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Coordination of Multi-Organizational Information Systems Development Projects—Evidence from Two Cases

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Abstract:

In this paper we study coordination of multi-organizational system development projects. In these kinds of projects a common information system is developed to several client organizations by several vendor organizations. We studied two large-scale projects in the public sector and analyzed the evolution of coordination mechanisms and the mode of coordination. Case 1 is a joint development project between thirteen universities and Case 2 is a joint system development project among public and private pension fund companies in Finland. Different coordination mechanisms and mode of coordination were used in the studied cases. In the first case the mode of coordination was mostly informal during the studied phases of system development lifecycle. The second case started with a formal mode of coordination and maintained that mode. In both cases the mode of coordination remained the same, but the coordination mechanisms used varied in different phases of the project. In Case 1 the informal mode of coordination led to difficulties with the schedule and the quality of the first version of the system. In Case 2 more formal approaches helped keep to the schedule, but the functionality of the system was reduced. We conclude that given the size and complexity of these multi-organizational system development projects, it is difficult to change the ways of working in a short period of time.

Keywords: Coordination theories, coordination mechanisms, mode of coordination, systems development

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Coordination of Multi-Organizational Information Systems Development Projects—Evidence from Two Cases

INTRODUCTION

Organizations spend increasing amounts of money on information systems services. The comparative disadvantages of in-house development of customized IS have in many cases led to outsourcing of IT functions and distinct ISD organizations in many areas of business. Recently, joint development of IS has proliferated, as organizations aim at procuring information systems for their needs more cost-efficiently, rapidly, and with fewer resources. Very often these joint efforts take place in sectors where no commercial software is available. This is the case in many emerging industries and small market niches. This activity incorporates interesting examples of private-public partnerships, e.g., in the areas of health care, education, and social security. We see that joint ISD efforts will become even more common in the future. However, management of such multi-organizational or complex (multi-client and multi-vendor) (Gallivan and Oh 1999) information systems (IS) development embodies many challenges that have not received sufficient attention in academic research. These include not only the management and coordination of development work, but also reconciliation of divergent objectives and goals, communication between different stakeholders, risks, and the various economic aspects of ISD throughout the lifecycle of the information system.

Coordination is one of the key processes of successful systems development efforts (Kraut and Streeter 1995). Previous research has acknowledged coordination as relevant to system development, and there is a wide body of literature around coordination and coordination theories (Malone and Crowston 1994). What is missing from the current research is the understanding of coordination in multi-organizational system development projects, where number of stakeholders adds complexity and diverse goals. Hence, our research questions are:

- What are the key coordination mechanisms used and mode of coordination in multi-organizational system development projects in different phases of the project?
- What are the implications of the chosen mode of coordination in multi-organizational system development project?

We wanted to capture the coordination mechanisms used and the mode of coordination. In addition, as we analyzed coordination in different phases of the system development, we had the opportunity to approach the evolution of coordination. We studied two cases in detail and adopted the exploratory case study method. For data sources we used both written and interview material. Our first case is a group of Finnish universities developing a common information system. In Finland universities are funded by the government, so this project takes place in the public sector. Our second case is a group of Finnish pension insurance companies that are developing a common information system for earnings-related pension registration purposes. The pension insurance system in Finland is partly governed by private and partly by public companies. Hence, in Case 2 there is a private-public partnership among the client organizations.

It was found that the mode of coordination was different in the studied cases, and the chosen mode of coordination led to different outcomes. In both cases the chosen mode of coordination remained the same during the system development lifecycle, while there where changes in the coordination mechanisms. Size and complexity of these multi-organizational system development projects may explain the unchanging mode of coordination even during difficult times. It takes time and energy to find and agree on common grounds of working. It is too laborious to change the ways of working in several different organizations, albeit some problems come up.

