Young users would interact with program content, customise and configure it and add personal content
[42] Users could bundle existing TV services, get additional info for TV programs and access virtual shopping facility

and valuable applications and in business model development. L was expert in assessing user requirements from any applications. Eight other partners (excepting two non-Europeans) were to assist in the task. They would contribute sector specific knowledge to help conceptualise hybrid models, encompassing technological activities of its entire constituency. The key output by month 6 (June 2000) was selection of a maximum of three[43] 'attractive' applications. Once applications were chosen, they would undergo development and integration with the rest of the platform technologies[44]. Alpha had to be completed within the specified 24 month timeframe. Although the work processes defined at the start were relatively flexible, its structure allowed no adjustments to the duration or timeframe. This meant that timely work output in this module was critical; any delays in application selection would adversely impact the rest of the development. Presumably, without a tangible integrated technology it would be difficult to demonstrate it[45].

Most discussion and debate regarding application selection was to take place by email. In addition, a series of quarterly technical working meetings were scheduled, supplemented by ad hoc meetings. When writing emails, partners could choose the distribution list they wished: module specific distribution lists to conduct a technical discourse or wider distribution lists for more general discussion or to seek consensus on specific issue. Emails consisted of a great deal of technological problem-solving; other members could step into any of these discussions. Module-specific technical language and implicit knowledge often required clarification (or simplification) when distributed to a wider audience.

Although Alpha's official start was 1st January 2000, activity actually began at the two-day project start up (PSU) meeting of 18th January 2000, hosted by a European partner and represented by all participant organisations. Its purpose was for partners to get to know each other; introduce organisational members, their expertise and present an outline of expectations. It enabled socialisation amongst participants and was thought to create conditions for people to work together more effectively. The EU considered kick-off meetings as highly important,

> '*...because people say what they expect and want, and meet with people they work with. Projects come together because individuals want them to*'.

Attendant participants expressed a great deal of excitement and enthusiasm for Alpha. L in its project coordinator role presented and repeated Alpha's goals and organisational details. It specified the milestones and deliverables over the coming months. Organisational tasks and technology contributions were reiterated with the intention of creating information symmetry and reinforcing understanding amongst the collective entity.

Partners were informed of the first module meeting scheduled for mid February at K's location. A great deal of interest and enthusiasm was expressed in this module and its potential value. All

[43] Despite some debate on the pros and cons of more rather than less applications, there was agreement that only two applications would be selected

[44] Imagine an application being equivalent to a word processing application; platform technologies under integration would be a PC, its operating systems, ability to network to other PC's and users across different networks comprising satellite, cable etc.

[45] E.g. without a PC application it would be difficult to imagine a PC's capability

partners undertook to contribute ideas over the coming weeks prior to the meeting so that the actual meeting could be used constructively for discussion and decision-making.

By 3rd February 2000 most partners had made little effort to participate, contribute and even commit to attend the forthcoming working meeting. This led to K's important email stating why attendance was critical, stressing the variety of knowledge held by the different organisations:

> *'During the PSU meeting we invited you to come to our first meeting…your support is extremely important not only for [this module] but for the whole project. E.g. 3 aspects that are of great importance for the project and [this module] are: broadcaster point of view (potential content, opportunities...); technological platform (flexibility, limitations....); MPEG4 consumer & user level perspectives'.*

It illustrates the complexity of technological segments and the importance of knowledge sharing for joint definition of hybrid business models. Unilateral action would be difficult in this interdependent technological structure, as no single partner possessed the knowledge that spanned all the industry sectors.

Generally, emails generated responses within a few days from partners that seemed committed to the tasks; others continued to be silent to this call for contribution. It was difficult to assess whether email silence was due to lack of interest to engage or due to conflicting organisational priorities. It would seem that organisations that were more committed to either Alpha or the specific module went to great lengths to make alternative arrangements to contribute, despite conflicting priorities. For instance, Partner G wrote on 7th February 2000:

> *'…cannot attend but will send contributions...'*

In many instances, Partner proxies were appointed to represent organisational views.

Despite an apparent hesitation by some partners others wanted to play a greater role either in the business model module or in the entire project. This was particularly the case with G, the conceiver of Alpha and Partner C's desire to expand the technological boundary (described in the next section).

K's email inviting participation led to a short exchange of ideas and views on what was considered a novel business model. Interestingly, it gave the first clue to a widespread problem of understanding the concept of business models. Technologists seemed confused and uncomfortable with this concept. The guarded understanding is illustrated in G's email of 7th February 2000:

> *'…a possible idea would be to include business models that each technology can support. E.g. MPEG2 broadcast (advertisement driven, subscription driven, pay per view only if a return channel is provided). As you can see I am simplifying a lot of the concept of business model. But what can I do with my ignorance if I have not read the tutorial on business models? Is a simple tutorial available?..'*

B responded briskly the following day:

'....what is new about this, I can do PPV[46] in DVB already and also subscription to a part of a multiplex...'

The significance of this response becomes clearer later, as B's own enthusiasm for Omega lacked conceptualisation of a credible business model. B was keen to block proposals of other applications presumably for fear of losing its own preferred application.

The first working meeting took place as planned on 8th February 2000, hosted by K, and attended by Partners L, J, and I. There was relatively little pre-meeting contribution that could usefully be debated and discussed. The attendants expressed concern about lack of contribution, wondering whether other partners were aware of their formal commitments to this module task. L undertook to remind partners of this. Participation was important for developing an understanding of the technologies being contributed, how they would inter-connect and what possibilities could be conceptualised. This clearly was difficult to achieve in isolation of others:

'we have to have information about what content is available and the limitations of the platform'.

Discussions centred on how the remaining partners could be made to participate so that application choices and decisions reflected the collective view:

'we need to make sure that all partners are aware that they committed some resources into this aspect of project....'; 'We need also to define the method of bringing in all partners so that they influence the decision which are going to be made at this early stage'

It illustrates an understanding of task requirements and the potential consequence of non-participation; an understanding of how future conflicts could be avoided by getting partners to participate from the very beginning. It is interesting that at this early stage attendees were resigned to the fact that some partners might not deliver the tasks they had committed to. But a key concern was to avoid disputes about any early decisions or choices as Alpha's work progressed:

'we may have to face the fact that we will have to decide the set of applications within [this module]. We need to make sure that the selection suits all participants and we don't have to reiterate on applications later in project'

During the meeting, K proposed a rigorous method for application selection:

'... produce a template to classify applications and clearly highlight the difference from currently available applications'

This template provided the criteria for a systematic analysis of proposals against existing applications, and guide suitable selection as an important project decision. This was received by the attendees, constructively and positively. At the same meeting, K further reiterated the problem of understanding and confusion about the concept of business models and attempted to expedite matters by giving a short presentation:

'...during the presentation it was clear that the terminology may be quite confusing for the technology oriented partners...'

[46] PPV - Pay Per View like a Movie from Sky Box Office

It illustrated K's ability to act on his understanding by providing a clarification of the concept. The selection criteria developed were broad ranging. They included aspects of commercial viability, potential for technological integration and flexibility for future adaptability.

> *'..at our meeting we agreed to come up with a set of criteria to select application domains and specific application - each partner should propose one application, argue in terms of list of criteria and have a vision on how the application should be implemented; criteria listed - viability aspects (chance of successful implementation e.g. clearly state availability, suitability and attractiveness of choice of content), development aspects (suitable for evolutionary technology, ...), commercial aspects (likelihood of being commercially successful....)…'*

Repeated attempts were made to engage the entire constituency. Subsequent to the working meeting, on 23rd February 2000, K sent an email to all partners detailing the template of criteria. K asked for contributions so that application selection and associated business models could be finalised. G followed up K's mail stating that the process was really useful and that joint proposals would be encouraged. If an organisation could not specify a particular application then they could support others in their proposals. He asked for support for his own area of interest without providing any real analysis along the specified criteria:

> *'I have seen that brainstormings (even via emails) produce great results. I think the best way is to broadcast via email among the partners our area of interest and see if there are any others who are interested in the same area: … we are interested in a kind of telelearning application.....anyone interested in the same area?'*

Despite a clear method for proposing application choices, important criteria continued to be glossed over; probably due to a lack of understanding of their significance. Instead, proposals seemed to rely on personal enthusiasm, pet interests and belief in the application. Amongst the earliest proposals was Partner B's choice of (Omega); B wrote on 25th February 2000:

> *'Omega is an interactive tv concept that works!…viability aspects …program director will accommodate the whole concept…but only when the possibilities go beyond the current…..; commercial aspects - digital tv will take off only when it adds fun to tv watching...strong concepts will generate new business and therefore be commercially interesting.....hope this is exciting'*

This email typified the lack of business understanding. Enthusiasm for a concept seemed to rely on almost no demonstrable evidence or market fit. No relevant knowledge was sought from organisational functional specialists. It seems that concepts were generated entirely on technologists' own beliefs or views.

By 28th February four suggestions were received - one (Omega) from B supported by L; two from J; and finally one from G. The latter three applications seemed to draw little direct debate or discussion. Omega was strongly supported by L, with enthusiasm and its own view of how it could develop:

> *'we propose to build on [B's] proposal - interesting dimensions for our ideas are age, gender…..with regard to commercial aspects we'll add the following arguments - application can be modified to suit other target groups of users; exposure at a young age facilitates the use when grow up; different age groups enable different versions of user interface. We can foresee a business model in which children interactively modify the user interface and determine their favourite interface ... enabling children to become involved in collecting, exchanging, and adapting objects, different versions of the content (different pricing options) become available..... yes we think this is exciting!'.*

It further indicated lack of understanding of the importance of broad business analysis. In this case, L's notion of application extension to other user groups was based on 'gut' feel. It is noteworthy that K, both as module leader and an academic organisation, seemed unable to influence or introduce rigor in the process of application selection.

On realising that choices were being narrowed down, Partner J interjected presenting an argument as to why Omega would be problematic and how J's own requirements would not be met by this choice. This concern was ignored. J also seemed to lack a fundamental understanding about the need for generic multi-network interconnectivity. It illustrated a preference and primary concern for its internal organisational benefit:

> *'we prefer applications where the network of [J] is used or where [J] will act as a service provider....2 main areas where [J] is interested - public tv with internet connection and backchannel; business tv where [J] act as a service provider....we are not quite sure if Omega will not require too much computational resources. ..our selection criteria for choice of application are mainly, that [J] networks will be used and that the internet provider may get additional revenues....'*

It was countered by this response from another partner:

> *'....the application we use must have the potential to demo everywhere in countries of the partners and cannot depend on a specific service provider...'*

On 2nd March 2000, Partner I highlighted an important constraint with respect to lack of access to interesting content, which would further limit application proposals. Although Alpha was constructed within a legal framework, contribution of content was clearly associated with some property rights issues:

> *'....there are a lot of interesting applications that we would like to do but since we don't have the necessary content or contacts to potential content providers it would amount to little more than a wish list and wouldn't help in selection.....our selection criteria that would be of interest to us would be: our background is in application development, not in broadcasting. We would prefer an application that allows a decent amount of user interaction....; we are service providers, but we are interested in the authoring process.... hence we are not interested in one application area....; we are a research institute and thus interested in demo-able applications...'*

Despite B being an owner of wide ranging content, Omega was the only application and content offered up to Alpha; perhaps because it represented a personal interest in the specific concept. It illustrates the close linkage between an application and content; content determined the definition of an application. It would be impossible to use Omega content for instance for a sports application. It is interesting that a general discussion regarding potential applications did not ensue; B might even have been persuaded to contribute an alternative content, thereby introducing other application possibilities.

F remained silent throughout this period, despite being an owner of content, particularly in the entertainment domain. This content was normally incorporated into a games platform that might be considered an alternative. F might have perceived an integrated TV platform to represent a threat to its existing platform. Later during the second year, F did contribute content to Phi. This decision was perhaps taken after assessing that Phi did not conflict with its platform: a sharp contrast with a children's story telling programme.

B's response on 10th March, in defence of its proposal was based this time on a different premise. It illustrated B's awareness of EU's desire for networking:

> *'....one point that probably is a strong point to Brussels is that [Omega] is the program that is a result of the [EU] tool development project in ...I think that the Commission will like that, building on knowledge from other projects... The other positive point is that at the Milia show in Cannes there was a lot of interest from broadcasters all over Europe.....'*

Once again there was little discussion or concern for commercial potential of Omega. B also argued against J's proposed e-commerce application, suggesting that other EU projects had already addressed this (recall B's argument against G's proposal earlier for pay per view content). Once Omega had been selected, the same applications and models seemed to elicit little concern from B).

> *'..many European projects addressed this in the past and future. We also can use [Omega] to demo e-commerce possibilities...'*

J countered B's response, stating that Omega was quite unknown outside the Netherlands; its acceptance in other countries was an unknown quantity. This important point was not discussed or pursued further.

Partner A proposed two applications without specific details again illustrating the content constraint:

> *'but need further information on them in terms of potential problems concerning rights to the material and availability to project partners....'*

Alpha's first formal report lodged with the EU on 31st March 2000 reiterated the starting goals and seemed to reinforce the purpose of the business model module. Its tone of this statement however was normative. It signified an understanding of the module's theoretical significance and interdependence with the next module:

> *'This report is part of the first phase of the Alpha project in which a review of business models as well as choice of applications is addressed; .... all of this requires new business models that are more flexible, adaptable and better attuned to sensing market shifts. The only possible survivors of this emerging scenario are players able to adapt, learn by doing, and open to adjustment as they go along... the aim of this document is to report on a set of reviewed business models, and the possible set of applications domain and specific applications that should be implemented in the Alpha consortium ....the future of these potential applications, i.e. the fact whether revenues can be generated by means of these applications, will depend on the new business models to be defined. Note however that the related business activities are interdependent with respect to the technology.... criteria to select applications: description aspects should clearly highlight differences from products / services already in market place; development aspects; commercial aspects i.e. likelihood of being a commercially successful; viability aspects i.e. chance of successful implementation..... the applications that will be chosen and their requirements will guide the integration of technologies in a complete end to end prototype. The future of these potential applications, from a revenue generation perspective, will depend on their associated business activities....'*

Following the submission of this report, on 5th April 2000, at the second technical meeting, a further discussion ensued about selected applications and associated business models. K described a number of existing business models with the intention of identifying a fit with

Omega. Phi already had an e-commerce model that seemed to be maturing in the marketplace. Although the starting plan was to define business models and then select applications, the reverse was underway; it illustrated a process adjustment. The formal report at the end of 2000, confirmed this. It stated that two applications were being developed, which would

'*induce different business models*'.

Partner G had suggested a tele-learning application but also conceded its budgeted resources would limit its development. This revealed a significant process change in how applications were developed. The starting conditions had defined the constituency responsible for application development. In other words, this constituency would develop an application irrespective of what it was. Yet, it now seemed that the proposing partner now was required to provide significant resources towards its development. Presumably those partners with under budgeted or limited resources were less likely to propose an application; whereas the technology developers had hooked up with applications already under discussion.

It seemed that L's support for Omega endorsed its selection; it is unclear whether the project coordinator role conferred a greater degree of power and influence. L wrote:

> *'..while no formal decision has been taken, the consensus seems to be that application 1 (Omega) will obviously be one of the applications chosen. What other applications will be chosen will depend on additional information from A, who presented a set of 4 applications the day before ...'*

No clear evidence of consensus building was seen; silent compliance was taken to mean consensus. Partner J highlighted a potential problem with Omega; an issue that seemed important yet glossed over. Omega's key users were children; they could not be asked to participate in the formal audit review of the demonstration. Presumably, concept demonstration would be expected to be of key concern for the constituency. Despite raising of a number of potential problems with Omega its selection went ahead.

Once application selection was made, Partner A flagged up a need to involve business development people in the technological development. On 2nd May 2000, he wrote:

> *'....the objective of this task is to get the right people from the business units of our company to define one or more meaningful profiles (I'd start with one..) that will allow the creation of the economy between producers of content down to its consumption....how this is done - the definition has to come from the business part. We need therefore to make a serious effort in getting in touch with these people and getting their feedback...'*

Partner G concurred immediately:

> *'...Yes! Practically I think we cannot achieve this goal if business units do not start working in collaboration with designers on REAL scenes....'*

Partners A and G had both recognised a need for specific knowledge need for the task yet they could not effect it. Over the following weeks, there was little involvement of business development people from any organisations, even from within A and G. It is possible that these

inputs were not sought in fear of the concept being rejected rather than supported by these people.

Interestingly, external reports continued to state that business models and market orientation were the key driving forces to technology integration:

> *'....project will follow user-centred methodology, implies that user requirements and accompanying business models are determining the course of the project. The technology is the enabling and maybe limiting factor....'*

> *'... new business model for itv are being investigated by Alpha. The project is studying interactive models of consumption, such as those used on the web and transferring them to the tv environment so as to achieve greater involvement by viewer....'*

In order to move this continuing issue forward, the meeting of 13th June 2000 attended by G and K agreed that Partner K should make direct contact with the organisations to gather insights into business issues. It should also contact the EU for relevant knowledge from other projects. It seems that K was charged to effect involvement with organisational colleagues that technologists had failed to do. Yet, even by as late as September 2000, there was little progress on how economic value would be exhibited from either of the two applications.

At the working meeting of 26th September 2000, H suggested that it might help if an analysis was done of the fit of the applications with the business framework. This idea was ignored. There was no evidence that K attempted to contact the organisations as tasked to do earlier. Based on individual experiences and understandings, the attending technologists made various suggestions about how revenues might be generated. B proposed Pokemon[47] cards based business model concept for Omega.

J requested:

> *'.... the business model should present some quantitative data as a decision instrument for product managers....'*

Although K agreed, he highlighted the problem of gathering the relevant knowledge from the constituent organisations. This might suggest that K had tried to make contact without much success:

> *'..... this is a very sensitive issue since key actors are unlikely to agree to disclosure of company figures...'*

J wondered whether figures could be approximated:

> *'...validation phase also involves assessment of business models. Is it worth providing some hooks to remind users (final and stakeholders) of business model behind the application. This could help what business model is in evaluation, and facilitate feedback from users. Depending on application, the cost of such hooks can be estimated...'*

[47] Cards have passwords to access certain aspects of a programme. Children engage in purchase and exchange of cards to experience different programme aspects

J had previously raised the problem of formal demonstrability of Omega, yet its approval was not discouraged. According to L's email, it would also seem that there was now an implied acceptance that discussions would remain within the technological knowledge domain:

> *'Partners recognised that Omega is not suitable for this type of analysis, as children are the users and cannot be asked such questions. [Phi] application business model is already clear. In any case such kind of analysis is quite difficult for different reasons - analysis involves marketing experts and psychologists; information gathered could be sensitive, most likely biased and not easy to obtain. For these reasons the hooks are unlikely to be given in the project...'*

By January 2001, Alpha's midway point, technologists were busy developing and integrating the two applications without concern for involving partners tasked to develop the business models. K was unaware of working meetings and the nature of developments being undertaken. Presumably technical communications were undertaken using specific task specific distribution lists. L asked the teams to involve K:

> *'... Concretely, some of the technical meetings are vital for [this module]. K should at least be aware of these meetings and have an opportunity to attend if technical meeting is relevant to its activities...since the development of applications is closely related to the business models developed in [business model module], K should be notified about further meetings of [Phi] and Omega groups and their corresponding agenda..'*

It is noteworthy that despite a lack of real progress on business models, L presented Alpha's goals to an industry gathering in April 2001 as follows, which contradicted the internal reality:

> *'Business models for both applications will illustrate revenue streams and marketing perspectives and demonstrate the effect of an end-user centric approach to application and business development...'*

The EU audit at the end of 2001 concluded:

> *'the subject of Omega application was probably not the most challenging but still absorbed a lot of resources....'*

Partner B had spent a significant amount of time and resource in its development and probably had accrued a great deal of internal organisational benefit.

Alpha's self-assessment at the end of the first 12 months acknowledged Alpha's complexity and the necessity for organisations to communicate and work together. At variance with informal documentary evidence the report suggested that discussions between technologists and business people had been effected:

> *'...a considerable effort was invested in facilitating cooperation and networking between all partners. Four 3 day working meetings with all partners were held to foster communication and working relations...Since the expertise of the consortium partners covers the major links in the end to end chain for delivery of content to consumers, people with different backgrounds and expertise in very different disciplines e.g. engineering, design and behavioural sciences had to learn to operate as a concordant team... The collaboration between partners is high, the dialogue between engineering, business and behavioural trade-offs proves to be challenging and fruitful and the developments look promising. The project is confident it will achieve its goals in the next period...'*

It was difficult to determine the basis for selection of Phi, other than the fact that G and J could contribute the necessary content and were keen to develop the concept. Both partners had

jointly proposed this application but discussions about its development only began in November 2000. Its business model was based on Internet's electronic shopping - considered 'nothing novel' by some participants. It was selected at the peak of the internet boom, when e-commerce was viewed by many organisations as a path to organisational success in new media. Phi's development continued to relative success despite G's withdrawal from Alpha during the second year.

8.5.1 Summary of Business Model Module

The key observation in the development of this module was repeated cycles of blocked social learning. This affected the task coherence; coupled with contextual constraints it contributed to a weak performance outcome. It is noteworthy that this poor performance outcome was similar to other IDT developments in the marketplace (see Chapter 4). Calls by executives were made to technologists to be creative in thinking beyond technology and think about business models (itvt). Various seminars on the subject of business models were on offer to industry participants at conferences.

The initial assumption that all necessary organisational knowledge resided with the engaged partners and would be willingly contributed, was not entirely correct. Technologists as key participants in Alpha lacked the necessary knowledge and market orientation. Moreover, they did not seem keen to mobilise this knowledge from their organisational colleagues. By contrast, smaller organisations possessed a broader business perspective despite their technical background; this was probably because their organisational roles were less specialised. Despite developing an understanding or learning about what knowledge was needed to complete the task, opportunities for action were either not taken or could not be taken. Whilst application selection was to be based on rigorous analysis, this did not happen. Application choice was champion-led with little obvious concern for market potential; business models seemed of peripheral concern. Yet, formal reports stated how the selection process would be thorough and systematic, sensitive to prevailing market conditions. This illustrated an external reality created for sponsors and industry that differed sharply to that internal to the project.

Despite some disagreements, there was surprisingly little organisational conflict throughout the module. The task was further constrained by limited availability of broadcast content. As a result, a narrow range of applications was considered. Efforts to explore contribution of other content by content owners were not made. In the chain of IDT it would seem that owners of content hold a significant amount of power[48].

The module was led by K, an academic partner assumed to possess the relevant business analysis knowledge. Although it devised a comprehensive list of selection criteria it was unable to influence selection process rigor; organisational frames of reference were markedly different. The module might have benefited from a sustained 'leader' who provided a broad vision of its

[48] Consistent with the evidence from the Premier League Football content prized by digital broadcasters

significance and technological interdependencies. G seemed to exercise this role spontaneously in bursts of communications, but not in any sustained manner.

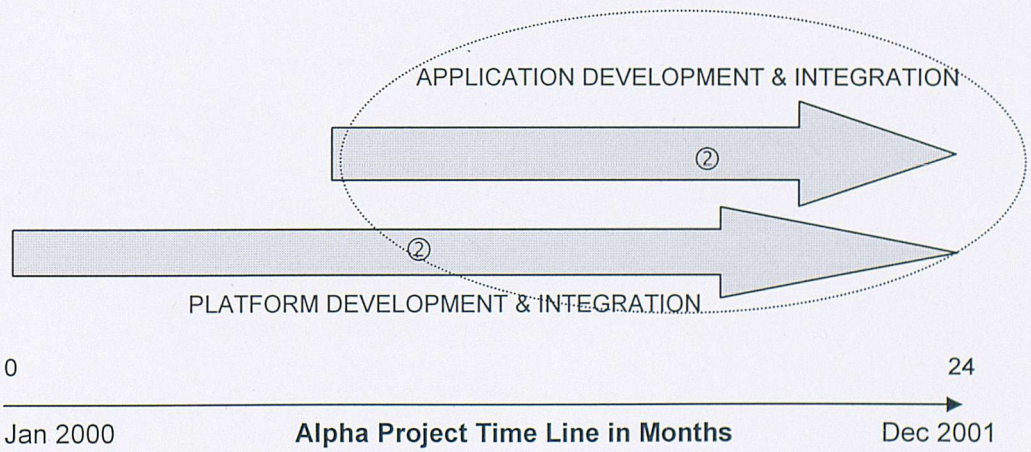
The starting conditions stated that application development task would be undertaken by the specified team that had the necessary knowledge irrespective of applications chosen; yet the task structure and interface were changed, which constrained some organisations' ability to propose applications. Interestingly, the same set of starting conditions proved highly generative in the development of the next module.

8.6 TECHNOLOGY INTEGRATION MODULE

This module (the second temporal bracket) occupied second position in the priority order of Alpha's starting goals. It resulted in a higher success outcome than the first module. The theoretical explanation of why this may have occurred is presented in Chapter 10; here some key events are described and traced that reveal the story of technology integration. Although the starting construction suggested a broad action plan of what had to be done, the dynamics illustrate an emergence of organisational groups that evolved around core application technologies, delimiting the scope of technologies first defined. The groups are conceptualised as Communities of Practice (Lave & Wenger, 1991; Brown & Duguid, 1991; Wenger, 1998) that created highly generative learning conditions. This theorised concept is discussed in greater detail in Chapter 10.

This module can be imagined to constitute two elements: I) development of a generic platform and 2) integration of application specific technologies. The platform consisted of technologies that enabled supply and distribution of content and its receipt by the user. Technological work on the first element was scheduled to start 1st January 2000 in parallel with the business module; its nature was relatively generic. In other words, it was independent of the application selected. The output of the first goal (business module) would feed into technological development at month 7; this would constitute the second element of this module: integration of application specific technologies depicted in Diagram 8.4 below.

DIAGRAM 8.4 TIME LINE OF THE TECHNOLOGY INTEGRATION MODULE



H was to lead platform technology development and Partner I, the development and integration of applications. Platform technology development consisted of hardware and software technologies; application development however was largely based on software technologies for subsequent integration into the hardware. This enabled a great deal of transfer and development to be undertaken at individual partner sites, for progressive aggregation through electronic file transfer. Aggregation was undertaken in small technology 'chunks' with progressive refinement through testing. In other words, there was an ongoing process of refinement between the different components. The partners that developed Phi particularly acknowledged the benefit of software based integration. They felt that updates of any emerging technological standards could be integrated relatively easily. H would manage the final integration of both applications with hardware technology.

Like the previous module, platform specific activity was introduced to partners at the two-day project start up (PSU) meeting on 18th January 2000 held at a European partner's facility. It was represented by the entire organisational constituency. With the exception of K, all organisations were to have a significant role in this module. Because of the unique and interdependent nature of technologies, their participation was expected for the entire duration. Technological integration would occur through a process of social interaction, discussion and refinement. This would suggest that participation failure by any partners would negatively impact Alpha's performance. The events and dynamics of the module illustrated reduced participation and disengagement by at least 2 organisations. Yet Alpha's overall output did not collapse. Failure was probably mitigated by: a degree of overlapping skills that enabled some task absorption by alternative organisations; and clustering of organisations to form two learning groups. These groups integrated technologies by redefining and delimiting technological scope. This led to a sense of common purpose within the limited group and championing of specific technologies being integrated. It illustrates readjustments of project goals, expectations and tasks. These groups are later theorised as Communities of Practice (Lave & Wenger, 1991; Brown & Duguid, 1991; Wenger, 1998).

Like the previous module, this module represented critical project activity but lacked momentum at the start. In particular, without a successful module output, technological concept could not be demonstrated.

> *'...we need to come up with an approach that will bring all partners at this point in the project.....'*

L sent an email to all partners on 1st February 2000, asking for a list of technologies to be contributed. It illustrated some flexibility for organisations to offer up technologies they wished to contribute, but also a mechanism to effect contributions:

> *'...as you will remember from the PSU, partners F, G, H, J, I, E and D promised to contribute to this deliverable [Platform development]. I propose we start with an inventory of all the technologies that we want to include...'.*

G provided a guiding role at various times; an example is his reminder on 9th February 2000 setting out the rationale for a list of inter-dependent technologies. He argued that this process

would enable mutual understanding; by making transparent who was contributing what, it would also help to show equity in the collaboration. He also implied that if organisations failed to offer their technologies, the module leader would propose them according to the technological domain. This would presumably be based on his own understanding of what was required:

> *'..as a reminder - let me try to explain what the idea about contents was ...we can change it, but I believe you will understand....to do what we want, we have some technologies available, and each company more or less expert in each. Moreover each company has some development ongoing related to each....eg. [L] in MHP-DVB; [G] and others in MPEG2/4 not 7, some in HTML....this should harmonise the knowledge that is interspersed among the partners, give visibility to everyone..... To explain better I propose a tentative TOC[49], as a general matter in preparation of a deliverable, WPL[50] starts a tentative list of subjects indicating subject each partner can contribute; partners reply indicating additional/alternative subject they can contribute... WPL tries to avoid uneven load (partner that has a lot of resources but very poor contribution or vice versa).....this procedure can be improved - comments and objections are expected...'*

Technological boundary had been defined at the outset, yet the conditions were conducive to make changes and therefore changes to project scope. For instance, C wrote on the 11th February 2000 with a request to include a technology that specifically fell outside Alpha's scope[51]. C made a proposal detailing his view of its benefits, seemingly understood and supported by G:

> *'Sorry for joining late...we, [C], are expert on MPEG7. We are looking for a possibility to introduce our MPEG7 technologies to this project...'*

> *'..if this is the case, let's reintroduce MPEG7 into the TOC....I see, ...it was just an example which makes some discussion to come out...that's exactly the purpose of this technology assessment....having this document done means discussing it...'*

G had prior collaborative experience with C and clearly wanted to accommodate C's technology. G's wholehearted support for this probably reflects satisfaction with prior organisational contributions and outcomes. C's conceptualisation helps illustrate the nature of the knowledge, its creation and transfer; organisational ability to envision this knowledge and its technology scope in a particular way might not have been possible by other members.

Partner J was participating in a parallel EU consortium called BASE. Its technology (the BASE player) would be borrowed by Alpha for further development. Presumably any delays in completing BASE technology would adversely affect Alpha's integration process. This again illustrated a path dependent nature. J identified what technology it could contribute if the BASE player was developed:

> *'...we would like to deliver an overview of digital video in general....moreover we think an additional survey on ...is relevant, here we could contribute something too....for integration of 3D player we are heavily relying on technology to be developed in BASE project...'*

[49] Table of Content
[50] Work Package Leader
[51] MPEG7 was expected to be released as an international standard during late 2001. It defined the formal description of multimedia content enabling search and retrieval of multimedia objects in hybrid networks and platforms

Alpha was required to obey EU's golden rule: to use open standards in the integration effort. Therefore awareness of changes or modifications to standards was critical. Contributed technologies would have to comply with these developing standards. If they did not, they would have to be adjusted. It is interesting that C's nationally approved standard[52] was rejected in Europe, yet C deepened its commitment and began to play a bigger role in Alpha. It contributed to Alpha's overall integration using the European standard and developed a parallel integration of Phi using its national standard[53]. This presumably was approved by the entire constituency to include their technologies in that integration. C learned and benefited greatly from Alpha; 3 patent applications were submitted in South Korea for technologies it was able to develop during this period.

This email from K on 12th February 2000, illustrated a contextual understanding of emerging technological changes, its likely impact on Alpha and a process of enabling group awareness:

> *'MPEG, HTML, DVB, MHP are important standards enabling future services of interest in Alpha. However, there are 2 other standards that we need to keep in mind - FIPA, OPIMA ([with this] we can satisfy J's concern about security etc), OPENISE….'*

As ideas and suggestions were tabled, there was a great sense of ease, willingness and enthusiasm to carry out collective tasks; misunderstandings were clarified effortlessly and with good humour. Partner J:

> *'…looking at the proposal from L, I'd like to add under item 1…..I am willing to produce a short paper that could be added to our actual list …..if there are no objections against it…'; '….I will do the …. over …..'*

In reply to an email from L intended to be interpreted by partners to provide information with respect to their technologies, J wrote:

> *'I interpreted it differently. I assumed that we should write some overview on the topic...'*

In most instances, mutual understanding was reached with relative ease. Despite the diversity in national origins, there were remarkably few misunderstandings. Partners had a flexible attitude to adjust tasks in accordance with group opinion, an example seen from G on 18th February 2000 to L:

> *'…. our contribution is bigger than what you requested. If you need us to shrink it please let us know….'*

This probably reflects differences in individual conceptualisations of how technologies might interact.

Alpha's goals and expected outcome were presented to an industry conference during February 2000. It suggested an understanding of how this module would fit with the rest of the project task. Their inter-dependences for overall performance were implicit:

> *'The realisation of the experimental application and the use of test beds already in place at time the project will reach maturity will allow the whole chain, including the final*

[52] ATSC - See Chapter 4 for details
[53] The parallel concept used the same principles of Phi but with local content containing national language as spoken words and symbols

> *application, to be tested in place with real users. The user feedback will allow to gather essential information about the possible actual realisation of the business model as well as the relevance of the new interactive multimedia content that they will have consumed..'*

Encouraged by the EU through bulletins and notifications of upcoming industry events, every opportunity was taken by the membership to give Alpha visibility at various forums. Alpha's broad concept and technology development was not kept a secret amongst the constituency. Through various industry forums, organisations would inform other industry players of the concept, any technological difficulties experienced, how the difficulties were tackled and what progress had been made. It illustrated a desire to share knowledge in a way that influenced the developing standards. The forums also provided opportunities to generate other organisational linkages.

A number of technologies were noticeably championed by some organisational partners. During March 2000, as technologies began to be put together for the platform development, a small group of partners (B and C, with other non-Alpha partners), led by G, presented a small integrated technology[54] to a standardisation body. G held a key position in this standardisation body. Present in this forum were industry players external to Alpha. The presentation elicited discussion and improvement suggestions. It was considered a highly successful endeavour and '*received with a great deal of enthusiasm*'. Comments and suggestions were fed back to the rest of Alpha constituency. As other Alpha partners became aware of the demo further technical questions were raised as they tried to understand the technology. This led to further knowledge creation. E.g. email from G to J's technical question:

> *'...as you may understand from the early date of the demo, the bricks are G background, while the stream is foreground. This does not mean that we cannot arrange NDAs to give some pieces of this background! I think that to have a 3D demo some pieces can be reused. However you should send me a clear description of the 3D setup so that I can try and understand which pieces are needed on your part and which are reusable on ours.....'*

This demonstration of technologies was the first of many similar presentations to different clusters of partners. Technologies development was clearly non-mechanistic; a great deal of conceptualisation of technologies, and trial and error learning ensued. When necessary, new knowledge was created through questions and idea generation with external organisations accessed through networks. Alpha's structure and module conditions seemed conducive to this.

At the first quarterly meeting during April 2000, two partners (J and A) highlighted the problem of under budgeted resources. Their concern was that without these resources tasks would not be fulfilled in accordance with their starting commitments. Individual organisations were at liberty to increase the resources at their own expense but the cost could not be passed onto the EU. Advice was sought as to how to deal with the problem:

[54] Over its 24 months, 16 public demonstrations of different clusters of technologies were presented internationally, to audiences consisting industry and standardisation bodies

> *'Partner A wants to know formal procedure for extension of project as it does not have enough manpower to do promised work. Not enough claimed during negotiations because of internal reorganisations and wants to apply for extension of 46mm*[55]*...'*

Although Alpha's overall structure like its 24month timeframe were fixed, efforts were always made to accommodate resource changes by renegotiating other tasks and relative contributions. Partners expressed doubt if any changes were thought to impact their work. For instance, H was unsure about the impact on platform development if A was allowed to make a resource swap:

> *'Partner A also wants to move 12mm from [platform development] to [application integration] to spend more time developing the application'*

> *'[H]...wants input from technical meeting...request is granted on the basis that should the technical meeting suggest otherwise the move will be reversed'.*

A great deal of formal and informal networks and external knowledge were relied upon for refinement of organisational and collective technologies. G used an external subcontractor to refine its own technology. Inevitably, different views on specific needs for technology refinement often ensued presumably because one partner's conceptualisation of technologies differed from another.

This is an example of different view points: At the review meeting of 4th April 2000, G announced its intention to optimise some of its technology by appointing a subcontractor. Alpha would suffer no budgetary impact as costs would be borne by G. Partners' permission was needed as some project details would have to be released to the third party; without this consent, G could not proceed. Partner A viewed the refinement as unimportant. He argued that this was something that may not be needed in Alpha after all. G disagreed and insisted that Alpha did need this technological enhancement and moreover, it was *'important to [G]'*. To help resolve the issue, the group decided to discuss the issue during a technical meeting the following day. It illustrates a tension between individual and collective goals and different understandings of technological needs.

G's prior collaborative experience contributed some insights to the project that G felt would help with overall performance of Alpha, but this fell on deaf ears:

> *'...I learnt from other projects in terms of evaluation and assessment - we should have appropriate resources allocated - 5-10% of total project resource and a professional evaluator....'*

As Alpha progressed, there seemed little formal discussion about analysing potential competitor firms or their technologies. G produced a list of firms and technologies and assigned them to different partners for continuous surveillance, assessment and report of likely impact[56].

[55] Compared with its total 20mm budget, there was a significant budget variance. It also indicates a great desire to remain in the collaboration

[56] including MicrosoftTV and OpenTV seen as competitively similar to Alpha

Use of email as a means for communication had potential for problems, as seen in this email from L dated 28th April 2000:

> *'I goofed up in a terrible way. I sent an email to you and gave it a wrong address. I found the demon after I returned from my vacation. My apologies for this……the most important action point of the meeting re: applications was to resolve the 'content issue' for the applications i.e. telelearning and shopping proposals - this is a discussion between G, J and A...'*

Such errors could potentially go unrecognised, resulting in unnecessary delays in project activity.

Over the next month, technology integration progressed in a piecemeal fashion; ideas were tabled, discussed, and problems were solved.

> *'.....the objective is to define the missing glue in order to integrate mpeg4 on existing platforms…'*

Technologies were progressively aggregated at different partner sites according to the tasks being undertaken: by electronic file transfer or through actual transfer of tangible hardware technology. This is illustrated in the following textual excerpts. There was a clear need for technology to be created by individuals within the context of the aggregating technologies. Knowledge enactment was individual, social and situated.

> *'J installed a Partner H…. hardware video decoder and successfully played back movies from a local disk and DVD…'*

> *'L is to coordinate a working meeting on … STB which will be available at sites of A, I, B and L. In conjunction with this working meeting a planning meeting for technical implementation of the applications will be organised..'*

> *I like the opportunity…. we have a lot of ideas... The difficult part is to find what can really be implemented at the moment and on what kind of platform. Next week we as a team will meet to discuss this....I know that G, and their teams are working very hard on the AIC… demo at the moment and I hope that will give us info how to proceed further. Another possibility can be to concentrate on audio. I think that 60% of the experience of tv is the audio and in audio MPEG4 promises a lot of very nice features like structured audio. If we can enhance normal…. with a very realistic….. effects, that will convince people also I think…'*

Technological modifications were discussed and adjusted as external contextual knowledge and understanding developed. For instance, it became apparent that STBs were now being developed with immense storage capacities[57]; Alpha technology would have to accommodate this capability immediately or prepare for future potential. Other contextual developments included changing standards and the likely impact on Alpha:

> *'MPEG Corrigenda has an impact on [platform development]…will have to update the players for the Alpha platform in order to keep aligned to the corrigenda on which the project relies for the implementation of the multimedia services for digital tv…'*

> *'at this stage, the impact of MPEG21is almost meaningless. However, [business module] and [platform development] are encouraged to keep an eye on the*

[57] By organisations such as TiVo

development, in order to foresee hooks in the production / consumption ...in view of a prospective extension of the project'

Similar product developments in the IDT domain were compared and assessed for impact:

'OpenTV does not aim to combine the two media types into one functional product unlike Alpha...where the market is going to....our project is based on MPEG4 capabilities. This standard is going to be one of the next international video/streaming standards...'

Over the course of the project, a stream of new organisational participants was introduced as additions or replacement of those that had moved on. They were usually brought up to date about project status by principal organisational representatives. By July 2000, plans were underway to construct a future collaboration. Its objective would be to develop the technological output from Alpha. This was driven by Partners A and L, presumably confident in the knowledge that something useful would result from Alpha. Few Alpha partners responded to the call[58].

By early July 2000, it emerged that Omega the children's story-telling application would be adversely affected by the technology being borrowed from BASE consortium. The nature of the Omega application required multi-user capability. BASE was already delayed and was unlikely to have the necessary capability. Alternatives were sought which might at least support the main functionalities until BASE became available.

The complexity of the technological development, Alpha's organisation and process illustrated that no single person had full knowledge of the task at any given time. Partners would define in broad terms what they planned to do and they were trusted in how they accounted for their contribution, as seen in L's email of 4th July 2000:

'....according to the technical annex all partners have some manpower allocated to this work package but only little information is available so far on how the individual partners intend to spend this...would each partner send this information asap'.

During August 2000, integration of C's injector technology with G's player technology was carried out at G's facility aided by a physical relocation of two people from C. It illustrated the strength of commitment of the two partners and flexibility to adjust the process interface.

As technologies were integrated, technical questions were often answered using informal networks of experts:

' a question for mpeg4 gurus...for the Omega application....we have the following questions...is it possible to do.....; is it possible to change the viewpoint of the screen as part of.....; is it possible to slide the viewpoint through this big square and switch channels?. We don't want that. We want to slide from one corner of the big square to some other corner.....can the players handle this? I attach a sketch to illustrate what I mean...'

H wrote to a technology expert:

[58] In fact the next collaboration consisted of 4 partners from Alpha (B, I, K, L) and five others. Partner A had initially expressed a desire to participate but did not proceed

'see this question from an Alpha partner. Can you confirm that the 2D player can indeed do it?'

H had access to a diverse network, with knowledge of who could best deal with specific technical problems. He wrote to yet another expert, the question and response here:

'...can you help me answer the guy on his question below?'

'..let's try....this is what I did and here is how it works....beware that.....hope it helps.'

'Thanks, sounds kinda non automatic cq experimental. Not to say challenging. I will first try to find the samples and then try to get them working....'

In September 2000, the alternative player used for integration of Omega began to encounter technical limitations; MPEG4 could not be synchronised; an alternative would have to be found. A great deal of individual knowledge consisted of making links with and seeing the possibilities of technologies outside Alpha. E.g. B had seen a player at a conference and felt it could overcome current limitations. The technology was owned by an organisation that was J's subcontractor on some other work. B wrote:

'...as [ ] is a subcontractor for J in Alpha we will make it a subject to discuss at next meeting and ask J to help evaluate and consider use of this player for testing and user tests..'

J responded as follows:

'...the short answer is no, J has no knowledge of this player as [ ] is subcontractor in another area'

Unlike H's willingness and ease with which relevant knowledge was imported on many occasions, J was reluctant to contact its subcontractor. Perhaps it sensed a conflict of interest at intraorganisational level.

Through September and October 2000, a number of integrated test scenes were created by Partner I; G and C's technologies seemed to be running smoothly. BASE player was still awaited as reflected in J's email of 7th November 2000:

'....after a long walk through administration (in older days we would have called it bureaucracy) I am glad to inform you that the BASE player can now be downloaded from J ftp site....please remember that this player is 'Alpha owned' and therefore you are not allowed to give it to someone who is not a project partner...'

BASE player was finally integrated but as anticipated, it began to demonstrate limitations; many requirements could not be fulfilled. L announced that Partners L, B and I would carry out Omega integration; other partners would not be needed. Technical questions relating to the 2D and 3D players would be directed to H/G and J respectively. An informal group seemed to have emerged. H offered to extend the 2D player owned by G as an alternative but the group failed to respond. It seems that the group decided to make significant changes to the technological boundaries and the integration. Boundaries were scaled down; focus was shifted away from MPEG4 technology, deemed *'not opportunistic yet, maybe in a later stage'.* Instead, MHP standard was implemented using L's STB. This illustrated a readjustment of the initial goals,

tasks and expectations as a result of understanding the various constraints. H asked L to explain the role of its STB in Alpha, which suggests that the group had introduced this technology without a great deal of discussion with the rest of the project participants.

Meanwhile, concern was expressed about D's contribution. D, a US based owner of an important, generic technology had made no contribution since attending the start up meeting in January 2000. This had resource implications for the project. L's efforts to make telephone contact elicited limited information. It led L having to write to D during September 2000. D responded claiming a misunderstanding regarding its level of involvement. D expected to participate in discussions and problem-solving relating to its technology and not as a collective activity. It regretted the misunderstanding. Interestingly, L's polite note in return apologised for not ensuring that D had fully understood the task. Yet, the roles and tasks were clearly set out in the DOW and were discussed at the start up meeting and furthermore, D itself had stated its expectation of participation (See Table 8.2). D was on various email distribution lists, and had been a recipient of project emails but had failed to participate in any discussion whatsoever. L's STB contained D's generic technology, presumably explaining L's delicate handling of the issue of participation.

Twelve months after the start of the project, on the 10th January 2001, D confirmed that it would not spend any resource[59] in Alpha. This created a resource problem for Alpha, as D's US government funding could not be transferred to non-US partners. L wrote:

> *'L will not spend their manmonths on the project. Their activities will remain in conform to the DOW, but they will not claim 13 manmonths. Since the actual funding comes from the US government the project cannot use these resources for other purposes...'*

It is interesting that the formal monthly reports for the entire year did not refer to D's lack of participation. In fact the final report stated:

> *'D has indeed considered the initial plans of the project team as very important. The team has been in close contact with D through various channels, one being the fact that D is a partner in Alpha, another important being its role in development of MHP standard...'*

Impact of D's lack of input was minimised as L ensured that necessary technological knowledge was elicited from D's technical support department on an ad hoc basis. F too, reduced its input over the course of the project. Its role was to optimise and develop the generic technology incorporated in L's STB. The refinement had in fact taken place by the technology owner in response to a market need. F's resources were therefore transferred to other partners.

All project communications (email or meetings) were carried out in English throughout the process. Video and telephone conferences were organised on an ad hoc basis for technological problem solving. Other than an email from L to C on 27th September 2000 making a reference for the participant to be able to communicate, few difficulties of understanding seemed to arise from national language differences,

[59] represented a shortfall of 18 man months equivalent to 4% of Alpha's total resource

'tell us who will work on the Phi application (with names) and make sure that this person can participate to the Phi video-conference on 6th October'.

Participation implied here in this text was not just a logistical availability but an assurance that the attendant spoke and understood English and would be understood by others. This deeper meaning was reached from other evidence too.

Midway through the project a self review report had to be submitted. This excerpt illustrated the formal process for claiming funds from the EU:

'Dear all, today we have a deadline to deliver input for review report for L. I missed this deadline due to the fact that most of you (8 out of 12) did not provide any input to me yet.....I cannot invent this information myself because for many of you I neither know what you have done in the reporting period nor what your plans for the next period are.....for activities which are not mentioned in the report you might have problems later on to claim for the money....'

L's mid-project report to the EU acknowledged the modular and technological interdependencies and associated complexities:

'...application development is at the cross-roads of business model framework, content consumption, production and platform development. Communication and knowledge transfer between these different parties are crucial to achieve results. A major lesson learned during this first period of project was never to underestimate the complexity and intertwining of the dynamic relations and dependencies between these entities...'

'Technologies have to be communicated in familiar terms to professionals in media authoring and production domains...'

During January 2001, the task of integrating Phi with the platform technologies was undertaken by J, G, H, C and A. Technological developments in the form of test streams were posted on secure websites for partners to download and test with their own technologies. Contrary to theoretical assumption about technology interoperability, various technological compatibility and performance problems were encountered.

'....issues that continue to be discussed off line are how to implement broadcast interface; what development is ready for integration; is there any receiver that can handle the interface; is there any potential.....; what do we want to have in the end; the player should be STB not Alpha PC; one demo should be done on a real PC....'

Further readjustments of project conditions ensued with respect to how the goal of user trials would be fulfilled. User trials were an important task, as user feedback would enable technological refinement. Two technical working meetings during January 2001 were devoted to this issue. A re-conceptualisation of the task and rationale of user trials was proposed by L:

'our current understanding is that user trials and technology implementation have a common starting point; from that we follow 2 paths - user trials are meant to get actual feedback on concepts and not to test technology; the technology implementation is meant to show that based on commercial available products a first realisation is made. They are not necessarily used to do user trials with'

Omega's integration was readjusted by excluding MPEG technology. This group looked for options for user testing. L's assumption of how this would be done varied with the understanding of others '*partners did not share the same vision on this issue*'. The starting plan

clearly stated that any integrated technology would be subject to validation and testing. L now proposed alternative ways to demonstrate user interactivity without a need to use a fully integrated technology - *'a mock-up that may be anything even a Power point presentation...'* L seemed to be driving what would be done and how it would be positioned with the EU. L argued that placing a greater emphasis on the full concept would take attention away from illustrating technological integration. A skilful management of EU's expectations was planned. The rest of the group finally concurred with this suggestion.

During February 2001, market intelligence of technological developments revealed a BBC project with similar technological architecture; its main difference lay in the way the content was generated. BBC had used live actors and camera shots for content whereas Omega used studio-based synthetic authoring tools. Otherwise, distribution and display were constructed similarly. This reinforced the fact that the broad technological architecture was in step with how the market seemed to be developing.

> *'BBC's Prometheus Project - defines a basic end-to-end system architecture. Parts of this architecture share the Alpha architecture. The main difference between the two projects is in the generation of the content: Prometheus uses real live actors and camera shots for content generation and therefore needs to extract or separate the different mpeg4 objects from live scene with motion capturing and tracking. Omega application takes a different approach - content is authored directly in studio using synthetic authoring tools. Despite the difference in content generation, distribution and 3D display of content can be shared because they both are based on.....'*

By March 2001, C had made tremendous progress with Phi. It integrated a parallel technology using local content (and language) and utilised ATSC standard. Its resource commitments continued to increase, far exceeding any other partner in Alpha. In total C spent four times the resource initially planned. It was clearly satisfied with Alpha's efficiency and had deepened its commitments to it.

During early April 2001, Partner A announced that its resources had been used up; no further contribution could be made to develop Phi. In fact A had integrated Phi with a proprietary player that would need its owner's permission for use in the demo for EU review. This was an example of activities undertaken by some partners at their own discretion, with little direct benefit to the collective project. J's resources were similarly limited, so transfer of A's task was not an option. G offered some resources to enable A to integrate Phi with the BASE player; Phi integration progressed slowly.

At the July 2001 review meeting, H was asked if extra resources would help accelerate the platform development. H suggested that the application development task was a bottleneck and probably in greater resource need. Partners were also reminded of previously reallocated resources by G to A.

As H set to integrate its technologies with the BASE player for subsequent Phi integration, an important concern about property rights was raised. BASE had been borrowed by Alpha on the basis of open standard. Yet, the legal consequence seemed unclear. J thought that it could not

be shared with non-Alpha organisations. This also raised questions whether its demo for formal review would contravene property rights. L undertook to seek clarification from its legal department. At the same meeting, G announced its intention to stop participation as a result of organisational changes[60]. G's remaining tasks of user testing and validation were transferred to E; presumably E possessed overlapping knowledge and skills to do this.

Technologies developed in clusters, without an entire integration along the whole knowledge chain as planned at the start. This was illustrated in L's email to participants in Alpha's closing weeks:

> *'First of all, we need to collect the software tools & modules that were developed within the Alpha project and make it available to all the consortium partners. The objective is that we are able to continue and/or reuse the tools and technologies that resulted from Alpha project and that were developed within the project. This is also fulfilling one of the major requirements for participating in a research consortium and by doing so, achieving technology and knowledge transfer….. we were especially interested in the platform software developed …. since this was hardly used for the current Alpha applications, only limited transfer took place from [platform development] to [application integration]. This was actually also one of the critical notes made at the review. ...in short, I am requesting all partners in [platform development] to submit the software and/or other substantial developments to consortium partners. ….we especially mentioned the Alpha … from H, the data…. from C, and the tools developed by I…. the… player of G….'*

Over the course of the project, different organisational motives and expectations were seen. For instance, H viewed the collaboration as a means for raising its own profile and credibility within its industry. H wished to make a press release about the membership and its own role within it. F was reluctant to be mentioned in any public release and objected strongly. It was difficult to find the reason for F's reluctance.

> *'Dear……., we will honor your request. ….I was surprised to see that you have an objection of being mentioned as part of the Alpha consortium. The list of the Alpha members is a public information on the project……web site…… The European commission highly appreciate when the consortium members are investing in the PR of the project like [H] is doing in this press release....'*

During early January 2002, after the official end of Alpha an intensive[61] exchange of emails occurred on the subject of standard specification and Alpha's contribution to it. Discussion centred on what should be included in the final report and reasons why MPEG4 technology had been dropped. H initiated the discussion with a question directed at E's draft report. Different levels of understandings were seen regarding what was the cause and effect of a lack of a specified technology. It seems that lack of market demand had probably constrained development of MPEG technology, which had initially been included in Alpha's scope. The interesting exchange revealed B's limited understanding of what constituted technological market demand:

H: *'I don't understand what is the problem with profiles…'*

[60] This coincided with a general unrest in the global telecoms sector and may well have been a result of a reassessment of the benefit of participation in Alpha

[61] 18 emails in a single day on the same subject

E: *'As far as I understand……no single mpeg4 tool covers the whole range of the standard (very understandable☺). Having a profile would help to focus the developments…..and to me that makes it a feasibility issue…'*

H: *'…but it usually goes the other way. You figure out what technology you need to use in your application, then you go to MPEG and require a profile…'*

E: *'I understand, and IF such a profile would have been available, mpeg4 players that would have fitted better to our (=Alpha) demands might have been available…'*

H: *'The lack of profile is the result, not the problem. The problem is not enough market interest in that profile…'*

E: *'Yes, that would be the first and final cause of all the 'problems'. However, I think it makes sense to describe this chain of cause and results, since the lack of profile and hence the lack of specialised mpeg4 players had their influence on the feasibility of alpha applications. And then the conclusion could be that, in order to change this, first the market demand should grow. Right?'*

B: *'Are we [B] the market? Then there is demand ☺...'*

E: *'Sorry [B], somehow I doubt that ☺'*

The collaboration concluded that the assumptions that technologies were available but integration was constrained by a lack of exciting applications and business models were in fact flawed. It had found a significant lack of technological maturity which hindered interoperability[62]. Phi demo had illustrated some user interactivity but the billing functionalities were yet to be completed. Omega integration demo based on a narrower technological scope was done but had yet to be tested by any users; in fact L was still trying to fathom what to ask users. L also reported that Omega application was put to immediate use as a demo for programme makers, to show potential of interactivity for the upcoming Dutch election.

L's assessment of the overall process was:

> *'Communication is crucial to achieve concordance between disparate lines of activities - platform technology, business framework, end-user applications; process is key….'*

Despite the fact that the two integrated technologies (Omega and Phi) were very much distant from the initial plan, developments had taken account of internal constraints and technological changes. EU considered the overall project as highly successful. Interestingly, their overview focused on the technological aspects, making little mention to the fact that novel business models were not or could not be developed.

8.6.1 Summary of Technology Integration Module

This module underwent some highly generative changes through dynamic cycles of learning and mutual adjustment. The key observation was the emergence of groups of partners around

[62] Presumably technological limitations were being eliminated rapidly as seen in this mpeg4 integration during 2003: IVast and Clearstar have tested an end-to-end mpeg4 system allowing delivery of broadband IDT applications over satellite and cable (Itvt 7/03/02)

technology clusters, depicted in Diagram 8.5. Technologies were championed by a few partners and the partner clustering had some internal 'logic' in its composition and structure.

The two groups consisted of the following organisational technologies:

Omega group consisted of a content owner/designer, a software developer and a STB maker (B, I and L), representing a degree of integrative knowledge self-sufficiency. Content was developed and integrated with the STB technology within the group. In fact this group continued on to a future collaboration, adding partners and technologies according to technology extension it envisioned. L's knowledge contribution of user interface was limited to Omega application only. The Phi cluster had key technologies contributed by J, H, A and C. J and H respectively played a major role in development of software and hardware elements; Partner A provided the distribution network. C brought a unique technology and contributed a great deal of developmental expertise. G played a significant role but had to disengage partway through the project in response to internal organisational changes. G's other substantial role of validation and testing of all applications was transferred to E. Omega re-conceptualised the meaning of user testing, therefore requiring little input from E. A limited testing and validation of Phi was undertaken.

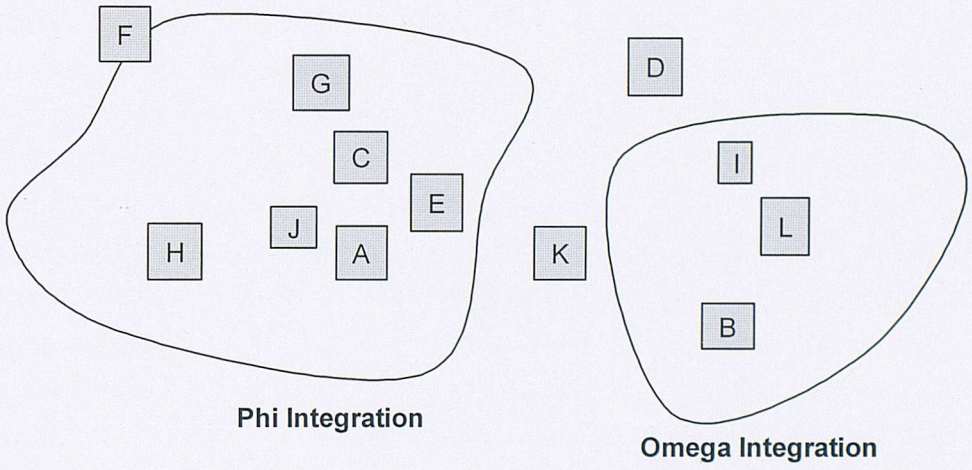
D contributed a generic technology but played no direct integration and development role. F contributed some content to Phi and showed some early involvement with technology refinement; K had very limited involvement with technological developments despite the fact that the business model module was originally designed to be highly interdependent with it. E's role was broadened to include G's remaining tasks of testing and validation. Much of the testing was done with Phi integration only.

Technological development within the group occurred in relative harmony to each other. There was remarkably little conflict over technologies that had become bounded in a particular group. For instance L was the only partner with a significant expertise in user interfaces. Yet its main participation and contribution was to Omega, without any apparent difficulty for partners developing the Phi integration. In spite of the clustering around the two concepts, some partners were able to step out of the specific groupings to either question the direction of development or provide a guiding hand. H in particular showed a remarkable degree of resourcefulness. Its main contribution seemed to play out in the Phi development, yet it helped resolve a number of technical questions and problems that arose in Omega; either directly or through a network of external experts.

The initial project design had imagined that all partners would play a role in the development of any application. Yet, the actual roles and technological commitments unfolded and emerged differently as depicted below.

The module structure proved highly flexible in the way organisations could offer technologies they wanted, without feeling pressured. It allowed for changes to the technology boundary and accommodation of partners' own aspirations. Development took into account contextual changes and technological limitations. The module illustrated much more brainstorming, ideas generation, technical problem solving and technological clarification. This was probably a result of technologists' sense of comfort in this domain than that of the previous module. Misinterpretations were rectified with little conflict. Resource changes were accommodated whenever possible. The transfer of tasks illustrated some overlap in knowledge, when a number of participants reduced their input.

DIAGRAM 8.5 TWO COPS AND RELATIVE ORGANISATIONAL ENGAGEMENTS IN TECHNOLOGICAL INTEGRATIONS



It was difficult to determine whether the overlapping knowledge was there by design. But overlap of knowledge and skill was clearly beneficial; acting as contingencies for unforeseen changes. Informal external networks were utilised to generate and transfer knowledge through joint problem-solving. Technologists seemed to trust the knowledge experts and were comfortable discussing technical problems, which may otherwise have been considered proprietary knowledge. Use of informal networks suggests that some partners contributed not just sector specific knowledge, but knowledge also, about who in the industry might have particular knowledge and how it might be obtained.

There was little evidence of major difficulties arising from sectoral technological differences or those from different national origins. This does not mean that difficulties did not occur. It is possible that prior collaborative ties helped overcome any difficulties. It is probably unrepresentative of what might be expected from a population of sectoral organisations. A great deal of process interface adjustments accompanied the technological developments; co-location of people and technologies occurred when necessary, frequent face to face technical working meetings were arranged within the groups. The adjustments facilitated collective intelligibility of what was being envisaged and how it could be achieved. The overall technological integration

occurred in a piecemeal fashion, within contextual and technological constraints. Knowledge was also derived from other EU projects and through demonstrations at different industry and standardisation forums. External visibility probably also engendered future network formation with other non-alpha partners.