CONTRIBUTION

This paper contributes to coordination theory research, as it is among the first studies of evolution of coordination in multi-organizational system development projects. The theoretical contribution of this paper is the understanding of coordination and evolution of coordination in multi-organizational system development projects. In addition, our results will provide useful insights for practitioners involved or considering multi-organizational information system development efforts.

In the study we have described coordination mechanisms and the mode of coordination from two multi-organizational system development projects. In both cases the mode of coordination remained the same, even though the projects faced difficulties. We conclude that the size and number of different stakeholders make it difficult to change the mode of coordination in multi-organizational system development projects. In Case 1 the informal mode of coordinating work led to difficulties with schedule and quality of the system. In Case 2 more formal approaches helped to avoid these difficulties, but when there were schedule pressures, the functionality of the system was reduced. As a result, we see that the chosen mode of coordination is an important factor to project outcome. In addition, in multi-organizational development projects there are a lot of issues that are out of the control of the project organization. According to our results, this is amplified in multi-organizational system development projects. In both cases new organizations joined the cooperation during requirements analysis, and that added complexity of the efforts.

The structure of the paper is as follows. In the next section we briefly review background literature. That is followed by research design and research methodology. Then we discuss our findings, and, finally, conclusions are drawn and future research directions are outlined.

COORDINATION THEORIES

Coordination theories focus on studying interdependencies between activities and coordination can be seen as the process of managing dependencies among activities (Malone and Crowston 1994). Van de Ven, Delbecq, and Koenig (1976), on the other hand, defined coordination as a mode of linking together different parts of an organization to accomplish a set of collective tasks. Both definitions are rather high level conceptualizations of coordination. However, the idea of coordination is the same: managing processes in which there are interdependencies and which are performed in cooperation between more than one task, people, or organizational unit. Most of the research studying coordination issues focuses on relationships within one organization and between different organizational units. Outsourcing and networked business models have increased the need to study coordination beyond organizational boundaries.

Previous research has used several different categorizations of coordination mechanisms (see Table 1). McCann and Galbraith (1981) proposed that coordination between organizational units can vary along three dimensions: cooperativeness, formality, and localization. According to these three dimensions, the endpoints of the organizational coordination mode continuum would be organic coordination (cooperative, informal, and decentralized) and mechanistic control (controlling, formal, and centralized). DeSanctis and Jackson (1994) proposed that major mechanisms for facilitating inter-unit coordination of IT management are: structural design approaches, functional coordination modes, and computer-based communication systems. Adler (1995) found five different coordination mechanisms (non-coordination, standards, schedules and plans, mutual adjustment, and teams) in electrical and mechanical engineering product development. Nidumolu (1996) saw coordination mechanisms as horizontal or vertical. Grant (1996) categorized coordination within a firm as: rules and directives, sequencing, routines, and group problem solving and decision making. Crowston's (1997) categorization is based on dependencies between task vs. task, task vs. resource, or resource vs. resource.

Table 1: Summary of Selected Prior Research on Coordination Mechanisms	
Coordination Mechanisms	**Reference**
Impersonal, Personal, Group Mode	(Van de Ven, Delbecq and Koenig 1976)
Mutual Adjustment, Direct Supervision, Standardization of Work Processes, Standardization of Skills, Standardization of Results	(Mintzberg 1979)
Structural Design Approaches, Functional Coordination Modes, and Computer-Based Communication Systems	(DeSanctis and Jackson 1994)
Non-coordination, Standards, Schedules and Plans, Mutual Adjustment, and Teams	(Adler 1995)
Rules and Directives, Sequencing, Routines, and Group Problem Solving and Decision Making	(Grant 1996)
Standards, Plans, Formal Mutual Adjustment, and Informal Mutual Adjustment	(Sabherwal 2003)

Coordination in Multi-Organizational ISD

Software development projects are typically team efforts, wherein groups of specialists work toward the common goal of building a software system. The individual efforts of team members need to be coordinated to ensure product quality and effectiveness of the team (Koushik and Mookerjee 1995). In large-scale system development projects, coordination goes beyond coordination within one team, and managing the interdependencies between different organizational units become vital for the success of the project.

Coordination becomes much more difficult as project size and complexity increase (Kraut and Streeter 1995). Complexity has been conceptualized in many different ways in previous research (Xia and Lee 2005). Complexity may be caused by the nature of IS development (McKeen, Guimaraes, and Wetherbe 1994), complexity of the system being developed (Meyer and Curley 1991), or project complexity (Baccarini 1996). Previous ISD literature has also made distinction between organizational and technological complexity (McKeen, Guimaraes, and Wetherbe 1994). Technological complexity may reflect on organizational complexity, while the complex software development project may lead to complex organization developing that system. On the other hand, if the user organization of the developed software is complex, the software developed for the needs of this organization is most likely complex as well. Therefore, there is a relationship between organizational and technological complexity. An increase in the number of different stakeholders increases the organizational complexity and, as a consequence, the need for coordination.

During the ISD project, the ways the project is coordinated may vary. First, the mechanisms used may vary, and, second, the mode of coordination may vary. Third, there are the dynamics of coordination, i.e., whether coordination is even considered an issue within the target organization and in what stages of system development coordination is considered an issue. Sabherwal (2003) used the concepts of non-coordination, consistent coordination, and late coordination to study the dynamics of coordination over the system development lifecycle.

RESEARCH SUBJECT AND METHOD

Given the small amount of prior research on such multi-organizational system development, a qualitative research approach seemed appropriate. We used an exploratory case study (Eisenhardt 1989; Yin 1994) to understand the coordination of system development in multi-organizational settings.

We started with a review of the literature and searched for articles that cover coordination in general and the coordination of system development. In the literature studies on coordination, mechanisms were found, as well as the fact that the coordination of system development has been studied in previous research (Kraut and Streeter 1995; Ovaska, Rossi and Marttiin 2003; Sabherwal 2003). However, we could find no studies addressing the evolution of coordination in multi-organizational system development. We chose our two case examples because it seemed that we could find a very different way of organizing the system development in them.

The reference literature gives us a framework, i.e., coordination theories, but data is used more inductively than deductively. Therefore, the approach is through exploratory case study. This kind of approach is useful as we aim to make sense on "eclectic" process data (Langley 1999). The data gathering and analysis are discussed next.

Data collection

We have followed the coordination of two multi-organizational system development projects. The two chosen cases are good example of the studied phenomenon. Cases are genuinely multi-organizational, as there are multiple vendors involved in the development project and the system is developed for multiple organizations. We had good access to different kinds of data in both cases, which helped us obtain a deep-level understanding of the cases and, more importantly, the coordination of multi-organizational system development. These two cases were also ideal to achieve a deep level of understanding of the cases. Given the large number people involved in the projects; the geographical location of the project organizations was one factor that influenced the selection of cases. We followed the cases from close-range longer periods of time (Case 1: three years, Case 2: two years). Our primary sources of data from the cases are interviews and written documentation. But if we needed further details, we were able to visit the project organizations when we wanted. We acknowledge that we cannot achieve full understanding of the research phenomenon with one study and two cases. As far as theoretical saturation is concerned (Eisenhardt 1989), we have reached saturation within our cases. We do not see that adding the number of cases would have changed the results of the study.

As we operate in the multi-organizational environment, there are several opinions and interpretations (Klein and Myers 1999) on the same issues, depending on the organization. Also, there are many differing views inside each organization. Taking these issues into account, we interviewed people from several organizations and more than one person from each studied organization. As we interviewed in different organizations (client, vendor, project organization) and in different hierarchical levels of organizations, we had to modify our questionnaire to fit the viewpoint of the interviewee. However, in all semi-structured interviews, we covered the same themes (see Appendix 1).