The broader more successful outcome is consistent with that seen in the development of other IDT products in the market place (Chapter 4). Various integrated concepts were being offered. It is however unclear whether the development of the more successful outcomes occurred through a process that consisted of these kinds of learning structures.

8.7 Concluding Remarks

This chapter has fulfilled its role of providing a narrative account, as a thick and detailed story, of 'what' happened in Alpha; and how it unfolded over the two year period and led to particular change outcomes. Alpha's structure and its starting conditions have been described. The narrative has served as an empirical chronology that tracked event developments and their influences on the process. It represents an early stage transitioning from raw text to finding meanings in that text through conceptual associations. This early stage in the process analysis has illustrated the rich quality of the data that might not have been captured if quantitative or even multiple cross-sectional methods had been used. The vast amount of real-time documentary evidence whilst overwhelming at times provided an extraordinary opportunity to construct this detailed process story. The analysis has shown the advantage of uncovering the objects of study, without which it would have been difficult to limit the process being tracked. The broad process was limited and organised into two interdependent modules or temporal brackets. The dynamics of the two modules illustrated constraining and facilitating influences which influenced the differentiated performance outcome development.

The next chapter benchmarks these empirical findings against the starting theory of LaMA. It aims to illustrate points at which theory was corroborated and the point at which inconsistency emerged.

CHAPTER 9

FINE-GRAINED PROCESS ANALYSIS:

FINDINGS AND EXPLANATION

9.0 INTRODUCTION

The previous chapter provided a narrative account, in the form of a thick and detailed story, of 'what' happened in Alpha; how it unfolded over the two years and led to particular process outcomes. The narrative served as a descriptive chronology that incorporated an interpretative analytical element and helped highlight causal linkages and process influences. The purpose of this chapter is to present a fine-grained process analysis that incorporates the starting theory of LaMA (Doz, 1996). It benchmarks the empirical process findings against the theoretical framework and helps to serve as an intermediate step in induction and theory generation (Pentland, 1999). A shift from a single 'macro-case' (Alpha) is made to study two comparative 'micro-cases' (Business Model Module and Technology Integration Module) that help inductively surface important analytical concepts from initial description (McNulty & Ferlie, 2002).

The rationale for the separate construction of Chapters 8 & 9 was to also provide analytical transparency; to enable the reader to gain a sense of data richness, its vastness, reliability and accuracy. By rendering a large amount of the text transparent in the previous chapter, the intention was to show its high internal validity and representativeness in constructing theoretical explanations (Mason, 1996). A key concern was for the reader to develop a sense of confidence and belief in the analytical process and basis on which ensuing process explanations were built.

The analysis shows how the concept of Communities of Practice (Lave & Wenger, 1991; Brown & Duguid, 2001; Wenger, 1998; Tsoukas, 1996) first emerged and helped guide the understanding of the process and outcome divergence of the two micro-cases. It helped with the subsequent theorising. The concepts were deemed particularly relevant in this setting, in the way they helped enhance the starting theory. This step was clearly critical in fulfilling the objective of this research, which was to use the empirical evidence to sharpen and refine the starting theory (Ragin & Becker, 1992). Chapter 10 provides a brief review of the CoP literatures that contribute the concepts and discusses how they add to LaMA Theory to help extend its application in this complex setting.

The advantages of fine-grained over coarse grained process analysis (Langley, 1999; Poole, Van de Ven, Dooley, & Holmes, 2000), particularly in research that uses single or a small number of cases were discussed in Chapter 6. Coarse grained approach was rejected on the basis that it reduced human actors and their social interactions to passive occurrences. This loss of contextual richness failed to capture an organisational gestalt (McNulty & Ferlie, 2002). Fine-grained process analysis is presented as a comparative development of two process outcomes representing two micro cases from within the single Alpha case.

The chapter sequence here mirrors those found for example in McNulty & Ferlie (2002) who used fine-grained analysis as an intermediate step leading to theory development. They too selected a number of micro-cases from their single macro-case as a means to compare uptake of an organisational change programme in healthcare. Although process variance development has been studied before in strategic management (Pettigrew, 1985), here there was specific concern to apply a theory of LaMA in the development of this variance. It would help establish the applicability of the theory in this complex setting.

The empirical research found that Alpha's initial conditions proved highly inertial in the development of the first (Business Model) module and yet the same conditions were highly generative in the development of the second module (Technological Integration). The differential performance outcomes are consistent with those found in other IDT market developments (discussed in Chapter 4). Similar to independent developments many technologies were being integrated successfully, yet new business models that reflected this integration were not clear to see. In fact, repeated calls were made by industry executives to its technologists to be creative in developing business models.

At a superficial level, the findings could be viewed to be consistent with LaMA Theory in that: inertial development led to a weaker success outcome than that from the more generative development. The process dynamics of the more successful development however show an interesting theoretical anomaly.

When the collaborative structure (as in the Business Model module) had to act as a unified learning and mutually adjusting entity, the initial conditions became much more inertial. Yet, technological development continued generatively at the exclusion of some important technologies and organisational participation. In other words, the originally defined unified structure of interdependent technologies became fragmented, yet development unfolded in a dynamic manner. The key mechanism which contributed to this, more successful development, is best explained by an emergence of organisational groupings. These informal groups illustrated properties similar in character to Communities of Practice (CoPs). CoPs and their theoretical concepts is the subject of a brief review in Chapter 10. Two CoPs emerged spanning different technological scopes within the single collaborative entity. The more delimited structure of a CoP created conditions for highly dynamic learning and mutual adjustment to take place; work was aided by some degree of skill overlap for specific technological tasks. The initial interpretative analysis was not informed by the CoP literature. This knowledge management literature actually surfaced inductively and *post facto* through an opportune reading of a related publication (Swan, Scarbrough, & Robertson, 2002). The structural characteristics described in this paper led to abstract linkages to be made to the empirical findings.

A CoP represented a group of organisations with closely inter-dependent technologies. They shared a common viewpoint about the conceptualised integration and change. They shared a view regarding possible outcomes, belief and enthusiasm in the envisioned concept and most

importantly, perceived organisational benefit arising from the contained social activity. Importantly, they seemed to have similar pace and rhythm of interaction and decision-making that might not have occurred within the wider inclusive setting. The process interface was mutually intensified through more frequent ad hoc meetings to solve problems and to speed up decision-making. The structure of the groups allowed a great deal of internal technological self-sufficiency by adjusting technological scope and boundary. Tasks were also adjusted with deepened organisational commitments.

Despite a relatively high degree of self-sufficiency, there was also evidence of healthy reciprocal support between the two groups. Little obvious inter group rivalry or competition was observed; perhaps because more than one technology integration was on the agenda. Access to each other's informal external networks helped fill emerging knowledge gaps. This too might have helped facilitate the separate, yet parallel development of the two integrated technologies within the single Alpha collaboration. The emergence of CoPs as a mechanism for dealing with complexity represents an explanation in this intellectual puzzle that might hold a wider meaning in other social situations (McNulty & Ferlie, 2002); indeed for managers who deal with other complex organisational situations. This is discussed in more detail in Chapter 10.

This chapter starts by describing Alpha's Initial Conditions (introduced in Chapter 5). It is followed by a fine-grained process explanation of the differentiated development of the two modules by focusing on key events, learning surrounding these events and their consequences over time. The chapter concludes by comparing the different characteristics of outcome developments and limits of LaMA Theory in this setting.

9.1 ALPHA'S INITIAL CONDITIONS

Alpha's broad aim was to develop an integrated technological concept that encompassed a diverse set of technologies. A critical concern was for the technological development to make economic sense for the constituency. For this, novel business models would be constructed which would determine attractive marketable applications. In essence, technology integration represented a part of the overall goal; user feedback would help refine the technology to improve its marketability and business models would legitimise it.

In order to achieve this broad goal there had to be a collective pooling of knowledge. This pool of knowledge formed the basis for exploration and creation of new knowledge for the business model module. Collective participation was absolutely necessary from the start. Technology integration task however was highly modular; modularity was established by different organisational tasks and sequence of technological development. Like the business model module, collective participation was absolutely necessary from the start. Partners had to generate and develop a list of technologies being contributed. Tasks were then split according to the technological development envisaged. Importantly, failure or delays in completing specific tasks within a chain of integration would adversely affect the performance outcome.

Collective participation was also important for the business model module, given the tight interdependent technological structure. Moreover, organisations were not expected to possess the knowledge from neighbouring sectors. For instance, a telecoms operator was unlikely to have intricate knowledge about content production or technology packaging. Collective new knowledge would require pooling of distributed knowledge and joint enactment in that context (Brown & Duguid, 1991; Tsoukas, 2002). Knowledge was emergent in the way it was perceived and understood at that point in time.

Pooling also required developing a broad conceptual understanding of how the different technologies would fit together. Technological complexity would be reduced by having specific teams work on specific tasks, irrespective of selected applications. Output from team effort would be aggregated progressively over time, as sequential and overlapping activity. The nature of technological integration was based on a theoretical possibility because a clear technology map did not exist. Integration would have to be imagined individually and collectively, by trial and error. Presumably, knowledge conceptualised, transferred and created would be highly specific to its time and space.

Contrary to what the business literature might imply, actual technological convergence and interactivity was expected to be much more difficult. No detailed map of technology inter-linkages existed; neighbouring technologies did not simply slot together. The practice of knowledge creation would confirm and validate the imagined linkages. It would generate conditions for further technological refinement. Alpha's starting assumptions enacted the following project conditions in January 2000:

TABLE 9.1 ALPHA'S INITIAL CONDITIONS

	Initial Conditions
Context Goals and Expectations	Business models was an industry buzzword, internet boom was at its peak and a number of IDT business models already existed e.g. pay per view, subscription fee and fee for premium content Technological integration across the 3 sectors seemed theoretically feasible. The belief that no integrated system as yet existed, provided an opportunity to demonstrate do-ability. Market and Alpha's perception was that economic benefit of integration could indeed be illustrated by creating novel business models. Definition of business models would help clarify organisational roles and values Development of integrated concepts incorporating open standards had potential for exploitation of diverse markets
Task definition	The collective tasks were to develop flexible and novel business models; develop applications by integrating sectoral technologies using open standards and specify adjustments to those standards; and demonstrate user acceptance and commercial attractiveness of the applications to generate market interest in the concepts
Interface structure	Business model task required collective action; technological integration was conducted through specified task teams. Teams were formed according to their knowledge; transfer and integration was to be carried out from remote sites, with

	Initial Conditions
	quarterly technical working meetings or on the basis of ad hoc task-related needs. Although the broad technology mix was defined, no detailed formula of how technologies would fit together existed; creative idea generation and collective understanding of the conjoined technologies would take place in dispersed sites and when the teams met
Skills and organisational practices	The complementary partner mix and associated domain knowledge would be sufficient to carry out necessary tasks. Presumably communication would present few constraints with respect to technological, organisational and national language differences

In addition to Alpha's overall starting conditions outlined above, each organisation was expected to have its own set of starting conditions[63]. Although not necessarily fully explicit, each organisation had a set of initial expectations; the task it would perform and the relevant skills and resources it would contribute. Presumably organisational representatives were assigned according to the necessary skill and knowledge. This broad set of starting conditions would either facilitate or hinder Alpha's progress depending upon the adaptive fit with the emerging situation.

As Alpha progressed, participants would gain insights and learn along some or all of the learning dimensions: context, task, process, skill and expectations. Learning might start with recognition of an event, followed by a process of reflection upon it (Fiol & Lyles, 1985). This reflection might generate explanations of how or why something might have happened or its likely consequence. New insights would determine the appropriateness of the goal and its fit with emerging organisational conditions, and whether revisions were needed. Individual and collective adjustments of conditions would result from both cognitive and behavioural learning along any of the five dimensions. Decisions to make adaptive changes would depend on the assessment of project performance, its effectiveness and perceived individual organisational value. These assessments would be steeped in the context of the time. The research expectation was that studying events at the collaborative interface would help reveal tensions between learning and non-learning; adaptation and non-adaptation; impact on outcome development in the higher complexity setting.

Although cognitive learning was evident in various individuals along almost all the learning dimensions, absence of collective learning and non-adjustment contributed to a highly stunted development of the business model module. Despite early indications for the need to change these conditions, and attempts by some partners to effect this change, a coherent group to action the change could not be achieved. Its consequence was that the task of defining novel business models could not be completed as first defined. The same starting conditions however proved highly generative in technology integration module; a number of adaptive changes to the interface structure, goals and tasks were made. Interestingly these findings seemed consistent

[63] Interpretation of change in individual partner conditions was based on behaviours and actions observed in the data gathered from joint project activities

with other technological developments in the market place. Technology integration was fairly successful but there was difficulty in developing novel business models.

In order to explore how LaMA Theory explains these differential process developments in the two modules, critical events and learning cycles that surround the events are discussed along the module time lines. They help illustrate: the dynamic unfolding of some important problems; the quality and extent of social learning and organisational actions or inactions; and impact on the ensuing process and performance outcomes.

9.2 BUSINESS MODEL MODULE: WEAK PERFORMANCE OUTCOME

It was discussed in Chapter 1 that a highly deterministic or planned view of strategy assumes that knowledge (relating to context, task, skills and process) is known with certainty. Starting conditions remain unchanged over time. In response to a stimulus, human action automatically occurs as planned. Presumably this also occurs in social settings that constitute collections of people from various organisations, who might bring different abilities, motivations or intentions. Processual view of strategy on the other hand accepts that plans are based on the best available information at the time. As new knowledge emerges, reassessment of conditions might necessitate their change. The process itself may be constrained by changing human expectations. The LaMA theory predicts performance failure as a consequence of mutual non-adjustment of initial conditions. Non-adjustment results from blocked or poor learning along some or all of the learning dimensions, due to a lack of problem recognition or understanding its impact; or, despite developing an understanding failure to action it effectively. Inaction may be intentional or unintentional depending on partners' assessments[64] of the project and each others' participation and performance.

The temporal development of this module showed that despite cycles of cognitive learning at some individual partner levels, a collective stunted learning occurred along all the learning dimensions, namely: goal, task, process, skills and context. The few partners that understood the change required could not effect a collective change without the support and engagement of the entire constituency. Business models could not be constructed without knowledge contributions from all participants. Contrary to the initial plan although two applications were selected, no novel business models resulted. The tele-shopping application (Phi) used an existing e-commerce business model; the children's story telling application (Omega) had no clearly defined business model despite its rapid progression to development and integration within a limited scope. This discrepant performance has managerial and policy implications given the strategic importance of undertaking collaborative technology transfers.

For any technology, the aim of a good business model is to convey a coherent story about who the customers are, what they value, how an organisation makes money, and how the underlying

[64] Formal records of individual assessments were neither found nor expected. Clues would only be found *ex post* in partners' behaviours, actions and degree of participation. Assessments were assumed to take place continuously, informally, privately and collectively

economic logic delivers value at an appropriate cost (Magretta, 2002). In a sense, business modelling is the scientific method for managers: starting first with a theory of how a concept may work and how the business system fits together; the concept is then tested in action and modified if necessary. Without a coherent story or underlying method, the selected technology may represent nothing more than an impulsive act to satisfy some individual interest. The problem is to then convince the entire collaboration of the concept's value.

Lack of business model definition here echoes the 'marketing myopia' problem (Levitt, 1960). Levitt has argued that complexity and sophistry of electronic products often leads to organisational domination by technologists. As a result, organisations fall into the trap of becoming focused on production at the expense of marketing; technology development then becomes a greater priority than a concern for customer satisfaction.

The business model module development exhibited repeated signs of technologist domination. They were probably motivated by the opportunity to develop technologies of personal or organisational interest, without proper concern for concept marketability and economic value. As initial conditions remained unadjusted, Alpha's broader remit remained unfulfilled; there was no evidence of the vital business knowledge that would have been held by product managers or marketing specialists. Given that Alpha's key concern was to illustrate economic value for the entire constituency, business models were expected to guide and drive the technological activity. Despite failure to define the models, technology integration was undertaken anyway. Integration seemed to be motivated by a need to broaden individual technologies, which represented a different set of organisational expectations.

9.2.1 Starting Conditions for the Business Model Module

Unlike the technology module where specific technological roles and tasks were assigned to teams of partners, this module expected all partners (except C and D)[65] to participate for the entire duration. As sectoral knowledge was deeply differentiated and therefore collective participation was critical, the business framework would serve to guide application-specific technologies. Each organisation's knowledge of its sectoral business models and competitors' activities would provide important insights to the group. This knowledge would enable the group to explore, envision and design hybrid, more attractive business models. Each partner would also conceptualise the technological fit from its technological domain perspective. Collective understanding about the technological contributions and economic value would emerge. In this way, shared sets of premises would develop.

Brown & Duguid (2002) characterise this process as emergent knowledge that requires a group to closely imagine the same nebulous concept; to push in the same general direction where knowledge is used in the context in which it has meaning. In this way, a shared social construction of integrated knowledge develops; and development of shared frames of reference.

[65] C and D were non European partners; their key contribution was expected to be in technology integration module

By contrast, if this knowledge were some isolated, atomised object and highly codified: a belief accorded by the dichotomous view of knowledge (Polanyi, 1967; Kogut & Zander, 1992), then new knowledge would have potential for construction outside a collaborative structure. Moreover, in the absence of key technological participants, knowledge would be conducive to effortless substitution. The following discussion illustrates that knowledge creation was much more complex than what the a-processual view might suggest. It exemplifies the emergent nature of knowledge (Tsoukas, 1996), specific to the context in which it is produced (Brown & Duguid, 1991).

The process of knowledge creation consisted of a bottom-up approach. First, to gather organisational technology offerings, then create and refine new concepts in accordance with the original goal. Creating a business model would be like writing a new story. To some extent, all new stories are rooted in old ones (Magretta, 2002). In the absence of collective engagement there was little likelihood of constructing models that included the old or broad experiences to satisfy the needs of the entire constituency. There was an assumption however that once a model was defined it would dictate application choice, which would reflect market suitability.

In order to carry out this task, there was an implicit assumption that organisational knowledge extended beyond an application's technology boundary. This knowledge would include: how the application would be integrated; business and market knowledge about its market acceptance and economic value. This would ensure that each organisation's place in the project was clear to see, with respect to technological contribution and relative economic gain.

The timing of the business module output was critical as it would drive application selection and subsequent development. Application development would enable traversing of heterogeneous transmission networks. Other than day-to-day electronic interaction, the process interface consisted of a start up meeting, which required all participants to attend. There they would discuss their distinct technologies. This was followed by specific working meeting to brainstorm and discuss any suggestions received from the group, for K and L to then analyse. This face to face communication was critical in order to gather, clarify and develop a mutual understanding of the diverse knowledge; it included an important socialisation aspect too. It also represented a more efficient means for mutual understanding compared to email exchange.

When knowledge bases are so different, a more intensive communication interface enables greater mutual understanding and knowledge enactment. Mutual knowledge can be particularly problematic with email communication (Cramton, 2001). Unlike face to face communication, the writer may use faulty suppositions about knowledge held by the recipient when constructing his message. The added complexity of national and organisational differences might also affect how a message was understood. Creating mutual knowledge is important as it reduces the likelihood of misunderstandings and troubled relationships.

9.2.2 THE UNFOLDING PROCESS AND QUALITY OF LEARNING ADJUSTMENTS

Although social and individual organisational goals were explicated in the formal document, the PSU meeting provided an opportunity to present and share individual project expectations and those of each other. A set of explicit and shared expectations were discussed regarding the development and introduction of new products. As illustrated in Table 8.1, a wide ranging set of expectations was presented. The expectations were either very specific to Alpha technologies and tasks, or more general to understand IDT sector development and likely impacts. The latter point probably signified the lack of clear understanding about the sector and a desire for strategic learning. The majority of engaged members seemed principally driven by their technologies; the concept of business models relevant to that technology seemed a secondary or distant concern. Neither G, the conceiver of the project nor K, the module leader could steer the group to develop compatible frames of reference. A unity of vision was neither created nor sustained.

Despite early expressions of eagerness and high expectations of the business model module particularly from Partners A, G and J (interestingly, all from the older telecoms sector[66]), the start to this module is best described as apathetic from lack of participation. Reduced organisational engagements may stem from readjusted expectations regarding project effectiveness and its likely value or organisational benefit. This reasoning seemed highly unlikely given the infancy of the project; partners had yet to be exposed to each others' actions, behaviours and likely project impacts.

In the early stage of this module, the dispersed nature of the process interface rendered it difficult to determine why partners did not want to engage. If their expectations or commitments had not changed, then was it due to disinterest or conflicting priorities? Over the course of the module, it became clear that limited participation probably resulted from poor understanding of its strategic importance and therefore value attributed to it by the constituency. Despite early optimistic, ambitious and seemingly converging expectations, many participants did not see their roles beyond those represented by Alpha's technological goal. For instance, although E and F made scant direct contribution, based on evidence of their deep involvement in the technological module, their expectations and commitment to the overall project had clearly not changed. For them, the overall project represented nothing more than a technological knowledge transfer. In the absence of collective learning and adjustment, a sustained dialogue to help define novel business models could not be carried out.

Even if they had wanted to, the small number of engaged members were not equipped with the necessary knowledge to influence the module outcome; their knowledge was limited to their own sectors. The nature of the goal also probably constrained their ability to make adjustments to the scope. If the goal was to encompass all technologies, any narrowed technological scope that excluded one or more technologies at this early stage might have meant that visibility would

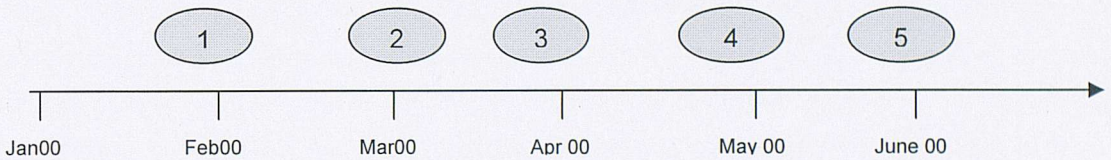
[66] Interesting because this sector perhaps more than the two others faced the greatest organisational challenge of working through different ways of doing business - see Chapter 4

not be given to the entire group; and importantly it might constrain the subsequent module in respect of technologies it expected to incorporate.

The module development is explained using five key 'events' (Poole et al., 2000) in the form of problems, issues or constraints that emerged over time and their learning consequences (Diagram 9.1). The events represent conceptual occurrences that occupied uneven time periods; some events might have been instantaneous. The implication of this is that as triggers for learning, small events might have a major impact later on module development (Poole et al., 2000).

The sequence of five events (representing identification of a problem, learning / understanding its consequence, resulting action to adjust starting conditions) illustrate cycles of blocked learning for mutual adjustment; stumbling blocks in making changes to individual and collective project conditions. The cumulative consequence of this was an inability to carry out the joint task of novel business model development as one of the project's key goals. It illustrates the path dependent nature of process in that an earlier stumbling block sets the process trajectory down a particular track (Pettigrew, Ferlie, & McKee, 1992; Teece, Pisano, & Shuen, 1997).

DIAGRAM 9.1 KEY EVENTS AND RELATED LEARNING DIMENSIONS IN BUSINESS MODEL MODULE



KEY:
1 Task learning
2 Task & Context learning
3 Goal, Task & Context learning
4 Goal, Task & Skill learning
5 Task & Process learning

EVENT 1 BETWEEN END JANUARY AND EARLY FEBRUARY 2000 ILLUSTRATES A BLOCKED CYCLE OF COLLECTIVE TASK LEARNING AND PROCESS ADJUSTMENT:

- An early problem of lack of collective participation recognised by some partners
- Cognitive learning by a small number of participants, about task requirements and knowledge gap in the group
- Their decision to action process changes to overcome the knowledge gap in order to effect collective task fulfilment
- Inability to engage the entire group in adjustment of the starting conditions

Cycles of individual task and process learning would have been insufficient; collective action was needed in order to generate ideas about the entire technological scope.

The early problem of poor participation was believed by G to be due to a lack of understanding of the business model concept. Definition of business models required substantially more market and business knowledge than the predominantly technological representatives apparently possessed. It would seem that national and organisational cultural differences were a lesser problem than technologists' struggle with intra-sectoral functional knowledge about business and markets. The starting conditions had assumed a broad business knowledge representation but the domination by technologists seemed to constrain it. G suggested a method by which participants could still generate conceptual ideas and be able to construct a shared meaning. This would be done through linking of business models with specific technologies; hence ideas would be drawn from participants' technological knowledge.

The first working meeting further illustrated partners' confusion with business model terminology. Although K gave some basic training to establish a common understanding, the meeting attendance was poor: only 3 partners attended including K. In order for the highly interdependent, inter-sectoral task to be completed, participation from the entire group was necessary; views were thought to be particularly important from e.g. broadcaster, technological platform and user level. The discussion within the small group of attendees led to an understanding and a learning about the nature of the problem; as a result, the group decided to make two work process changes to effect a wider engagement and knowledge contribution.

It was thought that task fulfilment could be effected if the nature of knowledge gathered was adjusted. A subtle change to the nature of organisational contributions was made: instead of emphasising the gathering of sector and technology specific business model knowledge, participants were asked to propose particular applications that encompassed functionalities of the three technology sectors. Business models would be created from the proposed applications. It was thought that contribution would be easier as technologists were more familiar with application-specific knowledge than business models. Another process change involved the introduction of a methodical and analytical instrument to make application proposals. A template was constructed by K that required participants to give rigorous consideration to any proposals: what was being proposed, why and how it would meet the goal requirements. Now all that was required was widespread engagement in discussion and decision-process for proposals and selection of applications, leading to business model development.

EVENT 2 BETWEEN END OF FEBRUARY AND EARLY MARCH 2000 ILLUSTRATES AN INERTIAL CYCLE OF TASK AND CONTEXTUAL LEARNING:

- continued problem of limited organisational participation and added constraint of content availability that would limit application proposals
- contextual and task learning by a handful of partners engaged in the module meeting
- blocked learning and non-adjustment not just by the collective group but also within the engaged constituency as it failed to pay due regard to the template; criteria for

application proposals were ignored and failure to discuss and debate the advantages and disadvantages of those proposals for business models development

Participation continued to be limited; the change in process helped generate a number of application proposals albeit from a handful of partners. Although the process had enabled technologists to propose some interesting concepts, the concepts required knowledge definition beyond its technical boundaries. Supporting arguments seemed to ignore this. They were based principally on personal preferences, 'pet' interests and concern for individual organisational gain. There was little evidence that choices were benchmarked against developments in the market place (See Chapter 4 for market development of 'attractive' applications). There was clearly a dual problem of lack of task and contextual learning.

Despite some compelling concerns about applications proposed and expressions of doubts from some partners, business models failed to be debated thoroughly; questions and ideas were often blocked by proponents of specific applications. Individual expectations and goals seemed to take priority over the collective project goal. Expectations of benefits to specific technologies through joint working were high on the agenda of these partners, discouraging broad discussion that might have worked against their proposals. The consequence of this behaviour was that the applications selected produced conditions that were not conducive to creation of novel business models. In addition, time pressure for output from this module and its tight interdependence with the technological module required application selection process to be finalised. Without this step, the progress of rest of the project was under jeopardy.

Interestingly, various partners that seemed disengaged in this module showed little evidence of reduced commitment to Alpha. Their greater engagement with the technology module was presumably because the business aspect was thought to be less relevant and of limited value. The expectations of the module output were considerably different to those assumed at the start. Without developing a common social strategic view of the context, the module development diverged from the plan.

Another problem – lack of broadcast content, was uncovered which also limited the application proposals. There seemed now an expectation, driven mainly by partners that had already tabled their proposals that proponents of concepts would have to provide the necessary content. Or they would have to propose a content source - implicitly, from outside Alpha. In other words, generation of ideas had to be firmly linked to specific broadcast content and its access. For instance if a telecoms operator wanted to table an attractive application idea, this could only be done if it had the means for accessing the broadcast content incorporated in the concept. It seems that the task and process adjustments made by some members left little room for a comprehensive discussion about generic concepts to take place. It is unclear why opportunities were not created to explore and discuss generic applications with organisations that owned content, to invite relevant contribution into the project. It seems that even if some partners had wanted to participate, the conditions had become less favourable. A limited number and

application choices clearly benefited those whose proposals had been tabled; there was a greater probability for their application to be selected.

Although individual cycles of learning identified a need for more thorough debate and discussion this could not be acted upon collectively. Individual benefits seemed to become a primary concern for application champions at the expense of collective task fulfilment.

EVENT 3 BETWEEN LATE MARCH AND EARLY APRIL 2000 ILLUSTRATES A BLOCKED CYCLE OF GOAL, TASK AND CONTEXTUAL LEARNING:

- Problem of resource constraints
- Cognitive task learning about further limits to generation of application proposals
- Two applications selected: Omega application with no associated business model; unclear international market attractiveness. Phi application was based on an existing internet based e-commerce model
- A number of problems were identified with Omega - its market attractiveness outside the Netherlands; its demonstrability using children as primary users
- Despite the many concerns, the final decision about the selected applications remained unchanged

The starting conditions had assumed that regardless of the selected applications, technological development would be based on partner competences and skills (i.e. telecoms distributor would provide network distribution knowledge; content bundler would provide technology bundling service and so on). It now seemed that application proponents were to contribute a great deal more resource to facilitate their proposed technological development. It is unclear how this change came about, but it had significant impact on roles of many participants. The starting resource budgets were based on tasks relating to organisational competences but the project conditions were changed by a small number of partners; the result was that some partners were unable to fulfil their task requirement despite a desire to develop certain applications. This further limited the generation of application proposals.

Despite the limited number of proposals, the selection process was not as rigorous as set out by the small group of partners that had attended the start up meeting. There was clearly limited contextual and task needs learning with little evidence of building real consensus in the selection process. Important problems went unchallenged. It seems that ownership of some key technologies brought a great deal of influence on applications proposed.

EVENT 4 BETWEEN END APRIL 2000 AND EARLY MAY 2000 ILLUSTRATES A BLOCKED CYCLE OF GOAL, TASK AND SKILL LEARNING:

- At least two partners identified the need to involve business people to help derive business models and define economics of the system

- All partners were asked to involve organisational functional specialists to gather this knowledge
- Collective failure to engage the specialists to generate the necessary knowledge

Initial conditions had assumed organisational contributions of business knowledge presumably by engaging organisational functional specialists. Although application selection was already finalised by the technologist constituency, it still needed business knowledge input in order to define a business system. Despite recognition of this fact by at least two partners, and their urge to involve the necessary organisational skills, a collective understanding or action could not be achieved. The conflicting frames of reference and differences in individual values meant that technologists could not or would not see the relevance of this knowledge.

EVENT 5 END OF THE MODULE, BETWEEN END OF MAY AND EARLY JUNE 2000 **ILLUSTRATES A BLOCKED CYCLE OF PROCESS AND TASK LEARNING:**

- Lack of invitation or engagement of organisational specialists
- Cognitive learning about skills and task
- Recommendation for K to remedy the situation by effecting the necessary organisational dialogue and gathering of relevant knowledge
- Organisational barriers to gather this knowledge

Given that individual organisations were unsuccessful or reluctant to engage organisational specialists, it was thought that K in the module leader role would undertake the task of gathering this knowledge. K would contact organisational specialists in partner organisations. The task was not accomplished; K stumbled on organisations' reluctance to release the necessary knowledge. A general concern over loss of confidential knowledge was expressed; in particular a sensitivity to disclose financial data. Despite the legal framework within which Alpha was to operate, this organisational knowledge could not be obtained.

The module's output was 'selection' of two applications, Omega and Phi. The selection occurred through limited dialogue about associated business models. Decisions were greatly influenced by organisational expectations of the technological task rather than a fit with the external context and the starting project goals.

9.2.3 SUMMARY OF THE BUSINESS MODEL MODULE DEVELOPMENT

The inertial development and poor performance outcome of this module is not dissimilar to that found in the inertial dyadic technology transfers (Doz, 1996). Consistent with the LaMA Theory, a mutual reconstitution and reconfiguration of the project conditions could not be effected. Despite discovery and understanding of some key problems, there was repeated failure of collective social learning to revise and refocus the module conditions. In the same way that the alliance of dyadic partners needed to make learning and mutual adjustments, this complex setting would have required a collective process engagement. Consistent with Doz's findings,

the inertial development was due primarily to the dense and tight systemic interdependencies. The deeply differentiated organisational skill bases, the seeming internal fragmentation between functions, and conflicting frames of reference hindered the necessary change. There was little overlapping knowledge that could easily be substituted by other project members. Poor performance seemed to be influenced less by national cultural and technological differences and more by intra-sectoral knowledge. It is unlikely that the predominantly virtual module interface had a significant negative impact on performance outcome. The engaged partners were able to overcome the thin interface by adjusting their interactions to facilitate day to day dialogue; conditions were created to adjust the interface but unfortunately the entire group failed to unite. From the very start of the module, the constituency did not seem to share a common strategic context. Their assessment of collaborative value was based less on the business module performance and more on the potential of technological integration.

The five events illustrate the quality of individual and social learning, and repeated cycles of stunted learning that hindered the necessary mutual adjustments. The consequence was that the goal of novel business models was not achieved. It might be argued that module performance was not a complete failure. Selection of applications had at least allowed the next module (technological integration) to proceed; in the absence of any application selection, technology module might have ground to a halt and led to Alpha's complete failure. It illustrates path dependent development. The fact remained that the goal first defined by the EU against which the module performance outcome would be assessed remained unfulfilled.

In considering the limited way in which IDT's business models have developed (see Chapter 4) during and since Alpha's completion (www.itvt.com), it could be argued that the specific goal of business models was unattainable. Consistent with what was being played out in the market with most of the technology developments perhaps there was little potential for new model creation. That said, the fact remained that there was no evidence of collective engagement for sustained debate concerning this issue. The disengaged members could not or would not see the potential importance of business models as a legitimating condition for technology development. Conflicting frames of reference meant that expectations of project performance were principally driven by the technology. The deeply differentiated technologies and knowledge bases allowed limited opportunity for knowledge to be substituted by other Alpha members: the highly motivated partners could not compensate or substitute knowledge for those seemingly less so. Interestingly, the technology oriented partners displayed signs of intraorganisational fragmentation; functional experts were not mobilised to contribute to debate and decision-making. Differences in pace of participation and response to problems further contributed to the module evolution. To some extent, the nature of the starting goal and task limited its redefinition: models had to include all the defined interdependent technologies.

There now follows a discussion about the development of the technology integration module.

9.3 TECHNOLOGY INTEGRATION MODULE: STRONGER PERFORMANCE OUTCOME

This module represented the technological aspect of the knowledge creation activity. It was separated into two distinct elements involving all partners (except K), albeit participating at different stages in the process. The first element consisted of the development of a generic platform technology. This would lead to the second element constituting integration of selected applications (from business model module) with the platform technology (see Diagram 8.2 in Chapter 8).

The theory predicts performance success as a consequence of generative cycles of learning and mutual adjustments of the starting conditions; essentially through collective enactment. The temporal development of this module exhibited various generative cycles of learning and mutual adjustment. Tasks were adjusted in response to contextual learning; interface adjustments were made as members increased and deepened their commitments; as a result module goals were revised and re-focussed. Adjustments contributed to a relatively successful performance outcome in that two applications were developed and integrated by Alpha, despite the immature nature of technological standards development. The notion of success, as viewed by the EU was based on technological integration despite little user tests and undeveloped business models.

At first sight it would seem that the empirical findings are consistent with what the theory predicts i.e. generative cycles led to a successful module outcome. Yet, mutual adjustments unfolded in a slightly different pattern to what the theory suggests. The difference being that mutual adjustments occurred despite loss of the originally defined interdependent technologies and disengagement of members. Two distinct groups emerged which enabled effective learning and mutual adjustments within those structures. They seemed to help deal with Alpha's complexity.

If as assumed at the start, technology components were interdependent, then even if just one knowledge partners were to act unilaterally, then interdependence could not be achieved. Thompson (1967) views collaboration as a complex organisation. He argues that organisational goals have to be established through alliance behaviour; unilateral action is incompatible with interdependence. Temporal development of this module showed that despite withdrawal or reduced participation by two partners with important technologies, technological development progressed generatively. Two applications were developed not through knowledge contributed by the entire group as initially designed but through emergence of two separate groups (similar to CoPs) (Lave & Wenger, 1991; Brown & Duguid, 1991); groups coalesced in a mutually reinforcing way within a single collaboration. Their emergence seemed to be triggered by contextual learning and organisational task expectations. The two groups were dissimilar in size with respect to technological membership; each in their own way adjusted the originally defined technological scope to achieve more contained knowledge integration.

By redefining technological boundaries the two group members adjusted the goals, tasks and process of this module. Driven by contextual learning, constituent partners converged on activities that they valued the most; they chose to work with the application and technologies they were committed to. Individuals were able to influence the nature of collective learning within the narrowly defined groups. A great degree of trust developed, with joint championing of selected technologies and search for creative ways to achieve integration. The quality of communication within the groups became highly efficient as interface adjustments were made in an effort to complete the task in a timely manner. In so doing, they developed a greater sense of alignment of their own organisational expectations with those of the adjusted project goals.

The unfolding process showed a great deal of adjustments of initial conditions through learning along dimensions of task, goals and expectations: constructive joint problem solving, clarification of misinterpretations and development of common frames of reference. Collaborative task flexibility was evident from the very beginning of the module. Technological scope and interface structure adjustment was facilitated by task modularity and some overlapping skills; chunks of technologies could be integrated and developed without engaging the entire constituency. Contrast this with the tight interdependence in the business model module, where there was little overlapping skill In spite of withdrawal of two partners over the module's course and in the presence of some critical technological constraints, knowledge integration still proceeded, albeit within a limited technological scope. Knowledge sought from informal external networks also helped complete some critical tasks within the two groups.

9.3.1 Starting Conditions for the Technology Integration Module

Specific technological roles and tasks were assigned to all partners except K. They were organised into teams to participate in work at different points in time: a form of modular task organisation. The deeply differentiated and interdependent nature of knowledge assumed that collective participation was needed for Alpha's entire duration; presumably this would make them self-sufficient in technology needs. Participants involved in earlier activities were expected to continue to participate by carrying out iterative technological refinement, as more and more technologies became aggregated along the integrative chain. Not unlike the previous module, knowledge would be created through interactive idea generation, experimentation, with gradual addition and refinement. No pre-defined technological formula existed. By integrating knowledge across the three sectors, it was expected that the module output would not only help illustrate feasibility of technological integration, but its commercial potential too. Timely accomplishment of tasks was important in order to carry out user tests prior to final project assessment by the EU.

Like the previous module, process interface was predominantly electronic interactions, supplemented by quarterly and ad hoc technical meetings. Participants also had other organisational responsibilities and duties whilst undertaking Alpha project tasks. A great deal of knowledge was expected to be generated at dispersed locations through individual or group interactions, then transferred via electronic files to be integrated with technologies at different

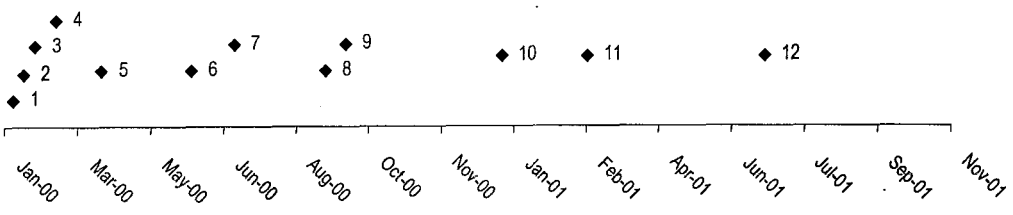
partner sites. Cycles of iterative refinement would follow as technologies became added and tested for compatibility and smooth operability.

9.3.2 THE UNFOLDING PROCESS AND QUALITY OF LEARNING ADJUSTMENTS

The DOW formally set out the scope of technology integration. It stated who would do what, but not how it would be done. The PSU meeting provided an opportunity for participants to share individual expectations of Alpha and of each other. Various partners expressed particular interest in technologies planned for inclusion, with a promise to contribute to them. The module evolution was highly dynamic despite D's (owner of an important technology) lack of direct participation. D formally withdrew from Alpha after 12 months, creating a resource problem for Alpha. D claimed that it had misunderstood its original role. G's withdrawal resulted from its intra-organisational restructuring almost two-thirds through the project. G's remaining tasks and role were transferred to E. Reduced participation seemed to cause little ill feeling amongst the members. In fact there seemed a mutual respect for each other despite the potential for adverse impact on the project.

The overall module conditions were highly conducive to brainstorming, idea generation, and clarification of misinterpretations. Despite differences in national cultures and technological sectors, technical language provided a common means for communication. Whenever misunderstandings from sectoral technological differences arose they were clarified with relative ease. The module development is explained using 12 key events and the ensuing learning cycles (Diagram 9.2). Events represented important problems, issues or constraints that emerged over time. The unfolding sequence illustrates generative cycles of learning and mutual adjustments. Individual learning influenced and led to collective adjustments albeit within narrower constituencies. Readjustments of goals, tasks, process and expectations were made in response to withdrawal of key participants and learning about some technological immaturities. The development also demonstrated how knowledge was sought from external experts through informal networks and how technologies were drawn from other EU projects.

DIAGRAM 9.2 KEY EVENTS AND RELATED LEARNING DIMENSIONS IN THE TECHNOLOGY INTEGRATION MODULE



KEY					
	1	Task & Process learning		7	Contextual & Goal learning
	2	Goal & Context learning		8	Contextual, task & goal learning
	3	Contextual learning		9	Task & goal learning
	4	Contextual & Task learning		10	Task learning
	5	Task & Process learning		11	Contextual & goal learning
	6	Contextual learning		12	Task learning

Like the previous module, this module's goal and process of task fulfilment was discussed and clarified at the PSU meeting in January 2000. Here most partners expressed their commitments to contribute the necessary technologies. This module too, started slowly probably due to conflicting priorities from within partner organisations. The 12 cycles of dynamic learning and mutual adjustments help illustrate the path that led to the emergence of two learning groups and the subsequent unfolding of their relatively successful outcomes. It illustrates events where individual cognitive learning enabled a social behavioural learning and adjustment within the groups:

EVENT 1: 1ST FEBRUARY 2000 **ILLUSTRATES A DYNAMIC CYCLE OF TASK AND PROCESS LEARNING:**

- L's understanding of the problem of early knowledge contribution
- G's proposal to action a flexible process to enable the group to perform the task
- Behavioural collective learning to generate a list of technologies partners were particularly committed to

Given the diversity of technologies, and that no single entity possessed the entire spectrum of knowledge, it was important that each participant identified and made explicit the technologies they would contribute. Without this information, partners could not begin to envisage how the technological fit would be carried out. Each organisation had to not only table their technology but also envision how it might fit with the entire concept; they were probably best placed to make those knowledge linkages. Individual conceptualisations would help develop a common understanding amongst the group and would provide a context for the group to work together. The slow start to the module elicited an email from G detailing why contribution was important. He explained that the technology list was a necessary means to achieve mutual understanding; partners could contribute according to their own wishes and that this mechanism would ensure equity in contribution. In other words, organisations could balance individual expectations with those of Alpha as they thought best. G also reiterated the module leader's power and authority. If organisations failed to respond, technologies would be nominated by the leader for process fairness. This contrasts sharply with the business model module, which had left intervention by the leader to a late stage in the process. G's email generated action from partners; through task learning a detailed list of technologies that partners were prepared to contribute was produced. The interactions illustrated a process of shared discovery as partners clarified task interpretations.

EVENT 2: 11TH FEBRUARY 2000 **ILLUSTRATES A DYNAMIC CYCLE OF GOAL AND CONTEXT LEARNING LEADING TO ADJUSTMENT OF TECHNOLOGICAL BOUNDARY:**

- C's desire to contribute a technology outside Alpha's scope
- His conceptualisation of knowledge combination and explanation as to how the rest of the technology would benefit, providing a strategic context for the group

- A collective understanding and agreement to accommodate the technology based on similar logics of its value

Technologies were offered and listed in accordance with organisational preferences and expectations. C's proposal to include a specialist technology that otherwise was outside the bounds was justified on grounds that it would better fit the emerging context and would be of benefit to everyone. This expansion and accommodation in response to C's conceptualisation of combined technology illustrated the processual nature of knowledge. By contrast, no boundary adjustment (albeit as a contraction rather than expansion) was considered in the business model module. The technology expansion was probably also approved because of C's previous collaboration with G and G's high respect for C. C's motivation to include its technology was based on an expectation of technological and process learning. In fact, at the end of the project, C became firmly placed within various networks of Alpha partners and submitted 2 patent applications of a refined and broadened technology in its own country of origin.

EVENT 3: 12TH FEBRUARY 2000 **ILLUSTRATES A CYCLE OF CONTEXTUAL LEARNING AND INCORPORATION OF EMERGING TECHNOLOGICAL STANDARDS:**

- K's identification of the emerging, changing technologies
- K's reminder to include emerging technologies in order to keep abreast of industry development
- Collective understanding of the necessity to do this
- Adjustment of technological scope to include the standards

Given the speed of technological development, K's understanding of a need to keep an outward focus ensured that platform development was not obsolete before it was completed. This strategic learning by one of the partners was enough to lead to a collective understanding and the resulting action to incorporate the change in the tasks. It is often this external market focus that product development projects forget to adopt (Littler & Leverick, 1995).

EVENT 4: MARCH 2000 **ILLUSTRATES ONE OF MANY SIMILAR CYCLES OF CONTEXTUAL AND TASK LEARNING AS 2-3 PARTNERS JOINED TOGETHER TO FORM TEMPORARY EXTERNAL ALLIANCES WITH NON-ALPHA PARTNERS:**

- Recognition of need to share knowledge with other organisations and industry experts in order to learn about task and context
- Spontaneous formation of alliances with shared views, used as platforms for technological discussions and knowledge refinement
- Collective group understanding of this external learning and incorporation into module activities

As partners became trusting of each other, spontaneous learning groups were formed comprising two to three Alpha partners together with a similar number from outside the project, identified through existing networks and common technological interests. Enactment of short lived associations with non-Alpha partners provided an important means of gathering knowledge. As a result emerging market knowledge became more accessible to the module. Knowledge was learnt and transferred into the project by first presenting 'chunks' of technology at external conferences, which were attended by industry experts. These served as platforms for brainstorming and discussion and represented the first of many such learning efforts. It also illustrated the fact that Alpha was not entirely self-sufficient in the knowledge that participants contributed; and that there was a particular skill and knowledge possessed by some partners about who to contact for the necessary knowledge.

EVENT 5: APRIL 2000 **ILLUSTRATES A CYCLE OF TASK AND PROCESS LEARNING WITH ADJUSTMENTS OF PARTNER TASKS:**

- Problem of under budgeted resources identified by two partners as they began to understand the task requirements
- An understanding that failure to fulfil the task would impact module performance
- Efforts were made by the group to accommodate resource changes

Partners' budgeted resource levels were based on interpretations or assumptions of individual role and task requirements when Alpha was first defined. As it unfolded and partners began to learn about the tasks, two partners realised the problem of inadequate resources and a need to make adjustments. Delay in resolving this issue would impact the entire module. The problem was that Alpha's resources that were defined at the start were fixed; there was no mechanism to alter them no matter what the justification. This meant that adjustments had to be made by rearranging tasks and partner resources. After some discussion and debate, mutual understanding was reached and task adjustments were made.

EVENT 6: JUNE 2000 **ILLUSTRATES A CYCLE OF CONTEXTUAL LEARNING ABOUT TECHNOLOGIES:**

- Some important changes in the nature of technologies being integrated (STB and MPEG standards)
- Contextual learning about refinement and incorporation of changes, otherwise Alpha's output would be incompatible
- Group's behavioural learning to make necessary task adjustments

The market revealed some key changes in technologies that were being integrated. In order to ensure compatibility and to remain competitive the group had to incorporate those emerging changes. The consequence of ignoring them was acknowledged; mutual agreement was reached to make the necessary component changes. This event illustrated contextual learning resulting in task adjustment.

EVENT 7: JULY 2000 **ILLUSTRATES A CYCLE OF CONTEXTUAL AND GOAL LEARNING**

- A potential problem of compatibility of BASE technology with Omega application
- Omega could not be integrated without BASE and it was too late to select an alternative application
- Alternatives for BASE were sought until functionalities could be tested and compatibility confirmed

Whilst the generic technological platform was being built, Omega and Phi applications were selected in the first module. Omega required various compatible functions in BASE player technology which were yet undeveloped. B and L, the Omega champions learned about the issue of compatibility and likely technology delays from the other EU project. Without compatibility, Omega could not be developed; an alternative was sought to begin integration. This event was probably the key trigger for emergence of a partner grouping: a CoP that proceeded to develop the Omega integration.

EVENT 8: SEPTEMBER 2000 **ILLUSTRATES A CYCLE OF CONTEXTUAL, TASK AND GOAL LEARNING AND *EMERGENCE OF A COMMUNITY OF PRACTICE*** *(SURFACING OF THE FIRST OF THE TWO COPS)*

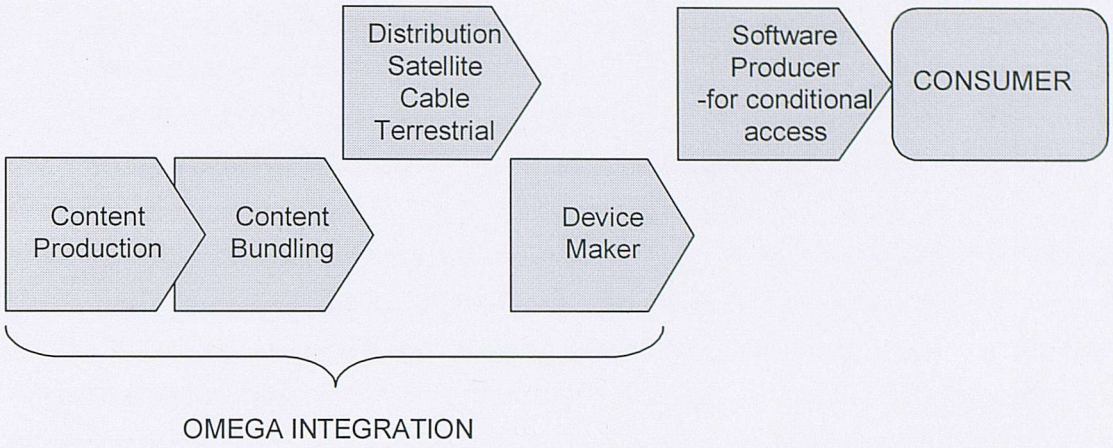
- BASE player was downloaded from the EU project; it began illustrating some expected limitations
- Key concern for the two Omega champions was failure to achieve integration
- L, B and I announced they would undertake Omega integration; other partners would not be required for this activity
- Technology boundary was readjusted

On learning about BASE technology's inability to accomplish the goal of application integration, H and G offered various alternatives but the group of 3 partners (L, B and I) decided to go it 'alone'. Presumably they shared similar frames of reference as to how the application would be integrated and the value it would generate. The CoP membership constituted technologies that seemed to make logical sense, based on the IDT value chain (Chapter 4): content provider, electronic device maker and technology integrator. It illustrated that some technologies could cluster and integrate at the exclusion of others as shown in Diagram 9.3.

This more intense cooperative process probably resulted as the group learned something about each other, the task and respective expectations. The interface was adjusted by intensifying interactions amongst its membership. Joint search for alternatives occurred in order to achieve satisfactory integration. Although L's role was to provide knowledge about user interface and testing for both applications, it seemed to have engaged itself solely in Omega development; presumably because of a greater perceived value from this.

Formation of Omega group did not lead to immediate formation of the second group. In fact it

DIAGRAM 9.3 THE EMERGENCE OF COP FOR TECHNOLOGY INTEGRATION OF OMEGA



was another two months before most of the remaining partners coalesced to agree a common agenda for development of Phi. One could argue that the remaining partners had little alternative but to unite and engage; in practice however, partners would be expected to assess the value of a newly defined technology boundary before committing to the change. Presumably any doubts over its value provided them the option of disengagement.

EVENT 9: SEPTEMBER 2000 **ILLUSTRATES TASK AND GOAL LEARNING**

- Other than participating at the PSU in January, D failed to attend any meetings or make direct contributions
- There was concern about resource implications and impact on task completion
- L undertook to persuade D to participate

D was a US based owner of an important generic technology incorporated in many STBs. Its role was clear at the start and was in fact reinforced by D's own statement of expectations from Alpha. As Alpha unfolded D's absence / non-participation became a cause for concern. D had received various streams of emails with no evidence of involvement in any discussions. Yet, it later claimed to have misunderstood its role. It probably illustrates D's early decision not to participate having assessed Alpha to be of limited value. Because of the nature of D's technology, the group continued to elicit relevant knowledge by engaging with D's technical support department. In other words, D's contribution was not proactive at all. D's motive for initial participation might have been to learn about technological issues and likely impact on its generic technology. It probably learnt what it needed to in the PSU and decided to disengage.

EVENT 10: JAN 2001 **ILLUSTRATES TASK LEARNING LEADING TO RE-CONCEPTUALISATION OF GOAL AND FORMALISATION OF THE SECOND GROUPING OR COP**

- The problem that user trials may be difficult given Phi's characteristics

- User trials were an important task and project goal; without user trials the concept's technological feasibility could not be illustrated and moreover it would lead to poor project assessment
- Reinterpretation and re-conceptualisation of the goal: instead of illustrating technological concept 'technology' would be separated from 'concept'

Although the problem of user trials had surfaced when applications were being first selected, it was swept aside by the application champions. Faced with the problem of user trials now, partners thought of ways to adjust the goal by re-framing its meaning without the risk of penalty in the final assessment. In the meantime J, G, H, C and A commenced integration of Phi application with the platform developed by H, G and C and application content contributed by J and A.

EVENT 11: MARCH 2001 **ILLUSTRATES CONTEXTUAL LEARNING AND ADJUSTMENT OF PROJECT GOALS**

- Part of C's technology was specific to its country and markedly different to that used in Europe and within Alpha
- Although C was integrating the European technology in Alpha it also wanted to illustrate the technological integration in its own country environment
- C developed technologies in parallel using its country standard supported by technology contributions from the partners

C joined the collaboration knowing that integration would involve a European standard; it was relatively easily allowed to contribute a technology that was otherwise outside Alpha's scope. Yet, as it established itself and became more trusted, it accessed and utilised partner technologies to develop a parallel technology based on a non-European standard.

EVENT 12: JULY 2001 **ILLUSTRATES WITHDRAWAL OF PARTNER G AND TASK ADJUSTMENT BY TRANSFER TO E THROUGH SOME SKILL OVERLAP**

- Internal organisation change leads to G's withdrawal from project
- Task of integration and validation has to be reassigned otherwise the outcome would suffer
- E undertakes the task of validation

Based on EUs statement each partner was a special contributor of unique knowledge. G's withdrawal illustrated the presence of some overlapping skills that enabled fulfilment of remaining tasks without any major adverse effect on module outcome.

The output from this module consisted of two separate technological developments, with adjusted technological scopes. Omega emerged in reaction to contextual learning about technological incompatibility and unsuitability; Phi developed more slowly by defining and

including technologies that remained outside the scope of Omega. Phi's development also helped illustrate the presence and advantage of overlapping skills. Neither applications underwent user trials as set out in the initial goals, nor did any novel business models become defined for either of the two applications. Nevertheless, the module outcome was assessed as relatively successful by the EU.

A considerable degree of learning resulted both individually and within the two groupings. Omega group received further sponsorship to develop its technology with a number of other non Alpha partners for another two years. H and C submitted technology patent applications in USA and South Korea respectively; K presented various papers at industry conferences and generated a number of academic publications.

9.3.3 Summary of the Technology Integration Module

Several factors led to the development of this more successful outcome. At a superficial level the dynamic development was consistent with the theory of LaMA. A more positive outcome had resulted from iterative cycles of learning adjustments. Importantly however, the learning adjustments took place not in a unitary collective entity but within two separate groupings that formed with different degrees of spontaneity. Groups emerged as vehicles for integration encompassing narrower technological scopes. The trigger for development of the first group was contextual learning about the technology and the integrative task; what seemed to hold the group together was the balance between redefined technological goal/task and individual organisational benefit.

The emergent development was aided by modular task organisation; there was technological complementary and yet differentiated tasks. Within the groups, technology champions developed compatible frames of reference that helped to reach agreements and make changes to technological boundary and process interface. They were united in action and the meaning that action represented for them (Brown& Duguid, 2001). Although organisational virtuality led to some early difficulties when partners did not know what non-contributors were thinking, the interface was intensified and deepened as partners within the groups became more trusting of each other and became more committed to a mutually redefined goal. Partners even re-located some organisational members to intensify interactions and solve technological problems. National cultural differences seemed to provide little process difficulty; this might have been aided by the predominance of European nationals and the fact that a number of partners had engaged in previous collaborations (see Table 8.3).

This technological success outcome is probably consistent with what was observed in the market place (see Chapter 4). It is unclear however whether market developments underwent a similar process that led to emergent learning clusters. If there was this clustering then it was highly likely that the business reports related to the final constituency of the technological collaboration.

9.4 COMPARISON OF THE TWO MODULES: CHARACTERISTICS AND OUTCOMES

Comparison of variation development is not a new concept in process study (Pettigrew, 1985; McNulty & Ferlie, 2002). Comparison can uncover some important themes and patterns that provide useful insights into variation development. By comparing the two development characteristics and outcomes, some key differences in patterns became apparent. They helped elucidate how the starting theory performed. The theory of LaMA states that initial conditions are either static by blocking learning and adaptation; or they are highly generative that foster learning and adaptation. In other words the transfer process does not progress independently of the initial conditions but is sensitised by it.

In this complex setting, the same starting conditions proved both inertial and generative depending upon the collaborative objective and task. The objective of business model development proved highly inertial and resulted in a weaker performance outcome; yet the same conditions allowed dynamic development of technology integration for a more successful outcome. The objective of novel business model development which required task completion through contribution of broader organisational knowledge could not be done effectively. Technologists resisted the mobilisation of knowledge that lay outside their functional domain. By contrast, the objective of technology integration was achieved relatively effectively by redefinition of the goal and task content. Interestingly, the two differential outcomes are not inconsistent with market developments: technological integrations were being demonstrated but novel business models had yet to be defined. In other words, how the integrated concept would be economic value to the integrating constituency could not be readily shown. The managerial implications of these findings are discussed in Chapter 11.

9.4.1 THE KEY DIFFERENCES IN MODULES' INITIAL CONDITIONS ARE CHARACTERISED AS FOLLOWS:

***Expectations*:** In the case of Business Model module, although there was a great deal of enthusiasm and optimism in wanting to develop novel business models, partners somehow developed conflicting frames of reference. In other words, a single, cohesive frame of reference did not develop. They seemed to base their assessments of collaborative value on different sets of criteria than first defined: a common strategic context did not develop; there was reluctance to share broad organisational knowledge, which manifested in a concern for loss of sensitive organisational knowledge. The Technology Integration module on the other hand demonstrated development of similar frames of reference amongst the group memberships. They developed common understanding and expectations of what was being pursued and its value.

***Interface*:** The technology module illustrated an interface and process that was fairly fluid from the start. It demonstrated the lengths partners went to gather knowledge, build trust through mutual understanding and achieve consensus, albeit within a smaller group. The frequency of face to face meetings increased; in one particular case organisational participants were relocated to another's facility in order to speed up integration. The business model module by contrast remained fairly rigid, narrow and distant in its interface design. Dominated by

technologists, very little room was created to engage functional members from respective organisations. Although a number of partners identified a need to make changes and adjustments to this interface, the group could not be moved. By keeping functional specialists out of the process, the participating group by itself could not agree on the goal and how the task could be completed.

***Skills and Organisational Practices*:** The lack of business skills amongst the participants limited the performance of business model module. Smaller organisations recognised the need for this knowledge to be brought into the process but larger organisations would not make it happen. The technology module on the other hand illustrated an ability to engage in a wide search for knowledge through utilisation of different networks and external sources. Even when a single participant within the groups put forward suggestions for specific knowledge, the rest of the group was highly supportive and receptive to the suggestion.