The interviews lasted from sixty to 150 minutes, and they were recorded. The interviews were transcribed and the interviewees could comment on the transcripts. More specifically for Case 1 (the consortium of Finnish universities), we have conducted ten semi-structured interviews (see Table 2). These interviews produced over 180 pages of transcripts and dozens of pages of field notes. In addition, we had access to a lot of written material (theses, documents, manuals) (see Table 3) and internal documentation (records, budget documentation, contracts. etc.). For Case 2 we have conducted twelve semi-structured interviews with different stakeholders (see Table 4). From these interviews, we have about 170 pages of transcripts and dozens of pages of field notes. In this case as well, we had good access to written material (project timetables, requests for proposals, etc.) (see Table 5).

Table 2: Interviews for Case 1						
	Interviews	Interviewees	CIO	Project Manager	Systems Designer	Student Administration	Administration
University 1	4	2	1	-	2		-
University 2	1	3	1	-	1	1	-
University 3	1	2	1	-	1	-	-
Consortium	3	2	-	1	-	-	1
Main Vendor	1	2	-	1	1	-	-
Total	*10*	*12*	*3*	*2*	*5*	*1*	*1*

Table 3: Documented Material for Case 1	
Other Written Material (n)	**Description**
Internal proposals how to develop the processes or organization (4)	Statements or studies
Master's thesis made by key persons (3)	Historical info of the system development process
Budget information of consortium organization (2)	Financial data
Agreement documentation (4)	Between consortium organization and the member universities
Records from board meetings (2)	
Organizational charts (2)	From 2001 and from 2005
Facilitated GSS session for strategy development (1)	Participants: Consortium staff, member universities staff (IT Managers, Heads of Student Registrar Office.
Description of the system development process (3)	
Records from project group meetings (1)	Detailed specifications of certain feature
Status report of the consortium organization (1)	
Yearly plan (1)	Plans for the year 2004
Newspaper articles (2)	From campus magazines
Strategy for the years 2002–2006 (1)	

Data analysis

In order to obtain a good understanding of the available data, the transcripts were read several times. This is an important part of the data analysis process (Eisenhardt 1989). During the process the interview data was compared to other written material. We did the data triangulation with interview and written material, and, therefore, we have more than one source of data to support our analysis. As we reached an understanding of our case development processes, we wrote the case descriptions. We also contacted interviewees for further information in case we missed some details.

Table 4: Interviews for Case 2									
	Interviews	Interviewees	CIO	Line Manager	Branch Manager	Project Manager	Project Director	CEO	CFO	Development Manager
Private Sector Pension Insurance Company	1	2	1	1						
Public Sector Pension Insurance Company	2	2			1	1				
Coordinating Organization	4	4					1	1	1	1
Finnish Center for Pensions	1	2			1	1				
Vendor 1	1	1					1			
Vendor 2	2	2				1	1			
Vendor 3	1	1				1				
Total	**12**	**14**	**1**	**1**	**2**	**4**	**3**	**1**	**1**	**1**

Table 5: Documented Material for Case 2	
Other Written Material (n)	**Description**
Project time tables (2)	
Requests for proposals (3)	Requests for proposals for different modules or services
Organizational chart	Description of different stakeholders within the project organization
Version plans (2)	Description of specifications of different versions of the system
Communication plan (1)	Communication within the project organization
Parts of feasibility study (1)	
Project plan from one pension insurance company	Description of change process within the one pension insurance company
Self-made report of the different stakeholders in the Finnish pension insurance scheme	A 30-page-report to identify stakeholders and their roles in the field

All the data were analyzed iteratively in order to understand the context of both cases. Therefore, in the beginning we studied both cases individually and divided the system development process into stages (i.e., the negotiation stage, including the feasibility study, requirement analysis, and coding). The division of system development into stages helped us to better identify and analyze the coordination mechanisms used in each system development phase. To help analyze the vast amount of data, QSR NVivo was used. As we analyzed the data, our first task was to identify the coordination mechanisms used. This was done primarily with interview data, but written material was also used to support the interview data. From the interview data we searched for sentences and statements that discussed coordination and management issues. After that, we did some data triangulation to see what could be

found in the written material on the same topic. As a result, we listed the most influential coordination mechanisms used in each systems development phase in a table for each case (see Tables 6 and 7). After the coordination mechanisms were identified, we wanted to know whether the mode of coordination tended more toward the formal or the informal. A formal mode of coordination may employ both informal coordination mechanisms, and an informal mode may employ formal coordination mechanisms. After the mode of coordination was identified, we could cross-analyze the cases. Finally, we synthesized our findings and compared it with prior research.