***Task*:** The deeply differentiated skill bases (with respect to technology and business component of knowledge), dense and tight systemic interdependence of task structure (associated with different sectors of knowledge) hindered the dynamic development of the business model module. The nature of the goal was such that it would have been difficult for a small mass of partners to engage and construct an all encompassing technological business model. They did not possess the necessary knowledge. The technology module by contrast had modular task definition with complementary technologies; despite some technological sectoral differences the group was able to envision the integration and accommodate task requirements. The process was greatly facilitated by internal champions who helped influence the group to move in the same direction.

The two resulting differential outcomes can be summarised as follows:

***Weaker Success Outcome*:**

The initial conditions led to a fragmented cognitive learning about context, task, process, goal and skill. Despite cycles of fragmented learning, there was a collective inertia to adjust the initial conditions; a critical mass of partners could not be motivated to see the value of the goal of business model development. In other words, the group was neither able to create conditions that enabled understanding the module's success requirements, nor could it act on the cognitions of the smaller organisational members. Because the tasks were not considered particularly important or significant, disengaged membership and lowered commitments to the module ensued, finally leading to a weaker success outcome. This business model related outcome was consistent with other contemporary technological developments. Without further testing of the research findings however, it would be difficult to say whether market developments had undergone and were a result of a similar learning and mutual social non-adjustment process.

***Higher Success Outcome*:**

The initial conditions created an environment that allowed cognitive learning about the context and the task, resulting in behavioural learning. This led to the formation of two separate partner groupings. The conditions within the two groups further led to cycles of cognitive and behavioural learning about the context, task, skills and process. The result was heightened expectations and higher commitments by the group constituency to the goal, and a final higher success outcome. In contrast to the previous module, goal and project assessments were considered of significant individual and collective value. One of the two groups continued to increase their commitments by going on to form a further two year collaboration. The more successful outcome is consistent with other technological developments in the market place. Without further testing of these research findings however, it is difficult to say whether those developments underwent a similar social learning and mutual adjustment process.

The preceding discussion of the conditions of the two modules and their differential impact on the process outcomes are summarised in Table 9.2.

TABLE 9.2 SUMMARY OF MODULE PROCESS FACTORS AND IMPACT ON OUTCOMES

		Business Model Module	**Technology Integration Module**
Initial Conditions	Expectations:	Conflicting frames of reference; lack of common strategic context	Development of similar frames of reference; common sense purpose and direction
	Interface:	A fairly rigid, narrow and distant interface; technologist domination with little room to engage functional members	A relatively fluid process interface with increasing trust and understanding
	Skills & organisational practices:	Lack of business skills; despite small organisations possessing these skills the larger constituency could not engage in it	Ability to engage in a wide search for knowledge through utilisation of different knowledge networks
	Task:	Deeply differentiated skill bases, dense and tight systemic interdependence associated with the different knowledge sectors	Modular task definition with complementary technologies; joint accommodation of task requirements
		No champion to push and sustain the cause	Development of internal champions
Impact of Initial Conditions		Blocked learning and Inertial module development	Interactive cycles of learning and Generative module development
Process Outcome		*Weaker Success Outcome*	*Higher Success Outcome*

9.5 CONCLUDING REMARKS

This chapter has served an intermediate step in induction and theory generation by presenting important inductively surfaced analytical concepts, from the initial process description. It has provided a fine-grained analysis of the process findings, by applying cycles of learning and mutual adjustments to key events over the course of Alpha. Development of variation in two process outcomes has been discussed to illustrate the different characteristics of the initial conditions and patterning of learning adjustments. This has helped benchmark the empirical process findings against the process theory. It has also shown that the empirical process outcome findings were consistent with the outcomes of other IDT technological developments in the market. The empirical process findings however cannot be generalised without further testing of the process research.

The rich nature of this process analysis has shown that alternative methods of analysis such as quantification (Van de Ven & Poole, 1989) might not have generated the depth and rich insights gained here. Quantification methods would have collapsed event cycles of learning into binary codes: whether learning had occurred or not. They would have failed to capture important human behaviours and reasons for those behaviours. They would have required a greater number of similar events for statistical testing. By contrast, the handful of critical events here painted a much richer dynamic picture. The enormous analytical task has also illustrated the reason why this type of research is limited to small scale studies. This process variation might not have been uncovered using secondary, de-contextualised data that reports outcomes in singular terms.

The analysis also uncovered abstract concepts that helped with theory development. The concept of CoPs drawn from the knowledge management literature (Lave & Wenger, 1991; Tsoukas, 1996; Brown & Duguid, 1991) surfaced during the analysis. The unexpected emergence of these concepts might have been missed if the methodology had relied on single or even multiple cross-sections.

The next chapter develops and provides the theoretical research contribution.

SECTION IV

THEORETICAL CONTRIBUTION & CONCLUSIONS

CHAPTER 10

THEORETICAL CONTRIBUTION

10.0 INTRODUCTION

This chapter represents the inductive and theorising element of this combined deductive-inductive qualitative research. It summarises how a high level of complexity affected the process of technology transfer and integration, leading to the development of a divergent performance outcome; how the dynamic theory of LaMA was empirically supported up to a point in this process. Beyond this, the findings were inconsistent with what would be expected or predicted by the theory. In other words, the theory was not entirely corroborated by the empirical findings in this high complexity setting. The objective of combining an inductive research element was that if the predicted outcome did not occur, theory development and modification would have to be made grounded in the data.

Theory extension is presented here in the form of a simplified pattern, theoretically constructed from the research findings. Simplified patterns are important theoretical narratives that underlie process explanations (Poole, Van de Ven, Dooley, & Holmes, 2000). They provide a means for explaining complex systems. And they are based on the premise that societies and organisations have simple, deep and recurrent underlying patterning that is identifiable and causally explained (Ferlie, 2002; McNulty & Ferlie, 2002). Comprehension of the particular evidence was required to construct a narrative explanation, to uncover this underlying pattern (Poole et al., 2000).

The developing pattern illustrated the emergent formation of smaller, more contained structures within Alpha's broad organisation. They allowed more dynamic social learning and change to occur. The structures demonstrated important features drawn from the Communities of Practice literature (CoP) (Lave & Wenger, 1991; Wenger, 1998; Wenger & Snyder, 2000; Brown & Duguid, 2000; 1991). The pattern was considered a synthesis of LaMA Theory with important concepts from CoPs, an emerging knowledge management literature stream. The CoP concepts provided a mechanism that helped explain how social learning occurred in the context of a high level of complexity. Importantly, the two theoretical perspectives were considered complementary. The added research contribution was the theoretical enhancement that explained the process by which CoPs emerged. Theory of LaMA provided a finer grained approach to explain how a more positive outcome within the overall collaborative structure developed, aided by CoPs. CoPs were triggered by shared understanding within the gravitating constituency, which allowed further cycles of dynamic social learning. In essence, the theoretical synthesis helped explain the anomalous, more successful development of the performance outcome.

The chapter starts by exploring the meaning of theorising or theory development. It makes explicit the approach taken for theory extension. The empirical findings are summarised: to illustrate how higher level of complexity impacted the process development; and how it resulted in the development of a theoretically anomalous outcome. The chapter goes on to reason why LaMA Theory was not rejected outright as a theory totally inappropriate in this complex setting. It discusses the complementarity of the two perspectives and the added contribution to the LaMA model. This contribution is a result of its synthesis with a social constructionist perspective using concepts of CoPs. These concepts and their characteristics are defined and a brief review of this stream of organisation literature is presented.

The theoretical synthesis consists of a fine-grained dynamic process of learning cycles and mutual adjustments within two emergent structures in the single collaboration. The emergent structures represented the facilitating intervening structures, which allowed highly dynamic cycles of LaMA to occur within the overall process. This learning might otherwise have been hampered by the starting collective structural design. They might also be considered mechanisms that helped the membership overcome the constraints of higher complexity. This synthesis represents an amalgam of insights formed from empirical observation, inductive reasoning and emergent reading of related organisational literatures. Finally, the extended theory should serve not just as statement of explanation of an occurrence. It must also operate in helping frame questions that might be applied in other settings in future research (discussed in Chapter 11). It must also generate important lessons that might be useful to practitioners and researchers. A closing theoretical proposition is constructed from the extended theory which might be tested in future research.

10.1 Meaning of Theorising or Theory Extension

Before summarising the findings and going on to discuss theory extension, it is worth spending a few moments understanding the meaning of theorising or theory extension. A key question reflected upon at some length in the research process was the point at which one could say that a theoretical extension had been achieved; and additive theoretical contribution had been made. Assuming that neither data alone nor mere diagrammatic representations (as mind maps) constituted a scrupulous theory, there had to be a clear understanding of what was meant by theorising. Once this understanding was made explicit, then the generative process would have to be consistent with it.

In using highly simplified therapeutic metaphors, Weick (1995) envisions data as symptoms, theory as diagnosis and prescriptions as treatments. If theory represented a diagnosis of what was observed in the research data then how did one arrive at this theory? Once theory was proposed, what propositions might be developed for use in future research in other complex settings?

The thinking around the issue of theorising was greatly helped by the work of two authors (Weick, 1995; Pentland, 1999). Their work clarified that theorising was not merely a search for

final product, known as theory. It included the traversing of a whole continuum in the interpretative process, culminating in conceptual construction of a process explanation. It included moving from the starting superficial text, to finding deeper meaning in that narrative, to constructing the final explanation. The final explanation was constructed by conceptualising the most likely generative mechanisms. This journey from text to theory is represented in this thesis by moving sequentially from Chapters 8, 9 and then 10.

Pentland (1999) argues that regardless of what approach one takes to create a narrative, 'an explanation is basically a process theory or a hypothesis about a causal sequence of events'. Weick (1995) similarly argues that theory is not a dichotomy but a continuum. It starts with guesses or speculations and ends with explanations and models. In other words, it is not just the output but includes the process that leads to the final product. In fact, the word theory belongs to a family of words that includes guess, speculation, suppositions, conjecture, proposition, hypothesis, conception and so on. The danger of concentrating on deriving a simple theoretical model as research output can de-contextualise dynamic process. Before reaching a simpler de-contextualised state, one has to gain an understanding of the surrounding circumstance. If the overriding concern remains for simplicity, then one might want to skip process theory entirely (Pentland, 1999). This of course was not the research intent. It also highlights the problem of simplicity and generality as a trade-off against accuracy (Langley, 1999). In this research, accuracy was highly important and the aim was for analytical rather than statistical generalisation (Yin, 1994).

Pentland conceptualises process as a grammatical model rather than a fixed linear sequence. The grammatical model represents a generative mechanism whose search is analogous to a search for deep structure in the narrative. The problem with deep structure is that it is not easy to see. To uncover deep structure, one has to progress down a number of levels: starting from text to story, through to fabula and finally to the generative mechanism. Text refers to the telling of a story by a particular narrator: for example, in this research it was my telling of the unfolding story of Alpha in the converging IDT sector. A story is a version of a fabula from a particular viewpoint; and a fabula is a generic description of a particular set of events and their relationships. Here, the constructed fabula consisted of development of two process modules which culminated in differentiated performance outcomes. They were analysed using theory of LaMA. Any given dataset can allow construction of a multitude of stories depending on the researcher's prior experience and conceptual lens used. As a consequence, another narrator might have told a different story. He might have focussed on a different set of events and constructed different linking relationships, representing a different fabula. Finally, generating mechanisms refer to the underlying structures that enable or constrain a fabula.

In constructing a fabula and its generative mechanisms, processes, events, actions and agents are central to analysis. This contrasts starkly with say dependent variables in positivistic paradigm, when temporal events, actions and agents are not necessarily included in analysis. The positivistic paradigm is generally based on singular, 'objective' views that link dependent

variables to a set of independent variables, in linear relationships, without the richness of the unfolding story. So, for instance one might find that *x* caused *y*, but the method limits the discovery of how *x* might have caused *y* or what influences a particular time and space might have had.

The richer generative mechanisms uncovered here, were the emergence of CoPs. They were mediating structures in the transfer process that created conditions for generative cycles of learning and mutual adjustments, and led to more successful process outcomes. This theoretical enhancement is discussed later in this chapter. It is noteworthy that during research analysis there was no conscious effort to search for these concepts. In fact, the start of the analysis was not informed by this literature stream at all. It was only over the course of analysis that the observed events and emerging pattern was thought to mirror CoP concepts. This connection was made by the opportune reading of a study located in the healthcare sector where managers had set out to construct these concepts to engender innovation and learning (Swan, Scarbrough, & Robertson, 2002). Further reading of this literature was undertaken to determine if the findings truly reflected the features displayed by CoPs. This then represented an inductive discovery of a new branch of theory.

If the principle of transitioning across deepening levels of text to discover generative mechanisms is adopted (Pentland, 1999), then this chapter cannot be read in isolation. The reading has to take place against a backdrop that includes the research method that guided the generation of raw text; and importantly, the empirical findings (Chapters 8 & 9) that captured the *gestalt* in its space and time (see also Chapter 4). The nature of this research data was critical in providing the depth and insight that might not have been possible otherwise, particularly when standardised variables, extracted away from the context were not the key concern. This backdrop should help the reader construct in his own mind how the researcher moved from raw text, uncovered some nuanced discourse and developed important insights to make conceptual linkages. Chapter 9 in particular showed how the process diverged from that predicted by the theory; how the concept of CoPs was imagined and related to the emerging pattern.

10.2 Summary of Empirical Findings and Limits of LaMA Theory

This section summaries the empirical findings and discusses the process divergence from that predicted by the LaMA model and the impact of higher complexity on the technology transfer process. In so doing, it uncovers the limits of LaMA Theory. It goes on to theorise the divergent findings.

Alpha was viewed as a highly complex collaboration, whose technological integrative goal relied on a mutually learning and adjusting social process for transfer of complementary technologies. It was argued in Chapters 3, 4 and 5 that higher level complexity along a number of dimensions would be expected to impact the process smoothness and performance outcome. To briefly recapitulate the predictions made by LaMA theory (discussed in Chapter 5):

i) For development of a successful technology transfer outcome, initial conditions would facilitate highly dynamic cycles of learning and mutual adjustments in a unified and collective entity. In this complex setting, the complementary technologies would be expected to be contributed by the constituent organisations in a mutually reinforcing manner

ii) For development of an unsuccessful performance outcome, initial conditions would hinder cycles of learning and mutual adjustments along one or more learning dimensions, particularly if one or more partners and their associated technologies became disengaged in the transfer process

The empirical research found that Alpha's initial conditions proved highly inertial in the development of the business model module and yet the same conditions were highly generative in the development of the technology integration module. The process dynamics of the more successful development showed an interesting theoretical anomaly. When the collaborative structure had to act as a unified learning and mutually adjusting entity, initial conditions became much more inertial. The high level complexity of the setting seemed to hamper its progress. Yet technological integration continued generatively at the exclusion of some important technologies and partners. In other words, the originally defined unified structure of interdependent technologies became fragmented, yet development unfolded in a dynamic manner. Here the effect of complexity seemed to be overcome by the emergence of two groups or CoPs that learned and worked separately by re-defining the technological scope, yet within the framework of the single collaboration.

The inertial development and poor performance outcome of the business model module was not dissimilar to the inertial development of dyadic transfers (Doz, 1996). Consistent with the theory, a mutual reconstitution and reconfiguration of project conditions could not be effected. Despite discovery and understanding of some key problems, there was repeated failure to learn collectively. Partners were unable to revise and refocus the much needed business model module conditions. In the same way that dyadic alliances needed to make learning and mutual adjustments jointly, this complex setting would have required a collective process engagement. Consistent with Doz's findings, inertial development was primarily contributed by dense and tight systemic interdependencies. The deeply differentiated skill bases, seeming fragmentation between intra-organisational functions, and conflicting frames of reference, hindered the change that was necessary. An adjusting change might have led to the development of a more positive outcome. But, it is of note that there was little overlapping knowledge that could have been substituted by other project members, particularly given the nature of the task that extended beyond the bounds of technological knowledge.

At a superficial level the dynamic development of the more successful (technological module) outcome was consistent with the theory of LaMA. A more positive outcome had resulted from iterative cycles of learning adjustments. Importantly however, learning adjustments took place not within a single, unified entity but within two separate groups that emerged with differing

degrees of spontaneity. Emergent groups redefined narrower technological scopes, yet worked within an overall single structure. The structure also contained some disengaged members.

The development of the first group was triggered by contextual learning about the technology and the integrative task, reflecting an emerging problem that needed to be solved. The bond that seemed to hold the group together was the balance between their view of the redefined goal and individual technological benefit. The development was also aided by modular task organisation; there was technological complementarity and yet sufficient differentiation in organisational tasks to integrate 'chunks' of technology. Within the groups, technology champions provided leadership to develop compatible frames of reference that drove the technology boundary changes and associated process interface. Development of compatible frames of reference meant that community members were united in action and the meaning that action represented for them (Brown & Duguid, 2001). Although organisational virtuality led to some early difficulties when partners did not know what non-contributors might be 'thinking', the interface was intensified and deepened as engaged members became more trusting of each other; they became more committed to a re-envisioned mutual goal. Partners even re-located some members to intensify interactions and solve technological problems. Intensive cycles of assessments and evaluations took place individually and within the groups, leading to deepened commitments. Clearly, the intensive cycles of understanding and action reflected the quality of learning within those structures.

This latter outcome demonstrates the limits of LaMA Theory. The discrepant performance outcome suggests that higher level complexity did matter in the way the technology transfer process unfolded in this setting. This raised an important question regarding the appropriateness of continuing with the LaMA model. In other words, given the limits of LaMA Theory should it be rejected entirely? Before dealing with this question, a brief discussion of the substantive analysis follows. It looks at the impact of dimensions of complexity and how the transfer process was affected by them.

10.2.1 Constraining and Facilitating Impact of High Level of Complexity

As stated in Chapters 3 and 6, the research aim was not specifically to track any of the five dimensions of complexity over the transfer course. The reason being that they were expected to have changing characteristics and properties; they might even influence each other over time. Moreover, they did not represent some objects isolated from the actual process. Instead, there was greater concern to follow the general development of the technology transfer. Nonetheless, some broad observations about the dimensions can be made; it is difficult to say whether any single dimension played a more dominant complicating process role.

Virtuality: The dimension of virtual organisational interface proved both facilitative and obstructive depending on how the initial conditions were set. In the case of the business model module, lack of participation or silence from various partners might have been easier to comprehend if the group had been co-located. Instead, some partners wondered if the goal and

task significance were understood by the rest of the collaboration: reflecting a problem of mutual knowledge (Cramton, 2001). In the technology integration module however, virtuality provided limited constraints as technology champions keenly adjusted the interface conditions to reach a revised mutual goal. The same dimension of complexity clearly became a constraint when the group could not envision a common or mutual goal.

ORGANISATIONAL FORMS: although differences in organisational forms did not seem to have a marked effect on the transfer process, larger organisations were clearly constrained by the lack of representation or participation by functional specialists. The technical specialists could not see beyond the technology when broader business knowledge was required; there was some evidence of technologists' reluctance to involve the business specialists. By contrast the smaller organisations whilst dominated by technical experts or engineers possessed a far broader business understanding. But they lacked the necessary knowledge spectrum and had insufficient power to influence the whole collaborative entity. Interestingly, one of the key contributions made to the collaboration by the smaller organisations was the ability to tap into large knowledge networks when internal knowledge or technical competence was insufficient. Expert knowledge was accessed easily and repeatedly when specific technological problems could not be solved by the constituency.

TECHNOLOGICAL DIFFERENCES: sectoral knowledge differences seemed to present surprisingly few problems; lack of understanding of technical language was clarified and quickly simplified. The biggest difficulty seemed to arise from intra-sectoral functional knowledge as seen in the business model module and the need to include business and marketing knowledge. The ability or willingness of technologists to learn beyond their functional expertise proved difficult. There might have been an underlying fear that the technological concept under development would be challenged for its marketability and economic value.

EXTERNAL CONTEXTS: emerging industry segment changes had varying impact on contributions of constituent technologies. Participants that could not see beyond contextual difficulties disengaged partially or wholly from Alpha. This occurred in both the modules, yet the two outcomes were considerably different. Technological scopes were more readily readjusted and some apparently overlapping knowledge enabled tasks to be absorbed from disengaged members.

Diverse national contexts provided remarkably few difficulties. Language differences had little impact probably because most members had a good grasp of English (main language for communications) and were bonded by a technical language and professional engineering backgrounds. In contrast to Browning, Beyer, & Shelter (1995) findings of distinct codes of technical language even within the same industry sector, these difficulties were not observed here. There also seemed some close and relaxed working relationships between partners with prior ties, perhaps because they did not have to prove themselves in any way. Differences in technological standards imposed by some national contexts were dealt with creatively. With

permission from the membership, the South Korean organisation opted to develop a parallel technology to include its nationally adopted standard alongside the European standard. This clearly signified its perception of collaborative value. Its deepening commitment to Alpha was illustrated in the significant increase in resource invested over time. Presumably, the learning it gained using a wider European and its own national standards enabled it to have a 'foot in both camps' to flexibly respond to market developments both at home and internationally.

SPEED OF LEARNING: although the method adopted in this research cannot claim to have properly or rigorously compared and measured the speed of organisational learning, it was evident that some partners chose to slow down at various points in time; seen particularly in the business model module. Slowing down in many instances was driven not by an inability to learn but a lack of congruence with the overall project goal and individual expectations. The faster learners seemed to have a sense of urgency and greater vested interest in Alpha's overall accomplishment. These champions led the various adjustments to ensure that knowledge gaps left by disengaging partners were filled relatively easily. This would suggest that despite partners' representation of unique technologies the presence of some overlapping skills had proved beneficial in task assimilation.

In summary, the dimensions of high level complexity had a complicating effect on the transfer process and led to a process variation not predicted by LaMA Theory. Process variation has been studied elsewhere in different industry sectors (Pettigrew, 1985; McNulty & Ferlie, 2002; Ferlie, Fitzgerald, Wood, & Hawkins, 2005), some using different organisational perspectives. Comparison of outcomes in process variation provides a useful basis for uncovering variation in patterns and limits of a theory. The distinguishing feature of this research as a process variation study was its greater emphasis on learning cycles and impact of those learning cycles on process outcomes. Its greater engagement with the micro-processes provided an opportunity to understand at a fine-grained level the various tensions in the collaborative: tensions amongst various content and process dimensions. Without focusing on learning cycles, these tensions and their influencing impact might otherwise have been glossed over.

The discussion now moves to the issue of the relevance of LaMA Theory.

10.3 SHOULD LAMA THEORY BE REJECTED ENTIRELY IN THE ANALYSIS OF THE IMPACT OF HIGH LEVEL OF COMPLEXITY?

If the empirical findings did not corroborate the LaMA theory then what theoretical modification or alternative theory might help explain the findings? This question led to reflect upon two alternatives, whether:

i) The LaMA Model should be rejected entirely in this high complexity setting on the basis that it had no relevance to the transfer process, or

ii) Whether another theoretical perspective might be added to the LaMA Model to deal with the impact of high level of complexity. This option would be feasible only if the additional perspective was congruent with the theoretical paradigm it was adding to

The first option was rejected on the basis that the model did indeed have applicability in this setting, albeit to a limited extent. The second option was chosen in the belief that addition of another theoretical perspective (Communities of Practice (Wenger, 1998; Brown & Duguid, 1991; Lave & Wenger, 1991)) greatly benefited LaMA Theory in helping to overcome its limitation. The intervening structures that emerged shared many of the features associated with the notion of CoP, namely: a spontaneous form of organising in response to a problem by a limited membership, which resulted in an excellent forum for problem solving and social organisational learning. This helped overcome the limits of organisational design. Learning was facilitated by emergence of internal champions or leaders, with a strong vision about a modified goal; development of shared understanding and importantly maintenance of a 'healthy autonomy' within the bounds of the overall collaborative structure (Brown & Duguid, 1991). By retaining LaMA Theory, there was complementarity between the two theories and greater potential for theoretical enrichment in this setting.

The two perspectives were considered complementary and not contradictory, given their fit within the same process paradigm. They both deal with the same phenomenon of social learning; neither has a concern for linking of discrete variables in linear relationships. Addition of a perspective very different in nature from the LaMA Model, from say Industrial Economics, would have introduced ontological and epistemological contradictions and would have invalidated the research process.

There might however be a counter argument that CoP perspective could represent a sufficient, alternative theoretical framework in this higher level complex setting. This would then call for rejection of the LaMA Model entirely. For instance, a highly complex collaborative organisation might be viewed as a single organisation or a workgroup, not dissimilar to any other organisation that became redefined over time, into two separate CoPs (Brown & Duguid, 1991). Whilst plausible, it was thought that CoP perspective alone gave limited insight into the embeddedness of the structures and their differential quality of learning within the overarching collaborative. In other words, it might not have given insights into the extent or boundaries of social learning and how mutual adjustments along a number of process and content learning dimensions occurred; how this influenced the construction of the structures; how the learning in these structures influenced the final process outcome.

It was thought that formation of local CoPs was just as important as the underlying structural dimensions that provided the formative conditions. It was also thought that the CoP approach alone might be far less fine-grained than the research process engaged in thus far. LaMA Theory clearly dealt well with content and process issues (Pettigrew, Ferlie, & McKee, 1992). CoPs represented redefined structures that allowed dynamic learning adjustments in content

and process. The method guided by LaMA Theory enabled uncovering of learning adjustments to the goal and tasks within the redefined communities. Conflicts and tensions between individual actions and expectations and their influences on the social community could also be captured. These might otherwise have been disregarded. This synthesised theory is considered relevant in that it might be useful in other high level complexity settings in allowing managers to draw naturalistic generalisations (Stake, 1995).

There now follows a brief review of the CoP literature.

10.4 COMMUNITIES OF PRACTICE (COP) AND ASSOCIATED LITERATURE STREAM

The theoretical perspective used to extend LaMA Theory is drawn from an emerging knowledge management literature in Organisational Studies, known as Communities of Practice (CoP) literature. The CoP perspective is based on a social constructionist view that sees knowledge as embedded in social work practice. In other words, knowledge is processual, socially enacted and situated locally. It is inseparable from the activity that creates it and learning plays a central role in its creation. It challenges the traditional view that learning takes place at the level of individuals or organisations as some distinct and separate activity from knowledge creation, and views it instead as a collaborative, adaptive social activity. The notion of locally enacted and situated learning was believed to resonate with LaMA's individual and mutual learning cycles along various learning dimensions: where behavioural learning resulted from a social understanding of the environment and task needs. With divergent learning, or a lack of shared understanding, individuals / organisations moved away from each other reducing their commitment to continued community membership, illustrating a lack of social adaptation.

The knowledge management stream conceptualises CoPs as an emerging form of organising that complements existing organisational structures. They provide a strong basis for knowledge sharing, learning and organisational change (Wenger & Snyder, 2000). Their organisational value is particularly relevant in that they help overcome the inflexibility of bureaucratic practice (Brown & Duguid, 2001); they help overcome the often rigid functional boundaries in large organisations. Not surprisingly, the concepts have gained popularity in the debate on how organisations learn and create new knowledge. They have also played an important role in highlighting the extent to which knowledge and learning are situated in work practice (Lave & Wenger, 1991; Brown & Wenger, 1991); how they represent the locus for real organisational work. In essence, CoPs signify that most organisations are beyond the scope of engagement of the entire membership.

The key argument made by this literature is that top down institutionalised work suffocates creativity. It inhibits organisational responsiveness to changing and unpredictable environments (Brown & Duguid, 2000). Situated work practice is significantly different from institutionalised design in that mutually reconstituted groups can learn through experimentation and improvisation (Wenger, 1998). Institutionalisation here does not necessarily signify a single formal organisation but may also apply to settings where institutionalised process may be

evident. One might say that despite Alpha's relatively short lifespan, it initial design displayed some institutionalised processes.

Although learning and knowledge creation is promoted within CoPs, more recent work has generated considerable internal debate about quality of learning between different communities, situated intra- or inter-organisationally (Swan et al., 2002; Ferlie, Fitzgerald, Wood, & Hawkins, 2005). The apparently contradictory learning within and across different CoPs reflects the sticky and leaky knowledge dilemma discussed in Chapter 2 (Szulanski, 1996; Polanyi, 1967). Before exploring these debates the concept of CoP is briefly defined along with its key characteristics.

A CoP has been defined as a work related community created through the sustained collective pursuit of a shared enterprise (Wenger, 1998). In this practice participants share understandings concerning what they are doing and what it means to them and to the community. They enact it in their daily work. Thus members are united in both action and in the meaning that action has, for themselves and the larger collective (Brown & Duguid, 1991). This perspective rejects knowledge transfer models that isolate knowledge from practice. It develops a view of learning as social enactment through learners' generation of understanding from a wide range of materials. Knowledge is firmly placed in the context in which it has meaning: including organisational context, individual histories and members' social relations. Thus what members learn is intensely connected to the conditions in which it is learned: a point ignored by the positivistic paradigm.

How does situated work practice promote higher rates of organisational learning?

Learning outcomes within the communities fare better perhaps because of their self constitutive nature; this sharply contrasts with top-down, organisationally imposed structures. Ease of flow or transfer of knowledge is clearly an important concept in this literature. Brown & Duguid (2001) refer to Orr's account of practice and analysis of work and argue that understanding work and learning requires focus on formation or change of communities where work takes place. Orr studied the canonical practice of field based technicians instructed to deal with machine faults. Their work was based on the premise that if formal instructions to deal with technical faults were exhausted, then repair was abandoned for replacement with a new machine. Orr argued that this type of learning was stunted and that both the faulty machine and the social context of the user site were essential knowledge for defining the problem and developing a solution. In other words, formal instruction as some discrete knowledge separated from knowledge in use was not sufficient in daily work. In practice, technicians and specialists exchanged versions of a problem as stories, until they arrived at a shared diagnosis. The specialist's insight became accumulated not because of some private substance but from social learning. Learning clearly was not an individual process. This situated practice was particularly applicable to Alpha's technology module in the way community members, led by one or two champions imagined different technological concepts, articulating the fit with key technologies. The emerging communities provided the work and social context for members to construct shared identities. Adaptive conditions were created that allowed improvisations and the thinking

outside the technological boundaries set initially. It is important to note that improvisation did not signify a decision to settle for an inferior outcome. It merely represented the membership's view of a better fit with the conditions at that time.

What are the features of the structures that allow situated work practice and learning?