The study examines two cases in detail. The first case is a consortium of Finnish universities developing a common student register system. The second case is in the domain of pension fund companies, through which Finnish pension fund companies develop a common system for the needs of both private and public pension fund companies. The primary unit of analysis in the both cases is the organization coordinating system development between clients and vendors (see Figures 1 and 2). More detailed descriptions on the research sites will follow.

Sites

Our Case 1 is a joint system development project, by which thirteen Finnish universities are developing a common student record system. The actual system development has been outsourced. The number of member universities has increased over time, as the system development was started in 1995 by five universities and two vendors. Over the years there have also been changes in the vendor setting. In 2007 there was one main vendor and a couple of smaller vendors who developed some modules to the system. The coordination between different universities and vendors is primarily done by a mediating organization, i.e., consortium that has the primary responsibility of system development. In Figure 1 one university is placed in the center of the university "network" because it is in a very central role in this development project. First, this university has been involved in the project from the beginning and is the biggest university in Finland. Second, this university gives physical space to the consortium organization. Third, this university runs a service center that provides outsourcing services to other universities in terms of IT infrastructure, i.e., hardware, IT-support, and user training.
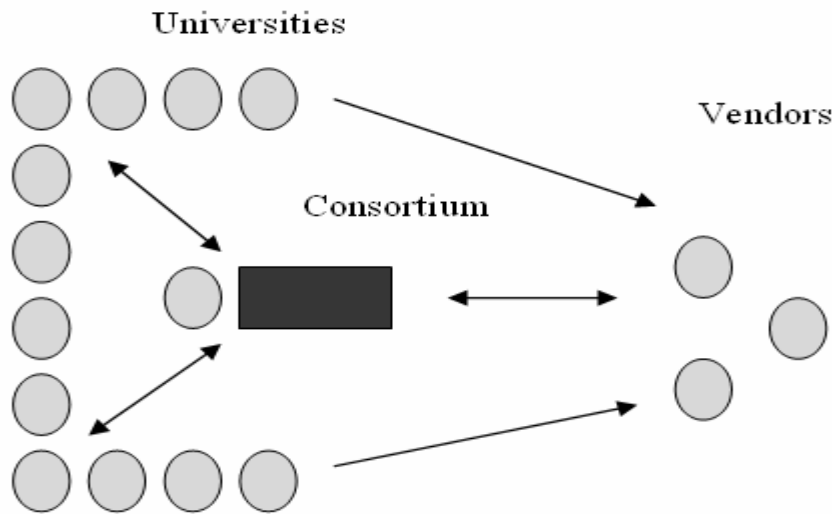

Figure 1: Case 1—The Involved Organizations as in 2007.

The first step of the joint development process was the foundation of the consortium, which is a coordinating organization between the universities and vendors. Before that the universities negotiated informally regarding the feasibility of cooperation in the new system. The first "consortium agreement" was made between five universities in 1995. Before that all five universities had their own information systems for student information purposes, and all the universities maintained their systems as well. There were different reasons for starting to develop the shared system. In many places there were some concerns that there would be problems with Y2K. In one university the old system was "too person-centric," and in another the old system was "out of date." All the universities had expressed a need for a new system. There were some informal negotiations between the universities' IT personnel regarding a joint effort as a reasonable way to develop a new system and cut costs.