CoPs differ from institutionalised entities along 3 dimensions (Wenger, 1998). Each dimension provides an important condition for learning and was seen in Alpha[67]:

i) They negotiate their own enterprise
ii) They arise, evolve and dissolve according to their own learning
iii) They shape their own boundaries, though these boundaries may at times be congruent with institutional boundaries

In essence, what distinguishes CoPs from say normally mandated organisational project teams or work groups is that they emerge spontaneously from an informal network of individuals with similar work related interests (Lave & Wenger, 1991; Wenger, 1998). The highly dynamic structure may have a changing membership, but it retains a history of learning. Members select themselves and come to know if and when they should join and whether they can contribute or indeed benefit from it. They may be invited to help solve a mutual problem. Members may disengage depending on their conception and expectations of the community. It is this selective engagement and social enactment that contributes to dynamic knowledge sharing and learning. Community membership may not be limited to single organisations, particular disciplines, job roles or professional affiliations; they may arise intra or inter-organisationally.

Organisational knowledge boundaries are crossed when members share an epistemic culture, resulting in multiple and heterogeneous CoPs. CoPs therefore are as diverse as the circumstances that give rise to them. But it would be difficult to know which problem would result in a CoP or what its constituency might be. Another important feature is that CoPs are held together by a shared passion, commitment and identification with the group's vision and expertise. They last as long as an advantage exists in maintaining the group. The community is self-perpetuating; as new knowledge is generated, it reinforces and renews itself to collaborate further[68]. One or more participants may provide the intellectual and social leadership that helps drive the community[69]. Leadership may change but is supported by the rest of the community. Whereas institutionalised workgroups may be concerned with accomplishing a specified task, CoPs recreate their own vision that may fall outside defined organisational agenda. In response to emerging problems, CoPs innovate by making local adaptations in their work practice by constructing conceptual frameworks and assessing their interaction with the environment. In essence, CoPs enable parts of the organisation to step outside the limiting core, to ask different questions and seek alternative explanations. In allowing different points of views to be heard,

[67] See development of Technology Integration Module in Chapters 8 and 9
[68] This feature was clearly seen in one of the technological developments
[69] Champions or leaders were evident in the two emergent communities

answers emerge from within the community. The enacting organisation re-conceives not just its environment but also its identity in a mutually constitutive way.

Wenger & Snyder (2000) argue that workgroups are generally structured for coordination, with a primary concern for efficiency. CoPs on the other hand are self-organising, free-flowing, informally bound entities that do not always follow set organisational agendas; they may be more effective rather than efficient. This spontaneity and freedom from organisational constraints has led scholars to make positive links between CoPs and learning, knowledge flow and innovation (Brown & Duguid, 1991).

Sustained social engagement by the membership that sets its own vision gives rise to conceptual knowledge boundaries. These boundaries confer a community identity not in an objectified sense but in how engaged members' understanding and behaviours. CoPs become legitimised by the membership and those seeking to participate in them. Significant work and learning differences are seen within and outside the boundaries. These learning differences may cause organisational fragmentation and impede knowledge flows across different communities. The shared engagement and practice may help explain why some members choose to engage in one community and not another. An important feature of the fit of the CoPs within the larger organisation is that they maintain control over their own activities as well as emphasising a belonging to the rest of the organisation. If this delicate link did not exist, CoPs might be considered highly anarchic.

Each of Wenger's (1998) three dimensions was demonstrated in the emergent structures in Alpha's technology module and the learning behaviours within the structures. The key features of the CoP concept that seemed helpful were: a problem to trigger formation of informal spontaneous structures within a formal organisation; internal conditions within the informal structures that enabled learning and knowledge creation. This structural formation to overcome an otherwise inflexible organisational core that provided the mechanism for dynamic learning was viewed as an important addition to LaMA Theory. Once formed, the membership remained fairly stable in Alpha's two communities. The communities took on recognisable identities associated with specific application developments (Omega and Phi). Conditions within the CoPs helped overcome some higher complexity of this setting. These structures might also be conceived as sub-levels of analysis, but firmly placed within the single collaborative structure.

CoP characteristics were considered relevant in the way learning blockages or inflexibility in problem re-conceptions was overcome by Alpha's technology module. It also reinforces the fact that knowledge creation was not some discrete, separate and pre-ordained activity from knowledge transfer but intimately interlinked to process; the higher rate of learning within the emergent structures was an important influencer of the final more successful outcome development. The emergent structures helped add to LaMA Theory, representing structural improvisations within which LaMA Theory continued to operate dynamically. From these findings, one might tentatively suggest that failure of communities to form in the business model

module probably led to poor process outcome. The key concepts are theorised in the theoretical discussion that follows after this review.

An important feature of social participation is that community members acquire its particular point of view and learn to speak its 'language'; they become socialised into behaving as community members. This has considerable resonance with LaMA's imagery of how individual behaviours and actions are influenced by the context and in turn influence the collective social entity. These features were observed in Alpha: the characteristic of unified action was seen in the two emergent communities, in the way goals and tasks were revised as joint understanding concerning IDT context and constraints of the starting goal developed. Without the smaller communities, this joint sense of purpose for a significant change of project goal might not have happened. The conditions in the collective collaboration clearly hindered the need for experimentation with different ideas, and socialisation of its membership to act in a unified manner.

An important debate in this literature stream is that whilst intra-community conditions are highly conducive to learning and knowledge flows, inter-community learning is often stunted; even within the same organisation, particularly in professional contexts. Difficulties are attributed to different values, competing priorities and their highly institutionalised existence. It probably helps explain the paradoxical 'leaky' and 'sticky' nature of knowledge that organisations experience.

Swan et al. (2002) inter-organisational study focused on construction of CoPs across various functional and professional boundaries spanning commercial and non-commercial organisations, to mobilise an innovative Prostate Cancer treatment. They found that clinicians clashed with existing CoPs and inhibited knowledge diffusion. Ferlie et al. (2005) studied variation of innovation spread in a healthcare setting. They found that in their complex, multi-professional setting, individual professions often operated within uni-professional CoPs with strong barriers to learning between neighbouring professional CoPs. When professionals had to operate as part of a multidisciplinary team, they found it difficult to agree role definitions because of established roles, authorities and professional social norms. They were so obligated by their affiliations and associated social norms that learning with others became constrained. These CoPs differed from those in non-professional work contexts analysed by Wenger (1998). The two CoPs in Alpha developed relatively independently with no real learning conflicts between them. There was no apparent need or desire to learn from each other given that their priorities were not competitive.

In summary, the key features and concepts drawn from the CoP literature that were helpful additions to LaMA Theory were: spontaneity of community formation as reaction to specific problems, providing an important medium for learning and organisational change; distinctive practice in the communities that led to creation of distinctive knowledge, identity and community boundary. Brown & Duguid (2001) have argued that work practice and learning has to be

understood not in programmed groups such as project teams but in terms of CoPs. In Alpha, there was an opportunity to link the collective collaborative with structures that emerged over time. Whilst CoPs provided a useful level of analysis, their construction and underlying linkages within Alpha's pre-ordained structure were considered equally important. Presumably, Alpha as a predetermined complex group probably was less conducive to collective engagement and learning than the CoPs that formed in response to technological and contextual constraints. In conclusion, depending on task and goal, Alpha's initial conditions either hindered or facilitated the communities to emerge.

10.5 Theoretical Extension and Refinement of the Theoretical Model

CoP concept from the knowledge management literature is applied in the technology transfer field in a novel way. It is applied to explain how social learning occurred in the presence of higher complexity leading to development of a more positive performance outcome. The polar outcomes of the two process modules reflect the results of variations in social learning and enactment of social boundaries.

It is argued that the empirical evidence showed emergence of two CoPs as intervening structures that facilitated the knowledge transfer process in the technology integration module. It is possible that the absence of formation of similar structures in the business model module might have contributed to a more negative performance outcome. The CoP characteristics were displayed (Lave & Wenger, 1991; Wenger, 1998; Brown & Duguid, 1991), in that they provided a means for dynamic social learning and knowledge creation to occur in an otherwise broader, more inflexible collaborative structure. This is consistent with Brown & Duguid (2001) argument that CoPs help overcome an otherwise ossifying effect of organisational life. CoPs, in contrast to the collective collaborative, seemed highly driven to work towards a re-envisaged goal that engaged members could subscribe to. There was increasing commitment and heightened expectations as the process unfolded, which created a basis for social understanding and shared identity. This allowed partners' original knowledge boundaries to be crossed.

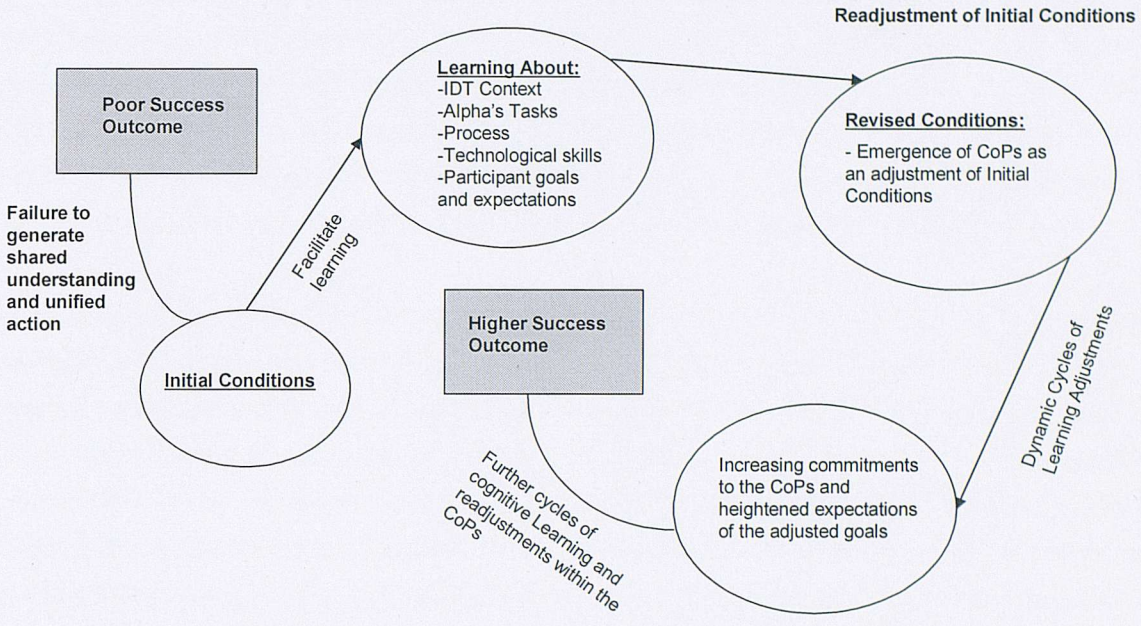
The synthesised theoretical patterning is depicted in Diagram 10.1. The following discussion represents a grammatical explanation of this model (Pentland, 1999). It also helps illustrate that learning processes are not reducible to highly simplistic variance models. Process models provide greater and richer insights that might be usefully drawn on by practitioners.

Why did CoPs emerge and how did they contribute to social learning?

The evidence showed that as contextual conditions unfolded and individual learning took place, the collaboration faced some difficult technological problems. It required the collective membership to re-examine and re-define its work. Technological diversity of the task required social understanding for unified action. Unfortunately, members failed to engage with the necessary intensity and commitment. The collective organisation could not move beyond the knowledge it had shared at the start. Given the nature of knowledge interdependencies, this type of rigidity or inflexibility leads to process failure unless other adaptive mechanisms

intervene. The adaptive mechanism here is represented by formation of two CoPs consisting of clusters of partners (shown in Diagram 8.5 in Chapter 8) not wholly inclusive of the starting constituency. These self-constituting structures displayed characteristics resembling CoPs.

DIAGRAM 10.1 PATTERNING OF THE SYNTHESISED THEORETICAL MODEL



The emergence of the first CoP - the Omega community consisted of 3 partners, illustrated in Event 8 of the Technology Module in Chapter 9. This group developed an application without incorporating knowledge from other partners (recall the starting goal was to integrate the entire technological knowledge chain). The event was triggered by the constituency's learning about BASE technology's technical inability to enable the application integration. This would potentially block any further progress for integration of the application selected early in the process.

Whilst the remaining partners recognised the technical problem they faced, they were less open to explore alternative solutions. Community membership was taken up by those with similar views. These views could not be forced on any partners. In a sense there operated a process of self-selection for inclusion into and invitation by that community. Lave & Wenger (1991) argue that CoPs emerge through negotiation in a work context over a short period of time; negotiation constitutes a form of learning when partners choose whether to participate or not. The emerging CoP enacted a knowledge boundary by re-conceiving the environment and its own identity within the collaboration. Based upon similar frames of reference about the work and social learning within the CoPs, agreements were reached for alternative application development solution. Dynamic cycles of learning and mutual adjustment occurred as process interface and communication was intensified and changes were made to the goals and expectations. In this way, the community adapted to current conditions that might not have been possible within the whole collaborative entity.

A key benefit of the smaller communities was their ability to overcome the inflexibility of the larger organisation (Brown & Duguid, 1991; Wenger, 1998). It provided a device for re-conceptualisation of alternatives. CoP members made sense of contradictory knowledge by asking questions and considering different points of view. Emerging problems were dealt with at a similar pace, with a willingness to take risks, improvise and even compromise, which might have been difficult otherwise. By acknowledging the limits of the starting goal, problem redefinition and reconstruction of a common objective occurred. This was probably driven by a mutual recognition that no single solution existed and that different points of view might generate solutions not considered before. The CoPs seemed to be driven by a desire to create an integrated technology, albeit significantly narrowed in scope. Partner commitments increased within the community, contrasting sharply with those who opted out of participation.

The more intense cooperative and knowledge creation probably resulted as the group learned about each other, the respective expectations, the task and the external conditions. As a great deal of social learning developed, interactions were intensified in a joint search for alternatives, albeit with narrowed technological scope. For instance, although L's role was to provide knowledge[70] for all applications developed by Alpha, it chose to work solely within the Omega CoP; presumably because of greater perceived benefit. In the more negative outcome, the partners developed neither a collective alternative view of the world nor did the conditions trigger the formation of a smaller critical mass of partners. The goal seemed to have conditioned the group into a highly inflexible organisation that could not reconstitute itself to explore and create new knowledge, even if technology contributions were different to those set out in the plan. It echoed the ossifying organisational effect (Brown & Duguid, 2001).

In essence, not only did CoPs foster an environment for knowledge sharing but more importantly they helped improve collaborative effectiveness, efficiency and adaptation. CoPs might also be conceived as devices that helped reduce or simplify the degree of complexity, by allowing a smaller more condensed constituency to mutually re-define its work.

The business model module developed into a negative outcome because of limited social learning and sustained participation. Despite a great deal of starting enthusiasm, conflicting frames of reference developed. As conditions unfolded a social unified view did not emerge either within the whole collaboration or within a smaller 'community'. No sustained champions emerged that could promote the collaborative value; a common strategic context could not be enacted. There was evidence of reluctance to share broader knowledge as expressions of concern for loss of organisational knowledge.

The more positive outcome of the technological module on the other hand illustrated developments of similar frames of reference amongst CoP members. Expectations of the tasks were readjusted; associated collective and individual value was albeit slightly distant from the starting goal. Members were able to engage in a wide search for solutions by utilising different

[70] Knowledge about user interface and testing

networks and external knowledge sources. When suggestions were made by any CoP members, fair and open debate ensued, and suggestions were received in a highly supportive and trusting manner. A fairly fluid process interface operated, demonstrating the lengths partners would go to gather knowledge, build trust through mutual understanding and reach consensus. The frequency of face to face meetings increased and its attendant social learning. In Phi, Partner C relocated to Partner G's facility in a different country in order to hasten the technology integration.

The business model module by contrast remained fairly rigid, narrow and distant. Dominated by technologists, little room was created to engage functional members from respective organisations. This might reflect Swan et al. (2002) observation that distinct communities, here functional, can inhibit knowledge diffusion. Although various partners identified a need for interface change, social united action did not emerge. Their deeply differentiated skill bases with respect to technology and business knowledge, the dense and tight systemic tasks associated with the different industry sectors hindered the module's dynamic development. A critical mass of partners could not engage mutually to construct adjusted technology-encompassing business models. The technology module by contrast had modular task definition with complementary technologies; despite sectoral differences the two CoPs were able to envision the integration and task adjustment, albeit guided by internal champions. The higher success outcome was clearly facilitated by Alpha's initial conditions, creating an environment for cognitive learning about the context and task.

If intensified social learning was evident within the CoPs, then what was the nature of learning between the two CoPs?

There was a distinct work distance, identity and independence between the two CoPs, but with little evidence of any social rivalry. CoPs took on distinctive identities in the tasks and goals they constructed; the social behaviour they displayed in promoting the benefits of the work the community undertook. Although other studies have found that different CoPs may block innovation (Swan et al., 2002; Ferlie et al., 2005), this behaviour was not observed here. Interestingly the two communities existed in harmony, utilising each other's external networks when knowledge gaps emerged in the work they each undertook. This mutual co-existence probably occurred because they were not in competition. Their side by side working was not thought to be disadvantageous because both operated within the broad spirit of Alpha's sphere of activity. CoPs in other studies were probably constrained by different value systems and internal competitive conflicts.

10.6 Closing Theoretical Proposition

The preceding discussion illustrated that the empirical findings displayed a pattern of social learning within the whole collaborative structure and emergent social structures characterised as CoPs (Lave & Wenger, 1991; Brown & Duguid, 1991; Wenger, 1998). Having presented a theoretical extension, it is worth going a step further by developing a theoretical proposition

grounded in the data. This proposition might be applied and tested to help assess whether the refined theory is corroborated by empirical findings in other high complexity settings.

Theoretical Proposition:

In the presence of high level complexity, a more positive performance outcome is likely to develop if the initial conditions allow social learning to lead to the emergence of Communities of Practice; which in turn provide conditions for further social learning within those contained communities. Hampered social learning and mutual adjustments or indeed failure of CoPs to emerge is likely to lead to poor performance outcome.

10.7 Concluding Remarks

This chapter has illustrated and discussed the limits of the LaMA Theory by re-conceptualising the process of technology transfer in higher complexity collaboration. It has made a convincing case for retention of the LaMA Model and its synthesis with key concepts drawn from the CoP literature. The complementarity of the two theoretical perspectives was discussed along with the value of adding to an existing theory. The theoretical refinement and extension was based on the empirical findings that were considered an important research contribution. It has also shown that a combined deductive-inductive process research of a single case study helped accumulate useful knowledge.

According to Karl Popper, a theory must not just provide a solution to a problem, but must also be compatible with all known observations and must contain its predecessor theories as first approximations. It must contradict them at points where it failed with an account for the failure. Applying Popper's principles to theory extension here, the empirical evidence showed theory corroboration up to a point beyond which, success developed through formation of CoPs. CoPs created a rich environment for social learning. In the presence of higher complexity, key organisational problems and technological issues were overcome by self constituting communities that helped re-define the work, and individual and collective organisational expectations. This refined theory cannot be considered a generalisable theory but intends to provide a framework to help construct relevant questions for future research. It may also help managers to draw naturalistic generalisations.

The next chapter concludes the thesis by considering the broader questions including the key research contributions and research implications.

CHAPTER 11

CONCLUSIONS AND RECOMMENDATIONS

11.0 INTRODUCTION

The previous chapter presented the theoretical research contribution by discussing the inductive extension of the LaMA Theory in this higher complexity setting. The purpose of this chapter is to bring the thesis to a close by considering the broader 'so what' question of this research. It considers questions such as: Why was this research important; what can be learned from its findings and how (if at all) does it contribute to policy making, managerial practice and academic knowledge. In essence the chapter's key concern was to consider its wider resonance in the strategic management field.

The chapter starts by reminding the reader of the research rationale. Summarised research findings are restated and broad conclusions are drawn from those findings. Implications of the findings are discussed for the various constituencies and recommendations are made. Research contributions are detailed along with wider theoretical implications. No research design can claim to be perfect, and this research is no exception. Limitations are presented, followed by suggestions for further academic research. Finally, the chapter ends with some learning reflections that might be drawn upon by other researchers.

11.1 RATIONALE FOR THIS RESEARCH STUDY

This research was driven by an observation that understanding of dynamic process of technology transfer in high complexity collaborations was limited. Given the extensive reports of high rates of failure in even relatively simple settings (Harrigan, 1986; Simonin, 1999; Szulanski, 2000), it seemed appropriate to question how the process might unfold in a higher complexity technology transfer. The question was also fitting, given the context of a rising number of 'complex' global collaborations (Doz & Hamel, 1998; Osborn & Hagedoorn, 1997), undertaken with significant financial and human investments.

The specific research setting was considered interesting in that it exemplified this form of complex organising. In addition, it represented a typical, EU sponsored complex collaboration that could be studied to discover any implications for future sponsorship of similar settings. These novel settings were considered to be more ambiguous, resulting in greater process uncertainty. Despite their apparent strategic benefit, given the significant public funds spent, performance difficulties raise concerns over their relative value (Doz & Baburoglu, 2000). It was therefore strongly believed that understanding the process of technology transfer and outcome development was important for managerial practice and academic knowledge.

The thesis argued that understanding of the phenomenon of technology transfer in the field of strategic management was limited on two fronts:

Firstly, a dearth of empirical process studies exist that view technology transfer and knowledge creation in dynamic terms: a view that also links the impact of process with performance outcome (Pettigrew, 1997). In seeking to understand the effectiveness of technology transfer, researchers have largely used quantitative cross-sectional methods. This is despite the fact that transfers have organisation-specific and time related characteristics. A processual view was considered particularly relevant because it introduced context, time and human action into the enquiry (Pettigrew, 1992). Each technology transfer was expected to have unique features that are influenced by its time and space. This includes its constituent participants, their changing conditions, interactions, expectations and how tensions and conflicts become resolved. Temporal development was important for the path development nature of organisational processes (Teece, Pisano, & Shuen, 1997). The processual view also acknowledges the plural and variable nature of performance outcomes. This is in sharp contrast with positivistic studies that treat outcomes in simplistic terms: either success or failure. This perspective ignores the unfolding nature of process, viewing it only as an end state (Yan & Zeng, 1999). This narrow focus was thought to lack managerial relevance. It provides limited insights into how practitioners might guide and manage organisational change over time.

Secondly, it argued that when empirical process study had been undertaken it had generally been in simpler settings (Doz, 1996; Arino & de la Torre, 1998; Doz, 1988). There seemed little concern to understand how a higher level of complexity might influence the evolving process and its strategic outcome. The complexity dimensions discussed in Chapter 3 were likely to make the process much more complex than the sum of dyadic relationships studied thus far (Ring & Van de Ven, 1994). For instance, multiple organisation sets with individual goal expectations were likely to create difficulties in decision-making and reaching consensus (Evan & Olk, 1990).

Alpha, a complex collaborative technology transfer setting was deemed particularly relevant, as it represented an organisational form in which many organisations seemed to be engaged in, across various national contexts (Osborn & Hagedoorn, 1997; Doz & Hamel, 1998). The 'emerging' IDT industry was considered an interesting context for its technological complexity and diverse multi-organisational interdependencies. Complex interdependencies that rely on individual and collective contributions for effective task accomplishment can create tensions and conflicts if mutual adjustments are not made (Thompson, 1967). They can be difficult to guide and manage. The integrated concept faced a number of business and technological uncertainties that remained to be resolved (Swedlow, 2001). Alpha was therefore considered a suitable setting for the study of process dynamics.

In order to capture dynamic process, the research design consisted of a longitudinal, processual study that used qualitative interpretative analysis, at the level of the single collaborative project -

Alpha (Yin, 1994). Unobtrusive documentary evidence (Webb, Campbell, Schwartz, & Sechrest, 1966) was used as a sole methodological technique to generate rich, detailed, fine-grained process data (Langley, 1999). The key advantage over quantitative methodology was the flexibility afforded to gather eclectic non-standardised form of data to generate critical process events. Meaningful event linkages could be made across various levels. Events ranged from a momentary event, to a small decision, to a change at organisational or industry level (Poole, Van de Ven, Dooley, & Holmes, 2000). Moreover, the design employed a combined deductive exploratory research approach (Eisenhardt, 1989), by applying an already well developed dynamic process theory of LaMA in a novel setting (Yin, 1994). Process study has come under criticism for lack of theory and often viewed disadvantageously by some for its limited sample size. This criticism was believed to be overcome by starting with a pre-existing theory. As LaMA Theory had been generated and applied in relatively simple, dyadic settings, its application in Alpha was expected to provide a means for theory verification and opportunity for theory enrichment. It was expected to help add to existing knowledge (Pettigrew, 1997; McNulty & Ferlie, 2002; Johnson, Melin, & Whittington, 2003).

The two dynamic process propositions derived from the LaMA Theory and associated organisational and strategic management literatures supposed that for a successful outcome development, highly interactive cycles of collective social learning and mutual adjustments would have to occur. Coherence of action within the collective constituency would have to occur throughout the unfolding process. If the interdependent technologies were indeed complementary, then disengagement or failure of one or more partners to make learning adjustments would be expected to contribute to a weaker success outcome. With multiple partner membership, it was highly likely that one or more partners would have changed expectations and lowered commitments over time. If this occurred, it was not known if outright failure would ensue or whether compensatory adjustments would take place, or even whether they were at all possible.

11.2 Summary of Research Findings

The empirical research found that LaMA Theory was corroborated up to a point in the transfer process. Beyond this it failed to explain how the technology integration task continued to develop successfully despite disengagement of some key actors and their technologies. The dimensions of complexity seemed to have a complicating influence on the transfer process. Technological uncertainties and change in organisational expectations of the collective goal and task requirements affected the integrative process. The anomalous findings were explained by synthesising the LaMA theory with important concepts from the Communities of Practice (CoPs) literature (Lave & Wenger, 1991; Wenger, 1998; Brown & Duguid, 1991). This synthesis was only possible because of the complementary nature of the two perspectives, in that both were considered processual. From the synthesised theory, a proposition was generated that might be tested in future work.

The findings are summarised here followed by a brief comparison with reported outcomes of other market developments.

The evidence showed that Alpha's initial conditions proved highly inertial in the development of the business model task and yet the same conditions were highly generative in the development of the technology integration task (Chapters 8 and 9). The process dynamics of the more successful development uncovered an interesting theoretical anomaly. When the collaborative structure had to act as a unified social learning and mutually adjusting entity, the initial conditions became much more inertial and inflexible. A collective identity for unified action could not be effected or sustained. The higher complexity of the setting hampered its progress because of the nature of the task and its organisation. Yet, technological integration continued generatively at the exclusion of some important technologies and organisational engagements. In other words, despite fragmentation of the originally defined interdependent organisational task structure, development unfolded in a dynamic manner. The complicating influence of higher complexity seemed to be overcome by the emergent formation of two Communities of Practice. These communities created fertile conditions for social learning that could not be achieved within the inclusive constituency. Community membership might also have been influenced by prior collaborative experience amongst some members.

The inertial development and poor performance outcome of the business model task was not dissimilar to the inertial development of the dyadic technology transfers studied by Doz (1996). Consistent with LaMA Theory, mutual reconstitution and reconfiguration of project conditions could not be achieved. Despite individual and collective discovery and understanding of emerging conditions, there was repeated failure of social learning behaviours. In the same way that the dyadic partners needed to make mutual learning adjustments, this complex setting would also have required a collective process engagement. Consistent also with LaMA Theory, the inertial development was contributed by dense, systemic interdependencies. There was little overlapping knowledge that organisations could substitute. The deeply differentiated knowledge and skill bases, the seeming fragmentation of intra-organisational functions, and conflicting frames of reference hindered unified action. As a consequence, the necessary change needed for development of a more positive outcome did not occur.

At a superficial level, the dynamic development of the more successful technology integration task was consistent with LaMA Theory. A more positive outcome had resulted from iterative cycles of learning adjustments. Importantly however, the learning adjustments did not occur within the single social entity. Highly dynamic learning took place within two separate Communities of Practice that emerged over time. They emerged in response to specific problems and the communities did not include the entire starting membership. Members engaged in the separate communities united to redefine the specific goals by setting and agreeing a variation to the technological boundaries or scope. Even the two aggregated communities did not constitute the full starting complement of organisations and technologies that were considered critical for the entire IDT knowledge integration.

An important question might be: Do these findings have any resonance with other contemporary IDT developments?

Examples of IDT developments contemporaneous to Alpha were presented in Chapter 4. In there, the discussion also considered two important issues regarding those developments: how successful was business model development that might help demonstrate their economic value and how feasible was technology integration. The industry review found that whilst technology integration was indeed being achieved fairly successfully in many novel initiatives, for applications in the private and the public sectors[71], there was little information on how economic value for all participant technology organisations was being demonstrated. There were repeated calls for technologists to extend their creativity to business models. Interestingly, Alpha's two task related outcomes seemed to reflect many of these IDT developments i.e. business model development faced some important challenges whereas technology integration was fairly successful. Whilst the process development in Alpha illustrated the nature of learning adjustments (constrained and facilitated by the initial conditions) leading to the two differential process outcomes, the outcomes in the market cannot be attributed to similar learning adjustments without further study.

The findings might also suggest that perhaps the task of novel business model development was too difficult and unrealistic. From Alpha's process findings however, there was a clear dominance by technologists. There was reluctance to engage organisational members with the necessary business or economic knowledge. This has implications for organisation and management of collaborations that undertake activities that extend beyond a particular functional expertise.

The discussion now turns to what broader conclusions might be drawn from the findings.