So, in 1996 a feasibility study and risk analysis were made in order to analyze the central risks and possibilities in joint system development. The system development in an outsourced multi-organizational environment was considered challenging, but, under the circumstances, it was the only feasible solution. This was because, by joint

effort, some development cost could be cut and a more up-to-date system could be developed. There was no suitable package software available for these purposes, so the IT managers of five universities decided to develop a dedicated system. It is worth mentioning that, at that time, the expansion of the consortium was not considered nor systematically studied.

A joint project was set up to conduct a feasibility study, with costs to be split by the attendant universities. The main idea was to capture the idea of how to develop an information system jointly and to establish some kind of "rules" for the cooperation. At this point, the aim was to identify the key processes within each university and try to merge them at the highest levels. The consortium was formed to act as a client for system vendors; because it was obvious early on that the universities lacked the resources to develop the new system internally.

After the feasibility study, an analysis of requirements was made in cooperation with the chosen vendors. The requirements analysis phase was the responsibility of a ten-member project group. This group had participants from all five member universities and vendors' representatives. The requirements analysis stage started in the fall of 1996 and was finished in February 1997. The specifications were seen as completed, and all the stakeholders were rather happy with the results at that time.

However, the requirements were too general, which caused problems later in the process. Furthermore, the university consortium did not specify the requirements accurately enough, which later caused difficulties with the vendors. Many issues were discussed and agreed on with the vendors, but left undocumented, so that later it was difficult to track what had been decided.

The coding of the system started in the spring of 1998. The coding started according to plan, but soon problems occurred. The client (i.e., the consortium) was under the impression that the vendors would ask for further information about the system features, but the vendor coded the system according to the available documentation, despite the fact that the documents were vague and the requirements, as stated, were too general. Also, the development tool made the system unstable, and the module testing was not sufficient. Therefore, the consortium decided to postpone implementation. The first implementation of the software was finally made in the late 1999.

Over the years, other Finnish universities have joined the consortium, and now there are thirteen member universities. As a consequence, the five original consortium universities and the later adopters are in different positions in terms of learning the organizational and technological environment of the system. The original members of the consortium have been involved in the system development from scratch, i.e., the system is tailored to their needs. But, from the late adopters' point of view, the student record system is more or less a software package that can be tailored by parameters and procured extra components.

In Finland there are twenty-one universities in total. They differ in size and main focus areas. Some have several faculties in different fields, and others have just one focus area, such as technology or business. Furthermore the universities are different in that most are science universities and some are art universities. As a result, the backgrounds and organizational structures in the consortium universities are fairly different.

Originally the system was planned to serve the needs of the administrative staff (student register, exam schedule, course results), but over the years the system has expanded to serve different stakeholders and different purposes. After the diffusion of the Internet in the late 1990s there have been an increasing number of student services available in the system. Students can apply to courses and exams, cancel their registration, do their enrollment, order their academic record, edit their contact information, and plan their studies via the system. Altogether, the system development has been going on for a long time (about ten years now), but the system improves all the time and new features are added constantly.

The number of system users is rather difficult to specify, but according to one estimate there are about 600–700 administrative users and tens of thousands of student users all over Finland. In this sense our case system is a rather widely diffused information system.

The second case is a joint effort of the actors in the Finnish statutory earnings-related pension scheme (see Figure 2). The IS in this case, an earnings system, was implemented in January 2007. While in the other western countries, earnings-related pensions are handled either centrally at a state agency or primarily in private-sector insurance companies, the Finnish scheme has features of both. The pensions from the public sector employers, i.e., pensions for state and local government employees, have their own pension providers. Some private-sector pension providers are industry-specific. In Finland the employer must take out insurance on all his employees and pay the insurance contributions. In practice, the employer directly deposits a certain amount to a pension insurance company or an industry-wide pension fund.