11.3 BROADER CONCLUSIONS

Four broad conclusions are discussed:

i) **Indeterminate Processual Nature of Technology Integration**: Technology transfer process clearly did not progress as planned. It was neither a determinate process nor an isolated event (Mintzberg, Dougherty, Jorgensen, & Westley, 1996). Emerging conditions influenced decisions, actions and participation intensity. To have viewed the transfer as a simple, fixed, and unchanging structure over time would have been laden with contradictions. If managers or organisational participants expect to operate in a defined, unchanging environment and are unreceptive to making any changes then the process is likely to be highly disappointing. The study design provided a powerful means for capturing the micro-processes in the

[71] For example: *A trial program in healthcare was launched in the Midlands, called 'Living Health'. Using Telewest's cable platform it features 24hour NHS access. Developed by a variety of collaborating partners including Smashed Atom, Opta, Medic Direct, Medic Logic, iMPower, using TV sets viewers can look up and book medical services and contact a nurse at any time (Itvt)*

development of change that would not have been possible had a-processual, linear models been used. This was particularly helped by the use of documents generated in real-time.

ii) **Variable and Partial Process Outcomes**: While many studies implicitly view performance as an either / or condition, the multidimensional, ambiguous and dynamic nature of change outcome was clearly evident here. Positivistic studies often rely on secondary, standardised data. This type of data conveys little if any detailed story that underlies a stated outcome and often whose perspective it might represent. This research on the other hand was able to uncover critical processes in the development of partial outcomes that might not have been apparent otherwise. It is of note that if the research had relied on EU's formal audit report alone as an indicator of collaborative technology transfer success then interpretation would have been superficial and perhaps misleading. It illustrates the advantage of utilising eclectic data.

iii) **Inseparable Nature of Knowledge and its Creation**: Technology transfer and knowledge creation was a social process. Knowledge was not fully defined or separated from the process of its creation. It was continually enacted through a shared context in understanding and action. Although the interdependent integrated knowledge was viewed as conceptually feasible, without engaging in the integration, process constraints would not have been uncovered. It required a considerable amount of learning and social knowledge enactment (Tsoukas, 1996). This learning was an ongoing process undertaken individually and socially within the embedded situation. Clearly, transfer models that isolate knowledge from situated enactment fail to capture its indeterminate nature.

iv) **Nature of Learning in Spontaneous Groups**: The theoretical extension showed that higher complexity was overcome effectively when partners were strongly driven to working and learning together. It showed that when self constituting communities emerged, they provided a powerful means for social situated learning. The thesis also argued that focussing on learning processes within CoPs alone whilst important, painted an incomplete picture. The research ability to uncover events that triggered their unexpected formation and uncovered the relationship with the broader collaborative structure provided important clues to why some partners chose to disengage when others made increasing commitments. This embedded nature of discrete social structures that emerged within the single overarching structure was considered an important theoretical contribution.

The discussion now turns to the implications of the findings.

11.4 Empirical Findings and Their Implications for the EU, Managers and Researchers

Strategy process research deals with questions of senior managerial interest (Chakravarthy & Doz, 1992) and broad organisational impact: strategic questions that tend to be oriented to the study of higher level decisions, policy design and macro organisational behaviours (McNulty & Ferlie, 2002). If few technology transfers develop in the way their designers imagined (Faulkner

& de Rond, 2000) and if the concern is to improve organisational design, their management and performance, then an important question might be: What are the implications of these empirical findings not only for practitioners but also for other important audiences of policy makers and researchers?

Although the findings here are grounded in the data from a single high complexity setting, they do have important implications in the context of a rising interest and engagement in this form of organising for knowledge creation.

11.4.1 IMPLICATIONS FOR THE EU

The findings illustrated a mixed performance outcome from Alpha's two key starting goals. Its relatively successful technological integration, albeit narrowed in technological scope led to a small group of partners seeking further collaborative development. The EU readily supported the request by granting further sponsorship. This seemed consistent with its broader agenda (see Chapter 8), of promoting collaboration and coordinating research, for commercialisation of technology and industry competitiveness. This suggests that the EU supports collaborations that are likely to succeed and fuel further sponsorships. It aims to foster a series of collaborations that build on prior work. Alpha's reliance on BASE Consortium's technology (see Chapters 8 & 9) and other consortia focussed on various aspects of the technology seemed consistent with EU's desire for intensive interdependence or networking amongst concurrent and past collaborations. This approach enabled organisations to make linkages and to seek further collaborative work; it also helped to agree, set and utilise common technology standards. This suggests that the EU sponsors a collaboration that is likely to generate a high degree of organisational interdependence. If the EU's overriding concern is to foster inter-organisational linkages, it has implications for how it might develop a methodology to assess a specific project performance.

EU's more flexible stance in assessing Alpha's performance may reflect the fact that its own key performance metric seems to be R&D expenditure rather than creation of a specific technology. Alpha was neither censured for its inability to achieve novel business models or to commercialise its technology, nor hindered from seeking further funding support. The relative ease with which sponsorship was granted gave little indication about how project selection occurred. It was difficult to determine whether any competing bids were considered and if so, how they were assessed. It might be argued that if at a given point in time, the EU's overall budget is under spent then funding might be granted relatively easily. Those organisations familiar with the system might engage in repeated participation for greater self-benefit. Alpha and its follow-on collaboration were conceived by a handful of partners who were also responsible for selling the idea to the EU. It seemed that technology champions with prior EU collaborative experience developed a trusting relationship and gained sponsorship fairly easily. Partners' networks were relied upon to introduce and engage organisations with new technologies. Whilst prior relationships might ensure greater process participation, it has the

potential to limit who participates. The EU needs to consider project proposals carefully to ensure there is sufficient knowledge and organisational diversity.

The research found that whilst the EU gathered regular progress reports, it adopted a non-interventionist approach; other than annual reviews, it appeared to have little interest in day to day activities. Surprisingly, it did not seem duly concerned about non-contribution or disengagement of some partners nor did it want to understand the reason for this. It was confident that an internal self-adjusting process eliminates non contributors or 'hangers on' in the long run. Its key concern was to engender networking amongst other collaborations. This might mean that partners with important technologies who collaborate for the first time, but experience difficulties adjusting to this style of working might never engage again. This project suggests that the EU would be advised in future programmes to explore any drop outs/changes in project constituency to determine any lost opportunities for possible future collaborations.

11.4.2 Implications for Managers

The research findings showed an emerging and changing basis of organisational knowledge and an evolving process of its creation. It showed that collaborative technology transfer broadly occurs through a process of social, situated learning and mutual adjustments; where certain behaviours and structural conditions either facilitated or constrained the development of a more positive outcome; where process success depended less on the initial structural design but more on its adaptability to learn and change. This suggests that managers need to adopt a frame of reference that accepts and accommodates emerging change: change that may include adjustment to tasks, goals and even constituency of the transfer process and to be open to the need to engage in substantial individual, group and organisational learning as the project unfolds. When managers first design or agree to participate in these types of arrangements, they are unlikely to possess complete knowledge or contextual understanding. Therefore, the structural conditions must not be viewed in rigid terms; if expectations about process or outcome are firmly fixed, disappointments are highly likely, leading to reduced commitment and process disengagement. Managers would be advised to be supportive of emergent change.

The research findings indicate the valuable contribution of spontaneous learning communities in the successful development of technology integration. The spontaneous learning communities when compared with conventional project teams or workgroups[72] were more effective at responding to and solving emerging problems, perhaps even at shaping organisational strategy. It highlights the need for managers to understand what these groups are, how they work, what conditions help create them and how they might be nurtured (Wenger & Snyder, 2000). They must understand what their own roles might be with respect to creating the conditions and providing an infrastructure that fosters their growth.

Participating individuals may find these kinds of fluid conditions and changing structures highly unsettling. The research showed that facilitative behaviours exercised by some organisational

[72] Representative of Alpha's starting structure

participants and organisation sponsors included openness to explore new ideas, flexibility and adaptability in action. This suggests that managers need to allocate people that are better able to deal with change and ambiguity. It needs to include people who do not expect to carry out a fixed task but can be creative and comfortable with stepping outside their given roles and interactively adapt to social practice. They must not only engage in the process of change but must act as agents of change that set the pace of action. Without these characteristics the initial design may become a constraint.

As CoPs are unique to the situation that creates them, they cannot be imposed from the top. In their construction the collaborations must have conditions that enable these learning structures to emerge; that allow social learning to shape the goal and work practice. This type of accommodating behaviour might be considered to have been demonstrated by the EU: even though a broad technology goal was defined at the outset, small evolving steps of technological integration towards the broader technology were encouraged. Its drive to combine current (and parallel) collaborative learning as platforms for future collaborative work was thought to benefit this process. Managers have to be able to assess collaborative performance and its value in non-traditional ways: in terms of the potential strategic benefit of any adjusted goals.

The informal, self-selecting and self-organising nature of these learning communities may create difficulties for management and control in the conventional sense. The direction and pace of action may be largely set internally: instead of formal leadership, self selected champions may be the ones that the group looks to for guidance and direction for driving the concepts forward. This requires managers to be tolerant to and accept these concurrent leader roles.

When a complex task such as, novel business model creation, requires multi-functional organisational knowledge inputs, then managers need to consider what formal and informal mechanisms are put into place for effective knowledge mobilisation. Alpha might have benefited from formal involvement of people that held the necessary business knowledge. The majority of engaged members seemed principally driven by their technologies; the concept of business models relevant to that technology seemed a secondary or distant concern. A good business model for any technology is important in that it can convey a coherent story about who the customers are, what they value, how an organisation makes money, and how the underlying economic logic delivers value at an appropriate cost (Magretta, 2002). In a sense, business modelling is the scientific method for managers: it starts with a theory of how a concept may work and how the business system fits together; the concept is then tested and modified if necessary. Without a coherent story or underlying method, the selected technology may represent nothing more than an impulsive act to satisfy individual interests. This logical process clearly did not happen in Alpha, the danger being that technologist dominance might focus on development rather than marketing and customer satisfaction. Managers need to coordinate complex inter and intra-dependencies through regular evaluation, reassessment and mutual

adjustment. Managers need to provide a vision that enables participants to see the strategic fit and share a common purpose throughout the process.

11.4.3 Implications for Academic Research:

The research findings suggest that studies that use de-contextualised performance outcome data miss the opportunity of discovering the perspectives represented in those outcomes and the process that has influenced their development. As a consequence, researchers may end up treating these complex collaborations as 'faceless abstractions'. For example, although Alpha's performance was deemed relatively successful, without probing below the surface it would not have been obvious that an important business model goal had not been achieved. Given also that there is no single objective reality, outcomes expressed in simplistic terms have to be interrogated further. The findings showed that process research offers a more flexible mode of enquiry when features of organisational change and its development are of interest. In particular when the concern is to understand how and why something changed. It is strongly maintained that findings generated from this kind of research have much greater practical applicability. Researchers would be advised to engage with this type of dynamic process study if they are to generate highly relevant and useful knowledge about important aspects of complex organisational life.

11.5 Research Contributions

This research makes three contributions:

i) Theoretical Contribution

This is considered an important research contribution. The theoretical contribution consisted of the extension of LaMA Theory to a higher complexity setting and its synthesis with the concept of Communities of Practice (CoPs) (Lave & Wenger, 1991; Brown & Duguid, 1991), discussed in Chapter 10. The overall extended theoretical framework (Diagram 10.1) consisted of a pattern that showed social mutual learning cycles. When these cycles became divergent, the transfer either proceeded to fail or the divergences were overcome by formation of CoPs. CoPs provided a situated structure for social learning.

Karl Popper argues that a theory must not just provide a solution to a problem of interest, but that it must also be compatible with all known observations and it must contain its predecessor theories as first approximations; it must also contradict them at points where it failed and must account for the failure. Applying Popper's principles in extending the LaMA theory, it is argued that the empirical evidence showed theory corroboration up to a point beyond which, success developed through formation of CoPs. CoPs created a rich environment for social learning. In the presence of higher complexity, key organisational task dependent problems and technological issues were overcome by self constituting communities that helped re-define the work, and individual and collective organisational expectations.

ii) METHODOLOGICAL CONTRIBUTION

Although documentary evidence is used extensively in a great deal of social science research, it tends to serve as supporting material to the more common techniques of interviews or surveys. Documents as a primary method have been used previously in process study (Garud, Jain, & Kumaraswamy, 2002), but they have been gathered from public databases or newspaper reports. They lack the richer real-time process detail relied upon in this research. The method found project interactions that explicitly or implicitly pointed to individual and group aspirations, intensions and decisions. They proved invaluable for constructing a longitudinal dynamic picture of the technology transfer. It is highly unlikely that interviews would have generated process recollections with such depth and accuracy, which were otherwise captured so well temporally in the documents' normal production. The use of these rich documents was considered an important methodological contribution. As organisations begin to utilise extensive electronic based dialogue for internal and external communications, they may indeed become a useful tool for organisational researchers in future (Lee, 1999). These natural document deposits provide an invaluable resource for uncovering the path development of organisational decision processes.

iii) EMPIRICAL CONTRIBUTION:

Of the two main schools in strategic management, this research contributes to the processual school that is concerned with dynamic process. Its study of a higher complexity setting combined with a dynamic process theory was believed to generate results that might have wider applicability. This kind of generalisability is particularly relevant given the increasing shift from simple to complex forms of organisation. It is believed that as organisations from various industries, increase their engagements in complex collaborations (Doz & Hamel, 1998; Liebeskind et al., 1996), they may face similar issues that might be managed more effectively.

11.6 RESEARCH LIMITATIONS

No research can claim absolute perfection, and this research was no exception. Although various limitations are discussed here, it has to be emphasised that the research design and methodological decisions were considered robust and rigorous under their own terms.

The first limitation arises from use of a single case study method, in that it does not have external generalisability (Yin, 1994). In any social science research that relies on single case study, contributions are almost invariably specific and highly context sensitive. As a result findings from Alpha cannot be generalised to all complex collaborative transfers, either in this industry or others; even to the many similar EU sponsored collaborations. This raises an important question: if there was no statistical generalisability, then how might one use the research findings?

The research aim was to seek theoretical rather than statistical generalisation. The deep probing of a single case does not seek predictive laws but intends to identify low level tendencies or patterns that might be repeated in other situations (Ferlie, 2002). In applying an

existing theory (LaMA) generated from more simple settings where a *'previously developed theory is used as a template with which to compare the empirical results'* (Yin, 1994: 38) provided the opportunity for theoretical generalisation. Theoretical generalisability is a claim that concepts, themes and patterns observed in one setting have the ability to describe and explain observations in other settings. The findings and the framework developed from this study were considered to have potential for wider applicability. Mintzberg & McHugh (1985) argue that single cases can uncover behaviours, which can be found in 'muted form in all kinds of organisations'. Naturalistic (Stake, 1995) or conceptual (Goffman, 1961) generalisations can be drawn by academics for their local empirical settings or by practitioners for their organisational settings, on the basis that certain activities, problems or responses are likely to recur repeatedly.

Despite the low external validity, case study method does hold high internal validity. This research claimed a high internal validity because of the eclectic documents and the fine-grained data generated from them. Detailed actions and interactions seen in the documents were corroborated through different documents and linked over time.

Critics might argue that this research was limited given the method used: other than the single interview with the EU leadership, data generation was based entirely on documentary evidence. It was not supplemented by interviews with organisational participants or observational evidence. Although it is conceded that interviews with project participants might have provided further richer insights, it is maintained here that the eclectic documents provided an ability to infer a variety of view points (Webb et al., 1966). Their real-time generation and almost complete accumulation provided an unusual ability for repeated questioning.

Another limitation might be represented by the use of interpretative analysis of documentary text in the absence of standardised data extraction tools. This however is countered by the argument that even the so called 'objective' data do not appear as 'facts' ready to be collected. Their creation is based on views at a given time: be it organisational profitability, market share, success etc.

The fact that textual interpretation relied on the researcher's single viewpoint, critics could argue that this might introduce biases and may indicate a lack of rigour. It is maintained here that whilst interpretations were indeed not compared with those of any other person, a great deal of reflexivity was exercised in the conduct of the analysis. The advantage of a single judge of meaning is that analysis is done consistently which yields understanding of a whole event (Cramton, 2001 cites Gersick, 1988). Furthermore, a great deal of data and interpretations were made transparent by setting them out as textual explanations in Chapter 8. They should help convey to the reader the analytic and interpretative rigor.

Despite the various trade offs in a single study such as this, the research process was considered rigorous.

11.7 SUGGESTIONS FOR FURTHER RESEARCH

Features of the research findings offer useful opportunities for further work in different settings and/or under different conditions:

Firstly, the theoretical proposition derived from the extended LaMA Theory would benefit from being tested for wider validity in higher complexity collaborations in other settings, in the same or other industry sectors. The European Union sponsors a large number of collaborations of a complex nature every year in various industry segments. Their goal and task definitions tend to be expressed along similar lines to those in Alpha. They would provide a fertile ground for comparing one or more cases.

Secondly, the complex setting of Alpha did not include any direct technological or organisational competitors. The model might be tested in settings that include the competitive dimension to explore how mutual understanding, trust and social adjustments evolve. How convergence of purpose develops and conflicting priorities and organisational concerns are reconciled.

Thirdly, the extended theory might usefully be applied to collaborations in more mature settings, where contextual conditions are more stable. These settings are likely to have fewer business and consumer uncertainties, and might contribute to less process complexity. It would help provide an understanding of how social learning and knowledge enactment progresses under more stable conditions.

11.8 PERSONAL LEARNING REFLECTIONS

Consistent with most qualitative social science research, this research did not unfold as smoothly as a completed thesis might suggest. It hit upon some significant constraints and blockages over the course of study. This section discusses the dilemmas faced and how the emerging constraints were tackled. These learning reflections should help researchers draw lessons that might be usefully applied to their own research. They demonstrate that researchers need to exercise resourcefulness and be open to adjusting their research design in order to overcome emerging difficulties. Given the particular obstacles encountered, this section also considers the question: If this research was conducted again how would it be done differently?

Unlike quantitative research where clear analytical conventions exist, qualitative interpretative research is always conducted in a manner that is inextricably linked to a researcher's own experiences and perceptions (Miles, 1979). In other words, the researcher and the researched are mutually influenced and are influencing of each other. Without the existence of formal analytical guidelines, an important concern was how to protect against any false interpretations and conclusions. To help minimise any biases, engaging in a process of self reflection was an important research aspect. This reflexivity focused on: the research question, methodology selected, documents gathered, research analysis, empirical findings, relating the findings to the research question, applicability of the findings, and process of theorising. A considerable

amount of cycling back to earlier stages occurred throughout the journey to help clarify and refine the research.

Significant challenges arose in the choosing of the research site and the final research method adopted (methodological issues were also discussed in Chapters 6 and 7). The broad learning grasped from these challenges was that guidance or direction often comes from within. It occurs particularly when one is grounded and receptive; receptive particularly to 'seeing' and creating linkages that might otherwise not be palpable.

I started this research with a keen interest to study the collaborative technology transfer process in the healthcare industry: an industry familiar to me. My particular interest lay in the developments over the previous decade in the biotechnology industry. I saw these developments as a result of intense collaborative activities amongst small biotech innovators, the pharmaceutical industry and academia, also across different nation states. I thought that their collective work would be particularly interesting to study. It however became clear in the early stage of research that I would not gain the level of organisational access I needed for this kind of process research; particularly when commercial organisations were concerned about proprietary knowledge and intellectual property issues. Any compromise was difficult because my process research approach required access where there was action (Poole, Van de Ven, Dooley, & Holmes, 2000). Whilst I might have collected data that resided in the public domain it was unlikely to generate detailed insights into process development. This led me to consider whether I should modify my research question. The following discussion illustrates that the research question was not changed a great deal; instead a change in the specific industry setting was made.

This industry change occurred quite serendipitously. I came across Alpha and the IDT context whilst assisting my Supervisor in the analysis of convergence of the Information Industry and its impact on the Telecommunications sector. This was a context unrelated to my research at the time. I observed that Alpha had already been in existence for over 1 year of its 2 year timeframe and that it had generated voluminous documents. I viewed these documents to constitute really rich real-time process evidence. I was convinced that this data would lend itself well to the type of research I was interested in, particularly given Alpha's relatively contained timeframe. On this basis, I gained research access to the site. It is of note that my research design was still evolving at this stage.

I was aware that Alpha partners would not be conducive to interviews during the project as they were 'extremely busy people'. I discussed my particular interest in studying Alpha with the EU officer and Alpha's project leader, L. Their positive responses reassured me that partners would willingly be interviewed on Alpha's conclusion. It was thought that the timing would work well because by then, I would have learned a great deal from the documents and interviews would supplement these insights. During early 2002, on Alpha's completion, I contacted Partner L to discuss setting up interviews. L was highly positive and willing to both participate and facilitate

the interviews with other partners. L also gave me details of a UK based contact from L's organisation who had led a parallel EU project from 2000 to 2001 (see Table 8.3). L felt that I would gain important process insights and be able to compare Alpha's performance. L also invited me to attend a forthcoming meeting where a number of Alpha partners were to gather. Some weeks later, just prior to the scheduled June 2002 meeting, L emailed me unexpectedly to inform me that meetings were no longer convenient. Moreover, it would not be possible to schedule them for a later date. Access to the partners was clearly withdrawn without any real explanation. I was informed that any information I required should be gathered from the lead person in Partner organisation K. It was suggested to me 'off the record' that K had blocked the interviews by wanting to be the agent through whom I should gather the necessary information; I decided not to verify this. K had not discussed this with me directly. It was clear from other evidence however that K had some significant internal organisational issues. Although I did not expect K to possess the knowledge that other partners might have given me, I attempted to seek a meeting to gather whatever information possible. Unfortunately, it proved difficult to engage K in any constructive dialogue. Whilst I might have found a way around this obstacle, it coincided with my supervisor taking up a new post abroad. He had introduced me to Alpha and represented a key intermediary. I was concerned that without his sustained presence, any effort to thwart this might put my research at further risk. I decided not to pursue seeking interviews but proceeded to conduct an interview with the EU leader. Fortunately, the apparent, self-imposed gate keeper was unable to block this particular interview.

This constraint impacted my data collection method. Other than the single interview with the EU I had to rely entirely on documents to make sense of the process. Its knock-on effect was the speed at which I could interpret and analyse what I was reading, given my lack of IDT industry and technical experience. It is of note however that by the time I became aware of access constraints, I firmly believed that the document repository contained really rich insights. The voluminous formal and informal documents were highly informative; had I relied on emails alone I might not have constructed the detailed story and process explanations. Indeed this research would have been severely constrained. I am in no doubt that interviews would have generated further important insights and might have made the analytical task less overwhelming. But my reading of the advantages and disadvantages of documentary method convinced me that I was not 'settling' for an inferior method (discussed in Chapter 6). It is noteworthy that most social science research does not have ready access to these kinds of documents and is probably poorer for it. If I were to conduct this research again, I would design it in such a way that there was formal consent for interview and observation through the EU leadership. In that way, no single individual or organisation could take on a gate-keeper role. Moreover, interviews would be an addition to the diverse and naturally occurring documents.

An important issue reflected upon at length was how to present the research findings. Without prior experience of writing-up a substantial piece of research, the concern was how to craft and present a meaningful 'story'. This crafting and re-crafting was particularly helped by the work of Golden-Biddle & Locke (1997). The decision to construct the two empirical chapters (Chapters 8

and 9) representing a transition from description to surfacing of theoretical concepts was arrived at after numerous attempts at crafting an integrated story. It is clear that a single chapter would have failed to convey effectively the intended separation and movement from one stage to the other.

Another aspect reflected on was the issue of research supervision. Most researchers are generally assigned two supervisors from the start of their PhD research. Once assigned, most researchers do not expect to see any major change to this arrangement. A key lesson from my research experience was the significance of building some contingency into research supervision. Whilst I did not plan this contingency, it seemed as if I had. I had started my research with a single supervisor from the Strategic Management group, who happened to have a particular interest in the Information Industry. As a matter of procedure, towards the end of my second year of research, I was asked by the research committee to seek a second supervisor. Whilst it might have seemed logical to seek that person from the strategy field as well, my leaning towards qualitative process method led me to approach and be accepted by Ewan Ferlie, Professor in Organisational Behaviour. He is an authority on process method but confessed to have relatively little interest in the industry of my research setting. I felt that the differences in interests and expertise of the two supervisors were complementary. As it happens, this addition and its timing were particularly apposite given the subsequent leaving of my primary supervisor. This event occurred at a time when my main research focus was on research method. As a result, no detrimental effect occurred. Changes such as these can be unsettling and can destabilise the research process. Researchers would be advised to consider these kinds of issues when choosing or being assigned research supervision.

In summary, when I first set out to undertake this research, I thought I had a clear map of what I was going to do and the approach I would adopt. As I engaged with the research, some changes were imposed on me by circumstances whilst others I made consciously. Despite the many constraints I thoroughly enjoyed the research journey. Although not always obvious at the time, every single difficulty and frustration contributed to learning and personal development. I would not hesitate to choose this setting again, but would enhance the method in the way discussed earlier. The most important learning was the realisation that spontaneous intuitive revelations flow into the mind when one is ready. I would not otherwise have made the particular theoretical synthesis with CoP literature.

11.9 Concluding Remarks

Dynamic study of higher complexity collaborative technology transfer process in strategic management has been neglected in the past. The emphasis has tended to be on strategy formation and performance rather than its evolution and how the process might be managed effectively. This research has shown that process research can uncover important issues that are relevant for shaping of effective organisational strategies and understanding change development. A marked rise in organisational engagements in these complex forms of organising and their reported performance difficulties emphasises the importance and

significance of this research. It contributes to the strategic management literature by providing important insights into the organisational life of a higher complexity collaboration that might be usefully drawn on by practitioners, policy makers and academics.

GLOSSARY OF TERMS

API	Applications Program Interface: operating system of a Set Top Box
ATSC	Advanced TV Systems Committee
ATV Forum	Advanced Television Forum whose mission is to promote IDT development by bringing together interactive content, delivery and technology professionals to distribute any content across multiple networks
DSL	Digital Subscriber Line, family of technologies that allow higher capacity over conventional telephone lines in the final 1-3 km to the home; comparable to cable broadband in being 'on' all the time
DVB	Digital Video Broadcast standard for digital TV transmission
ETSI	European Telecommunications Standards Institute
HTML	Hypertext mark-up language
IDT	Interactive Digital Television
ISDN	Integrated services digital network
ISP	Internet Service Provider
JVM	Java Virtual Machine: a virtual computer that runs compiled Java programs; implemented in software on top of 'real' hardware platform and operating system; allows applications to be platform independent
Middleware	Software run by STB to decode digital stream, display information on TV screen and enable interactivity
MPEG	Motion Pictures Expert Group, an international group of industry experts to set global standard for moving images and audio
OPIMA	Open Platform Initiative for Multimedia Access - specifies a standard for decryption process used by STB; aims to achieve independence of system from hardware or software used in the STB
STB	Set-top Box device converts and displays data from analogue, digital cable, or digital broadcast to display on a standard analogue TV
Streaming	Sending of video, audio or other data in a continuous flow for immediate consumption by end user
TV-ANYTIME	Forum to develop open specifications to allow CE manufacturers, content creators, telecoms, broadcasters and service providers to exploit high volume digital storage in consumer platforms
W3C	World wide web consortium
XML	Extensible mark-up language

REFERENCES

Abbott, A. 1990. A Primer on Sequence Methods. ***Organization Science***, 1(4): 375-392.

Abbott, A. 1992. From Causes to Events: Notes on Narrative Positions. ***Sociological Methods and Research***, 20: 428-455.

Allen, P. 2001. Interactive Television Business, ***Accountancy***, June: 55.

Allison, G. T. 1971. ***Essence of Decision: Explaining the Cuban Missile Crisis***. Boston: Little, Brown and Company.

Argyris, C., & Schon, D. 1978. ***Organisational Learning: A Theory of Action Perspective***. Reading, MA: Addison Wesley.

Arino, A., & de la Torre, J. 1998. Learning from Failure: Towards an Evolutionary Model of Collaborative Ventures. ***Organization Science***, 9(3): 306-325.

Barkema, H. G., Bell, H. J., & Pennings, J. M. 1996. Foreign Entry, Cultural barriers, and Learning. ***Strategic Management Journal***, 17: 151-166.

Barkema, H. G., & Vermeulen, F. 1998. International Expansion through Start-up or Acquisition: A learning perspective. ***Academy of Management Journal***, 41(1): 7-26.

Barnes, T., Pashby, I., & Gibbons, A. 2002. Effective University - Industry Interaction: A Multi-case Evaluation of Collaborative R&D Projects. ***European Management Journal***, 20(3): 272-285.

Barnett, W. P., & Burgelman, R. A. 1996. Evolutionary Perspectives on Strategy. ***Strategic Management Journal***, 17: 5-19.

Birmaier, C. 2001. Defining Interactive Television, Vol. 2001: www.digitaltelevision.com.

Bjorkman, I., Barner-Rasmussen, W., & Li, L. 2004. Managing Knowledge Transfer in MNCs: The Impact of Headquarters Control Mechanisms. ***Journal of International Business Studies***, 35(5): 443-456.

Bogdan, R., & Taylor, S. J. 1975. ***Introduction to Qualitative Research Methods***. New York: John Wiley & Sons.

Bohlin, E., Brodin, K., Lundgren, A., & Thorngren, B. 2000. Convergence in Communications and Beyond: An Introduction. In E. Bohlin, K. Brodin, A. Lundgren, & B. Thorngren (Eds.), ***Convergence in Communications and Beyond***, Vol. Chapter 1: 3-23. Amsterdam: Elsevier.

Boutellier, R., Gassmann, O., Macho, H., & Roux, M. 1998. Management of Dispersed Product Development Teams: The role of Information Technologies. ***R&D Management***, 28(1): 13-25.

Boyatzis, R. E. 1998. ***Transforming Qualitative Information: Thematic Analysis and Code Development***. London: Sage Publications.

Bozeman, B. 2000. Technology Transfer and Public Policy: A Review of Research and Theory. ***Research Policy***, 29: 627-655.

Bresman, H., Birkinshaw, J., & Nobel, R. 1999. Knowledge Transfer in International Acquisitions. ***Journal of International Business Studies***, 30(3): 439-462.

Brown, J. S., & Duguid, P. 1991. Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning and Innovation. ***Organization Science***, 2: 40-57.

Brown, J. S., & Duguid, P. 2000. Balancing Act: How to Capture Knowledge without killing it. ***Harvard Business Review*** (May - Jun): 73 - 80.

Brown, J. S., & Duguid, P. 2001. Knowledge and Organization: A Social-Practice Perspective. ***Organization Science***, 12(2): 198-213.

Browning, L. D., Beyer, J. M., & Shelter, J. C. 1995. Building Cooperation in a Competitive Industry: SEMATECH and the Semiconductor Industry. ***Academy of Management Journal***, 38: 113-151.

Bruce, M., Leverick, F., & Littler, D. 1995. Complexities of Collaborative Product Development. ***Technovation***, 15(9): 535-552.

Chakravarthy, B. S., & Doz, Y. 1992. Strategy Process Research: Focusing on Corporate Self-Renewal. ***Strategic Management Journal***, 13: 5-14.

Child, J., & Faulkner, D. 1998. ***Strategies of Co-operation: Managing Alliances, Networks, and Joint Ventures***. Oxford: Oxford University Press.

Cohen, W. M., & Levinthal, D. A. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. ***Administrative Science Quarterly***, 35(1): 128-152.

Cramton, C. D. 2001. The Mutual Knowledge Problem and its Consequences for Dispersed Collaboration. ***Organization Science***, 12(3): 346-371.