This system development project was started by the private sector pension providers in 2003. At that time the companies made a feasibility study regarding whether they could cooperate in storing the pension data. The trigger for the initial discussions on cooperation was the change in legislation that would take place in 2007. Several different laws are combined under one law to simplify the rules of pension accumulation. The change in legislation would bring about changes to information systems, and the private sector companies thought that they could save money if they could develop the new system jointly. Before this the pension insurance companies have had their own tailored information systems for handling the pension data. Different pension insurance companies had different rules for implementing their pensions (i.e. legislation), so it was feasible for them to have tailored information systems. The pension insurance companies are competitors, which also has limited the possibility of cooperating.
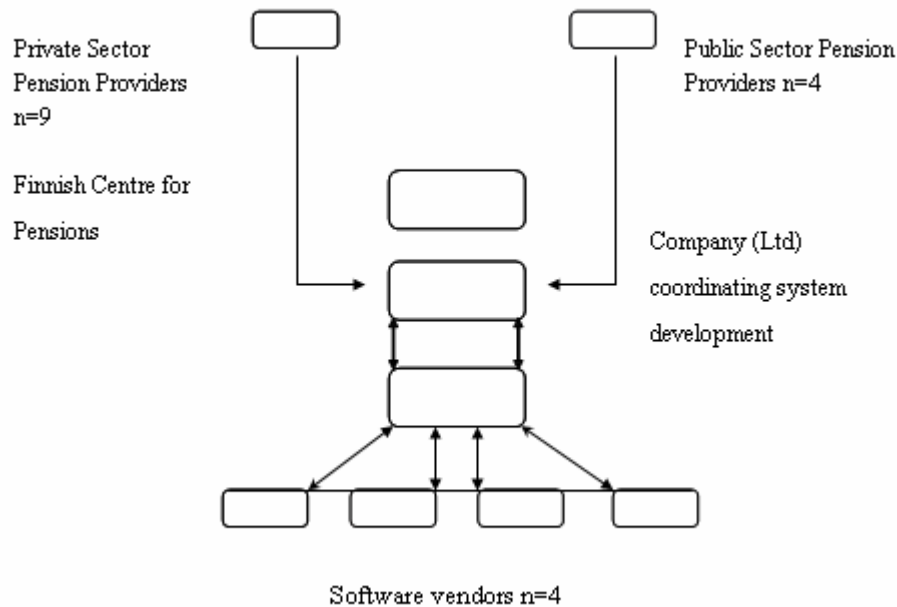
Figure 2: Case 2—Pension Fund Companies.

After the feasibility study, the private sector pension providers decided to go on and start developing a joint repository for the needs of new legislation. About five people took part in the feasibility study. The idea was to explore the possibility and the scale of cooperation in information systems related services. In the fall of 2003, a separate company was established to coordinate system development. As in the case of the Finnish universities, this new project organization coordinating system development would act as a client for software vendors and as a vendor for the pension insurance companies. The Finnish Centre for Pensions (see Figure 2) also plays a vital role in this system development effort, as it is the central body of the Finnish statutory earnings-related pension scheme. It safeguards the coherence of the administration of the earnings-related pension provision and handles tasks that are common to the whole scheme. The Finnish Centre for Pensions employs about 400 persons.

Requirements analysis also started in the fall of 2003. After the requirements analysis had already started, the public sector pension providers joined the cooperation. This event made the further development of the system more complex for many reasons. First, as the number of different stakeholders increased, more interdependencies developed, which led to complexity. Second, legislation in private and public sector pensions is different; therefore, new modules and interfaces had to be added to the system. And third, the decision-making culture is quite different in private and public sectors. In the private sector, decisions can be made rapidly if needed, but, in the public sector, the same kind of decision can take significantly more time, as different kinds of official resolutions must be made. When the public sector companies had joined the cooperation, only two pension fund providers stayed outside cooperation. Hence, the number of private sector companies involved in this joint effort is nine and the number of the public sector pension providers is four. Because of the public sector joining the system development initiative, a new round of requirements analysis was carried out, even though the schedule was tight.