Cyert, R. M., & March, J. G. 1963. A Behavioral Theory of the Firm. Englewood Cliffs: Prentice Hall.

Das, S., & Van de Ven, A. H. 2000. Competing with New Product Technologies: a Process Model of Strategy. ***Management Science***, 46(10): 1300-1316.

Day, G. S., & Schoemaker, P. J. H. 2000. Avoiding the Pitfalls of Emerging Technologies. ***California Management Review***, 42(2): 8-33.

Denis, J.-L., Langley, A., & Pineault, M. 2000. Becoming a Leader in a Complex Organisation. ***Journal of Management Studies***, 37(8): 1063-1099.

Denscombe, M. 2000. ***The Good Research Guide***. Buckingham: Open University Press.

Dierickx, I., & Cool, K. 1989. Asset Stock Accumulation and Sustainability of Competitive Advantage. ***Management Science***, 35(12): 1504-1513.

Dodgson, M. 1991. The Management of Technological Collaboration. ***Engineering Management Journal***(August): 187-192.

Dodgson, M. 1993. Learning, Trust and Technological Collaboration. ***Human Relations***, 46(1): 77-95.

Doz, Y. 1988. Technology Partnerships between Larger and Smaller firms: Some critical issues. ***International Studies of Management & Organisation***, XVII (4): 31-57.

Doz, Y. 1996. The Evolution of Cooperation in Strategic Alliances: Initial conditions or Learning Processes. ***Strategic Management Journal***, 17: 55-83.

Doz, Y., & Baburoglu, O. 2000. From Competition to Collaboration: The Emergence and Evolution of R&D Cooperatives. In D. O. Faulkner, & M. de Rond (Eds.), ***Coopertive Strategy: Economic, Business & Organizational Issues***. New York: Oxford University Press.

Doz, Y., Olk, P. M., & Ring, P. S. 2000. Formation Processes of R&D Consortia: Which path to take? Where does it lead? ***Strategic Management Journal***, 21: 239-266.

Doz, Y. L., & Hamel, G. 1998. ***Alliance Advantage: The Art of Creating Value through Partnering***. Boston, MA: Harvard Business School Press.

Duysters, G., & Hagedoorn, J. 1997. Technological Convergence in the IT industry: the Role of Strategic Technology Alliances and Technological Competencies: 1-27. Maastricht: MERIT, Faculty of Economics and Business Administration.

Easterby-Smith, M., Crossan, M., & Nicolini, D. 2000. Organizational Learning: Debates past, present and future. ***Journal of Management Studies***, 37(6 September): 783-796.

Edosomwan, J. A. 1989. ***Integrating Innovation and Technology Management***. New York: John Wiley & Sons.

Eisenhardt, K. M. 1989. Building Theories from Case Study Research. ***Academy of Management Review***, 14(4): 532-550.

Eisenhardt, K. M. 1991. Better Stories and Better Constructs: The case for rigor and comparative logic. ***Academy of Management Review***, 16(3): 620-627.

Evan, W. M., & Olk, P. 1990. R&D Consortia: A New U.S. Organizational Form. ***Sloan Management Review*** (Spring): 37-46.

Faulkner, D., & de Rond, M. (Eds.). 2000. ***Cooperative Strategy: Economic, Business and Organizational Issues***. NY: Oxford University Press.

Ferlie, E. 2002. Organisational research: The turn to Qualitative Methods, ***Research methods course for Postgraduates***. Imperial College of Science, Technology and Medicine, University of London

Ferlie, E., Fitzgerald, L., Wood, M., & Hawkins, C. 2005. The Nonspread of Innovations: The Mediating Role of Professionals. ***Academy of Management Journal***, 48(1): 1-17.

Ferlie, E., & Mark, A. 2001. Organizational Research and the New Public Management: The turn to Qualitative Methods. In K. McLaughlin, S. P. Osborne, & E. Ferlie (Eds.), ***New Public Management: Current trends and future prospects***: 311-323. London: Routledge.

Fiol, C. M., & Lyles, M. A. 1985. Organisational Learning. ***Academy of Management Journal***, 10(4): 803-813.

Fransman, M. 2000. Convergence, the Internet and Multimedia: Implications for the Evolution of Industries and Technologies. In E. Bohlin, K. Brodin, A. Lundgren, & B. Thorngren (Eds.), ***Convergence in communications and beyond***: 25-38. Amsterdam: Elsevier.

Garud, R., Jain, S., & Kumaraswamy, A. 2002. Institutional Entrepreneurship in the Sponsorship of Common Technological Standards: The case of Sun Microsystems and Java. ***Academy of***

Management Journal, 45(1): 196-214.

Garud, R., & Van de Ven, A. 1992. An Empirical Evaluation of the Internal Corporate Venturing Process. ***Strategic Management Journal***, 13: 93-109.

Geisler, E. 2001. Explaining the Generation and Performance of Intersector Technology Cooperation: A survey of the literature. ***Technology Analysis & Strategic Management***, 13(2): 195-206.

Geisler, E. 2003. Benchmarking Interorganisational Technology Cooperation: the Link between Infrastructure and Sustained Performance. ***International Journal of Technology Management***, 5(8): 675-702.

Geisler, E., Furino, A., & Kiresuk, T. J. 1991. Toward a Conceptual Model of Cooperative Research: Patterns of Development and Success in University-Industry Alliances. ***IEEE Transactions on Engineering Management***, 38(2): 136-145.

Gersick, C. 1988. Time and Transition in Work Teams: Toward a new model of group development. ***Academy of Management Journal***, 31: 9-41.

Ghoshal, S. 1987. Global strategy: An Organising Framework. ***Strategic Management Journal***, 8(5): 425-440.

Glaser, B. G., & Strauss, A. L. 1967. ***The Discovery of Grounded Theory: Strategy for Qualitative Research***. Chicago: Aldine.

Glick, W. H., Huber, G. P., Miller, C. C., Doty, D. H., & Sutcliffe, K. M. 1990. Studying Changes in Organizational Design and Effectiveness: Retrospective event histories and periodic assessments. ***Organization Science***, 1(3): 293-312.

Goffman, E. 1961. ***Asylums***. London: Penguin.

Golden-Biddle, K., & Locke, K. D. 1997. ***Composing Qualitative Research***. Thousand Oaks: CA: Sage.

Granovetter, M. 1992. Problems of Explanation in Economic Sociology. In N. Nohria, & R. Eccles (Eds.), ***Networks and Organizations: Structure, Form and Action***: 25-56. Boston, MA: Harvard Business School Press.

Grant, R. M. 1996. Toward a Knowledge-Based Theory of the Firm. ***Strategic Management Journal***, 17(Special Winter Issue): 109-122.

Grant, R. M. 1996. Prospering in Dynamically-Competitive Environments: Organizational Capability as Knowledge Integration. ***Organization Science***, 7(4): 375-387.

Grosse, R. 1996. International Technology Transfer in Services. ***Journal of International Business Studies***, Fourth Quarter: 781-800.

Gulati, R. 1998. Alliances and Networks. ***Strategic Management Journal***, 19: 293-317.

Gulati, R. 1999. Network Location and Learning: The influence of Network Resources and Firm Capabilities on Alliance Formation. ***Strategic Management Journal***, 20: 397-420.

Gupta, A. K., & Govindarajan, V. 2000. Knowledge Flows within Multinational Corporations. ***Strategic Management Journal***, 21: 473-496.

Hagedoorn, J. 1993. Understanding the Rationale of Strategic Technology Partnering: Interorganisational modes of Cooperation and Sectoral differences. ***Strategic Management Journal***, 14: 371-385.

Ham, R. M., Linden, G., & Appleyard, M. M. 1998. The Evolving role of Semiconductor Consortia in the United States and Japan. ***California Management Review***, 41(1): 137-163.

Hamel, G. 1991. Competition for Competence and Inter-Partner Learning Within International Strategic Alliances. ***Strategic Management Journal***, 12: 83-103.

Hamel, G., Doz, Y., & Prahalad, C. K. 1989. Collaborate with your Competitors and Win. ***Harvard Business Review,*** (January-February): 133-139.

Hamel, G., & Prahalad, C. K. 1994. Competing for the Future. ***Harvard Business Review,*** (July-August): 122-128.

Harrigan, K. R. 1986. ***Managing for Joint Venture Success***. Lexington, MA: Lexington Books.

Hart, C. 1998. ***Doing a Literature Review***. London: Sage.

Hitt, M., Dacin, T. M., Levitas, E., Arregle, J.-L., & Borza, A. 2000. Partner Selection in Emerging and Developed Market Contexts: Resource-Based and Organisational Learning Perspectives. ***Academy of Management Journal***, 43(3): 449-467.

Hofstede, G. 1980. ***Culture's Consequences: International differences in work-related values***. Beverly Hills, CA: Sage.

Hoskisson, R. E., Hitt, M. A., Wan, W. P., & Yiu, D. 1999. Theory and Research in Strategic Management: Swings of a Pendulum. ***Journal of Management***, 25(3): 417-456.

Inkpen, A. C. 1996. Creating Knowledge through Collaboration. ***California Management Review***, 39(1): 123-139.

Inkpen, A. C., & Currall, S. C. 2004. The Coevolution of Trust, Control, and Learning in Joint Ventures. ***Organization Science***, 15(5): 586-600.

[itvt] InteractiveTV Today: Swedlow, T. **www.itvt.com**. Accessed 2000 to 2002

Jick, T. D. 1979. Mixing Qualitative and Quantitative methods: Triangulation in Action. ***Administrative Science Quarterly*** (24): 602-611.

Johnson, G., Melin, L., & Whittington, R. 2003. Micro Strategy and Strategizing: Towards an Activity-Based View. ***Journal of Management Studies***, 40(1): 3-22.

Johnson, J. L., Cullen, J. B., Sakano, T., & Takenouchi, H. 1996. Setting the Stage for Trust and Strategic Integration in Japanese-U.S. Cooperative Alliances. ***Journal of International Business Studies,*** (Special Issue): 981-1004.

Kanter, R. M. 1994. Collaborative advantage. ***Harvard Business Review,*** (July-August): 96-108.

Katz, R., & Allen, T. J. 1982. Investigating the Not Invented Here (NIH) syndrome: A look at the performance, tenure, and communication patterns of 50 R&D project groups. ***R&D Management***, 12: 7-19.

KeyNote. 2000. Cable and Satellite TV. Middlesex: Key Note Ltd.

KeyNote. 2001. Commercial TV. Middlesex: Key Note Ltd.

Kim, D. H. 1993. The Link between Individual and Organizational Learning. ***Sloan Management Review***, 35(1): 37-50.

Kogut, B., & Zander, U. 1992. Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. ***Organization Science***, 3(3): 383-397.

Kogut, B., & Zander, U. 1993. Knowledge of the Firm and the Evolutionary Theory of the Multinational Corporation. ***Journal of International Business Studies***, 24(4): 625-645.

Koski, H. A., & Majumdar, S. K. 2000. Convergence in Telecommunications Infrastructure Development in OECD countries. ***Information Economics and Policy***, 12: 111-131.

Kumar, R., & Nti, K. O. 1998. Differential Learning and Interaction in Alliance Dynamics: A Process and Outcome Dicrepancy Model. ***Organization Science***, 9(3): 356-367.

Lall, S. 1987. Building Industrial Competitiveness in Developing Countries: Development Centre of the OECD, Paris.

Lam, A. 1997. Embedded Firms, Embedded Knowledge: Problems of Collaboration and Knowledge Transfer in Global Cooperative Ventures. ***Organization Studies***, 18(6): 973-996.

Langley, A. 1999. Strategies for Theorising from Process Data. ***Academy of Management Review***, 24(4): 691-710.

Larson, A. 1992. Network Dyads in Entrepreneurial Settings: A Study of the Governance of Exchange Relationships. ***Administrative Science Quarterly***, 37: 76-104.

Larsson, R., Bengtsson, L., Henriksson, K., & Sparks, J. 1998. The Interorganizational Learning Dilemma: Collective Knowledge Development in Strategic Alliances. ***Organization Science***, 9(3): 285-305.

Lave, J., & Wenger, E. 1991. ***Situated Learning: Legitimate Peripheral Participation***. Cambridge: Cambridge University Press.

Lee, T. W. 1999. ***Using Qualitative Methods in Organizational Research***. London: Sage Publications.

Leonard-Barton, D. 1990. A Dual Methodology for Case Studies: Synergistic use of a Longitudinal Single site with Replicated Multiple sites. ***Organization Science***, 1(3): 248-266.

Leonard-Barton, D. 1992. Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development. ***Strategic Management Journal***, 13: 111-125.

Levinthal, D. A., & March, J. G. 1993. The Myopia of Learning. ***Strategic Management Journal***, 14: 95-112.

Levitt, T. 1960. Marketing Myopia. ***Harvard Business Review*** (July-August): 45-56.

Liebeskind, J. P., Oliver, A., Zucker, L., & Brewer, M. 1996. Social Networks, Learning, and Flexibility: Sourcing Scientific Knowledge in New Biotechnology Firms. ***Organization Science***, 7(4): 428-433.

Lincoln, Y. S., & Guba, E. G. 1985. ***Naturalistic Inquiry***. London: Sage Publications.

Littler, D., & Leverick, F. 1995. Joint Ventures for Product Development: Learning from Experience. ***Long Range Planning***, 28(3): 58-67.

Luukkonen, T. 2002. Technology and Market Orientation in Company Participation in the EU Framework Programme. ***Research Policy***, 31: 437-455.

Lyles, M. A. 1988. Learning among Joint Venture Sophisticated Firms. In F. J. Contractor, & P. Lorange (Eds.), ***Cooperative strategies in international business***. Lexington, MA: Lexington Books.

Madhok, A. 1997. Cost, Value and Foreign Market Entry Mode: The Transaction and the Firm. ***Strategic Management Journal***, 18: 39-61.

Magretta, J. 2002. Why Business Models Matter. ***Harvard Business Review***, 80(5): 86-92.

March, J. G., & Olsen, J. P. 1989. ***Rediscovering Institutions: The Organizational basis of Politics***. New York: Free Press.

Mason, J. 1996. ***Qualitative Researching***. London: Sage.

May, T. 1997. ***Social Research: Issues, Methods and Process*** (Second ed.). Buckingham: Open University Press.

McKelvey, M., Alm, H., & Riccaboni, M. 2003. Does Co-location matter for formal Knowledge Collaboration in the Swedish Biotechnology - Pharmaceutical Sector? ***Research Policy***, 32: 483-501.

McKenna, A. 2000. Emerging Issues surrounding the Convergence of the Telecommunications, Broadcasting and Information Technology Sectors. ***Information & Communications Technology Law***, 9(2): 93-127.

McNulty, T., & Ferlie, E. 2002. ***Reengineering Health Care - The Complexities of Organizational Transformation***. Oxford: Oxford University Press.

Miles, M. B. 1979. Qualitative Data as an Attractive Nuisance: the Problem of Analysis. ***Administrative Science Quarterly***(24): 590-601.

Miles, M. B., & Huberman, A. M. 1984. ***Qualitative Data Analysis***. Beverly Hills, CA: Sage.

Mintel. 1999. Digital TV: Mintel International Group Ltd.

Mintel. 2001. In-home Interactive Media: Mintel International Group Ltd.

Mintzberg, H. 1979. An Emerging Strategy of "direct" Research. In J. Van Maanen (Ed.), ***Qualitative methodology***: 105-116. Beverly Hills, CA: Sage.

Mintzberg, H., Dougherty, D., Jorgensen, J., & Westley, F. 1996. Some Surprising things about Collaboration - Knowing how people connect makes it better. ***Organizational Dynamics*** (Spring): 60-71.

Mintzberg, H., & McHugh, A. 1985. Strategy Formation in an Adhocracy. ***Administrative Science Quarterly***, 30: 160-197.

Mohr, J., & Spekman, R. 1994. Characteristics of Partnership Success: Partnership Attributes, Communication Behavior, and Conflict Resolution Techniques. ***Strategic Management***

Journal, 15: 135-152.

Moore, G. B., & Yin, R. K. 1983. ***Innovations in Earthquake and Natural Hazards Research: Unreinforced Masonry***. Washington, DC: Cosmos Corporation.

Mowery, D. C., Oxley, J., & Silverman, B. S. 1996. Strategic Alliances and Interfirm Knowledge Transfer. ***Strategic Management Journal***, 17 (Winter Special Issue): 77-91.

Mueller, M. L. 1999. Digital Convergence and its consequences. ***Javnost / The Public***, 6(3): 11-28.

Murphy, E., Dingwall, R., Greatbatch, D., Parker, S., & Watson, P. 1998. Qualitative Research Methods in Health Technology Assessment: A Review of the Literature, ***Health Technology Assessment***, Vol. 2. Southampton: National Coordinating Centre for Health Technology Assessment.

Nelson, R. N., & Winter, S. G. 1977. In Search of a useful Theory of Innovation. ***Research Policy,*** (6): 36-76.

Nonaka, I. 1994. A Dynamic Theory of Organizational Knowledge Creation. ***Organization Science***, 5: 14-37.

Nonaka, I., & Takeuchi, H. 1995. ***The Knowledge-creating Company: How Japanese Companies Create the Dynamics of Innovation***. New York: Oxford University Press.

Nonaka, I., Toyama, R., & Konno, N. 2001. SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation. In I. Nonaka, & D. J. Teece (Eds.), ***Managing Industrial Knowledge***. London: Sage.

North, R. C., Holsti, O. R., Zaninovich, M. G., & Zinnes, D. A. 1963. ***Content Analysis: A Handbook with Applications for the study of International Crisis***: Northwestern University Press.

OECD. 1992. Telecommunications and Broadcasting: Convergence or Collision?, ***Committee on Information Computer Communications Policy***, Report No. 29. Paris: Organisation for Economic Development.

Orlikowski, W. J. 2002. Knowing in Practice: Enacting a Collective Capability in Distributed Organizing. ***Organization Science***, 13(3): 249-273.

Osborn, R. N., & Hagedoorn, J. 1997. The Institutionalisation and Evolutionary Dynamics of Interorganisational Alliances and Networks. ***Academy of Management Journal***, 40(2): 261-278.

Parkhe, A. 1991. Interfirm Diversity, Organisational Learning, and Longevity in Global Strategic Alliances. ***Journal of International Business Studies***, 22(4): 579-601.

Parkhe, A. 1993. 'Messy' Research, Methodological Predispositions and Theory Development in International Joint Ventures. ***Academy of Management Review***, 18: 227-268.

Penrose, E. T. 1959. ***The Theory of the Growth of the Firm***. New York: Wiley.

Pentland, B. T. 1999. Building Process Theory with Narrative: From Description to Explanation. ***Academy of Management Review***, 24(4): 711-724.

Pettigrew, A. M. 1985. ***The Awakening Giant: Continuity and Change in ICI***. Oxford: Basil

Blackwell.

Pettigrew, A. M. 1992. The Character and Significance of Strategy Process Research. ***Strategic Management Journal***, 13: 5-16.

Pettigrew, A. M. 1997. What is Processual Analysis? ***Scandinavian Journal of Management***, 13(4): 337-348.

Pettigrew, A. M., Ferlie, E., & McKee, L. 1992. ***Shaping Strategic Change: Making Change in Large Organisations, the Case of the NHS***. London: Sage.

Pettigrew, A. M., Woodman, R. W., & Cameron, K. S. 2001. Studying Organisational Change and Development: Challenges for Future Research. ***Academy of Management Journal***, 44(4): 697-713.

Polanyi, M. 1967. ***The Tacit Dimension***. New York: Doubleday Anchor.

Poole, M. S., Van de Ven, A., Dooley, K., & Holmes, M. E. 2000. ***Organizational Change and Innovation Processes: Theory and Methods for Research***. New York: Oxford University Press.

Porter, M. E. 1979. How Competitive Forces Shape Strategy. ***Harvard Business Review***, 57(2): 137-145.

Porter, M. E. 1980. ***Competitive Strategy***. New York: Free Press.

Pothukuchi, V., Damanpour, F., Choi, J., Chen, C. C., & Park, S. H. 2002. National and Organizational Culture Differences and International Joint Venture Performance. ***Journal of International Business Studies***, 33(2 (Second Quarter 2002)): 243-265.

Powell, W. W. 1998. Learning from collaboration: Knowledge and Networks in the Biotechnology and Pharmaceutical Industries. ***California Management Review***, 40(3): 228-240.

Powell, W. W., Koput, K. W., & Smith-Doerr, L. 1996. Interorganisational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. ***Administrative Science Quarterly***, 41: 116-145.

Prahalad, C. K., & Doz, Y. 1987. A Process Model of Strategic redirection in large Complex Firms: The case of Multinational Corporation. In A. M. Pettigrew (Ed.), ***The Management of Strategic Change***: 63-83. Oxford: Basil Blackwell.

Prahalad, C. K., & Hamel, G. 1990. The Core Competence of the Corporation. ***Harvard Business Review***(May-June): 79-91.

Ragin, C. C., & Becker, H. S. (Eds.). 1992. ***What is a Case?: Exploring the Foundations of Social Inquiry***. Cambridge, UK: Cambridge University Press.

Rappa, M. A. 1989. Assessing the Emergence of New Technology: The case of compound semi-conductors. In A. H. Van de Ven, H. L. Angle, & M. S. Poole (Eds.), ***Research on the management of innovations: the Minnesota Studies***. New York: Harper Row.

Rebentisch, E. S., & Ferretti, M. 1995. A Knowledge Asset-Based View of Technology Transfer in International Joint Ventures. ***Journal of Engineering Technology Management***, 12: 1-25.

Reed, R., & DeFillippi, R. J. 1990. Causal Ambiguity, Barriers to Imitation, and Sustainable

Competitive Advantage. ***Academy of Management Review***, 15(1): 88-102.

Ring, P. S., & Van de Ven, A. H. 1994. Developmental Processes of Cooperative Interorganisational relationships. ***Academy of Management Journal***, 19(1): 90-118.

Roberts, J. 2000. From know-how to show-how? Questioning the role of information and communication technologies in knowledge transfer. ***Technology Analysis & Strategic Management***, 12(4): 429-443.

Rogers, E. M., Carayannis, E. G., Kurihara, K., & Allbritton, M. M. 1998. Cooperative Research and Development Agreements (CRADAs) as Technology Transfer Mechanisms. ***R&D Management***, 28(2): 79-88.

Romme, G., & Dillen, R. 1997. Mapping the Landscape of Organisational Learning. ***European Management Journal***, 15(1): 68-78.

Sakakibara, M. 2002. Formation of R&D Consortia: Industry and Company Effects. ***Strategic Management Journal***, 23: 1033-1050.

Selway, J. R. 2000. ***Developing Business Models for Interactive TV Applications***. Unpublished MBA Dissertation, London University, Management School, ICSTM.

Senge, P. M. 1990. ***The Fifth Discipline: The art and practice of the learning organization***. London: Random House.

Silverman, D. 2001. ***Interpreting Qualitative Data: Methods for analysing talk, text and interactions***. London: Sage.

Simon, H. A. 1991. Bounded rationality and organisational learning. ***Organization Science***, 2: 125-134.

Simonin, B. L. 1997. The Importance of Collaborative Know-How: An empirical test of the learning organisation. ***Academy of Management Journal***, 40(5): 1150-1174.

Simonin, B. L. 1999. Ambiguity and the Process of Knowledge Transfer in Strategic Alliances. ***Strategic Management Journal***, 20: 595-623.

Simonin, B. L. 2004. An Empirical Investigation of the Process of Knowledge Transfer in International Strategic Alliances. ***Journal of International Business Studies***, 35(5): 407-428.

Sole, D., & Edmondson, A. 2002. Situated Knowledge and Learning in Dispersed Teams. ***British Journal of Management***, 13: S17-S34.

SPIG. 1999. EC Green Paper on the Convergence of the Telecommunications, Media and Information Technology Sectors, and the Implications for Regulation, April 2001: www.spig.org.uk/papers/euconver2.htm.

Stake, R. E. 1995. ***The Art of Case Study Research***. London: Sage.

Strauss, A., & Corbin, J. 1998. ***Basics of Qualitative Research*** (Second ed.). Thousand Oaks, CA: Sage.

Subramanian, M., & Venkatraman, N. 2001. Determinants of Transnational New Product Development Capability: Testing the influence of transferring and deploying tacit overseas

knowledge. ***Strategic Management Journal***, 22: 359-378.

Suchan, J., & Hayzak, G. 2001. The Communication Characteristics of Virtual Teams: A Case Study. ***IEEE Transactions on Professional Communication***, 44(3): 174-186.

Swan, J., Scarbrough, H., & Robertson, M. 2002. The Construction of 'Communities of Practice' in the Management of Innovation. ***Management Learning***, 33(4): 477-496.

Swedlow, T. 2001. 2000: Interactive Enhanced Television: A historical and critical perspective, www.itvt.com/etvwhitepaper.html.

Szulanski, G. 1996. Exploring Internal Stickiness: Impediments to the Transfer of Best Practice within the Firm. ***Strategic Management Journal***, 17(Winter Special Issue): 27-43.

Szulanski, G. 2000. The Process of Knowledge Transfer: A Diachronic Analysis of Stickiness. ***Organizational Behavior and Human Decision Processes***, 82(1): 9-27.

Tarjanne, P. 2000. Convergence and Implications for Users, Market Players and Regulators. In E. Bohlin, K. Brodin, A. Lundgren, & B. Thorngren (Eds.), ***Convergence in Communications and Beyond***: 39-43. Amsterdam: Elsevier.

Teece, D. J. 1976. ***The Multinational Corporation and the Resource Cost of International Technology Transfer***. Cambridge, MA: Ballinger Publishing Company.

Teece, D. J., Pisano, G., & Shuen, A. 1997. Dynamic Capabilities and Strategic Management. ***Strategic Management Journal***, 18(7): 509-533.

Thompson, J. D. 1967. ***Organisations in Action***. New York: McGraw Hill Book Company.

Tidd, J., Bessant, J., & Pavitt, K. 1997. ***Managing Innovation: Integrating Technological, Market and Organisational Change***. Chichester: John Wiley & Sons.

Tsoukas, H. 1996. The Firm as a Distributed Knowledge System: A Constructionist approach. ***Strategic Management Journal***, 17: 11-25.

Tsoukas, H. 2002. Knowledge-based Perspectives on Organizations: Situated Knowledge, Novelty and Communities of Practice. ***Management Learning***, 33(4): 419-426.

Van de Ven, A., & Poole, M. S. 1988. Paradoxical Requirements for a Theory of Organizational Change. In R. E. Quinn, & K. S. Cameron (Eds.), ***Paradox and Transformation: Towards a Theory of Change in Organizations and Management***. Cambridge, MA: Ballinger.

Van de Ven, A. H. 1992. Suggestions for Studying Strategy Process: A research note. ***Strategic Management Journal***, 13: 169-188.

Van de Ven, A. H., & Polley, D. 1992. Learning while Innovating. ***Organization Science***, 3(1): 92-116.

Van de Ven, A. H., Polley, D. E., Garud, R., & Venkataraman, S. 1999. ***The Innovation Journey***. New York: Oxford University Press.

Van de Ven, A. H., & Poole, M. S. 1989. Methods for Studying Innovation Processes. In A. Van De Ven, H. L. Angle, & M. S. Poole (Eds.), ***Research on the Management of Innovation: The Minnesota Studies***: 31-54. New York: Harper & Row.

Van Maanen, J. 1979. Reclaiming Qualitative Methods for Organizational Research: A preface. In J. Van Maanen (Ed.), ***Qualitative Methodology***. London: Sage.

von Hippel, E. 1994. 'Sticky Information' and the Locus of Problem Solving: Implications for innovation. ***Management Science***, 40(4): 429-439.

Webb, D., & Pettigrew, A. M. 1999. The Temporal Development of Strategy: Patterns in the UK Insurance industry. ***Organization Science***, 10(5): 601-621.

Webb, E., Campbell, D. T., Schwartz, R. D., & Sechrest, L. 1966. ***Unobtrusive measures: Nonreactive research in the social sciences***. Chicago: Rand McNally & Co.

Webb, E., & Weick, K. E. 1979. Unobtrusive Measures in Organization Theory: A reminder. ***Administrative Science Quarterly*** (24): 650-659.

Weick, K. E. 1995. What Theory is not, Theorising is. ***Administrative Science Quarterly***, 40(3): 385-390.

Weick, K. E. 1999. Theory Construction as Disciplined Reflexivity: Tradeoffs in the 90s. ***Academy of Management Review***, 24(4): 797-806.

Weitzman, E. A., & Miles, M. B. 1995. ***Computer Program for Qualitative Data Analysis: A Software Source Book***. Thousand Oaks, CA: Sage.

Wenger, E. 1998. ***Communities of Practice: Learning, Meaning and Identity***. Cambridge: Cambridge University Press.

Wenger, E. C., & Snyder, W. M. 2000. Communities of Practice: The Organizational Frontier. ***Harvard Business Review***(Jan - Feb): 139 - 145.

Wernerfelt, B. 1984. A Resource-based View of the Firm. ***Strategic Management Journal***, 5(2): 171-180.

Whittingham, J. 2000. Digital Local Storage: www.durlacher.com Durlacher Research Ltd.

Whittington, R. 1993. ***What is Strategy and does it matter?*** London: Routledge.

Williamson, O. E. 1975. ***Markets and Hierarchies***. New York: Free Press.

Wolcott, H. F. 1994. ***Transforming Qualitative Data***. London: Sage.

www.carmelgroup.com. 2001. TV Personalisation: A Key Component of Interactive TV.

Yan, A., & Gray, B. 1994. Bargaining Power, Management Control, and Performance in United States - China joint ventures: A comparative case study. ***Academy of Management Journal***, 37(6): 1478-1517.

Yan, A., & Zeng, M. 1999. International Joint Venture Instability: A critique of previous research, a reconceptualisation, and directions for future research. ***Journal of International Business Studies***, 30(2): 397-414.

Yin, R. K. 1984. ***Case study research: design and methods***. London: Sage.

Yin, R. K. 1994. ***Case study research: design and methods*** (Second ed.). London: Sage.

Zander, U., & Kogut, B. 1995. Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: An Empirical Test. ***Organization Science***, 6(1): 76-92.

Zhao, L., & Reisman, A. 1992. Toward Meta Research on Technology Transfer. ***IEEE Transactions on Engineering Management***, 39(1): 13-21.