During the summer and fall of 2003, the methods were developed by a chosen software vendor. During the spring and summer of 2004, the development platform and system architecture projects were done. So, as the actual coding of the system was started in the fall of 2004, the development methods, development platform, and system architecture were somewhat ready. However, as it was urgent to get the actual coding started, the methodologies needed to be revised during the system development.

During development phase, the organization coordinating system development employed about 150 to 200 employees. All these employees (from four software vendors) worked at the same premises provided by the Finnish Centre for Pensions. The four software vendors developed different modules to the main system. The first version of the new system was implemented in January 2007.

These two cases provide several interesting similarities and differences. In the first case, the user organizations are public (i.e., government-funded universities, which have formed a consortium), and the system developers are private IT corporations. In the latter case, the users are both private and public organizations, while the developer organizations are private. The actual system development is managed by a joint venture of the public and private pension funds.

Having described the context of studied cases, we can investigate coordination in the cases. We have described the lifecycle of the cases, as we wanted to study the evolution of coordination over different phases of system development.

FINDINGS FROM THE CASES

When we analyzed the coordination mechanisms used in our case settings, we inductively identified the coordination mechanisms, given that coordination theories have not been applied in this kind of organizational settings before. After we had identified the coordination mechanisms, we could move over to mode of coordination. As we analyzed the mode of coordination, we applied control theories to the concepts of formal and informal mode (Choudhury and Sabherwal 2003; Kirsch 2004; Kirsch 1997). As *mechanism* refers to devices or practices to implement the coordination, *mode* can be seen as a higher level concept. *Informal* and *formal coordination* refer to whether the coordination is more control-oriented (formal mode) or more informal (informal mode). In control theories the formal mode is formally documented and initiated by management, whereas informal mode is unwritten and often initiated by employees themselves (Jaworski 1988). In practice, there will be several coordination mechanisms used in all organizations at the same time. We synthesized the coordination mechanisms found in our cases and reached conclusions regarding whether the combination of coordination mechanisms refers to more formal or informal mode of coordination in a more general level. As we identified coordination mechanisms in the cases, we interpreted whether they are seen as informal or formal. And more importantly, as we interpreted the mode of coordination, we saw how coordination could be characterized as a collection of coordination mechanisms, whether formal or informal. In this section, we present findings from the cases. The summary of coordination mechanisms and the modes of coordination can be found in Tables 6 and 7.

Negotiations Case 1

In Project 1 the system development started with a very loose form of cooperation. The idea to start to develop the new student record system jointly emerged through informal relations among staff in different universities. Also, the coordination mechanisms used during the feasibility study were very informal. However, general agreement, i.e., consortium agreement, was needed in order to a provide a framework for the forthcoming cooperation. Hence, the coordination mechanisms used in the negotiation phase were informal meetings and the consortium agreement. The quote below reflects well the informal way of working the early stages of this project.

> There was a need for a new system in many universities. Then we informally discussed the possibility
> to develop a new student record system jointly with colleagues from the other universities (Project
> Director from the consortium organization).

Negotiations Case 2

Project 2 started with more control-oriented approach. The feasibility study was made by a seven-member project team, together with the chosen vendors. After that, in the fall of 2003, a company was established to coordinate system development. As the quotes below indicate, the approach toward coordination was more formal in Case 2 than in Case 1.

> With ever-increasing costs, we tried to find a way to cut costs. If we do things together and only once,
> i.e., not registering the same transaction several times in different places, we could save money
> (Development Manager, Project Office).

> The Project was initiated by a project group. During feasibility study there were 5 or 6 of us…. During
> the coding phase there are about 200 of us (Development Manager, Project Office).

Requirements Analysis Case 1

During the requirements analysis phase, the main coordination mechanisms used were a ten-member project team that held mostly informal meetings. The team did not document well enough the results of the meetings. This caused problems during the coding phase. At the formal level a cooperation agreement was needed to make coordination possible. The consortium agreement was a vehicle for setting a common goal among the consortium participants, but it was an agreement made by the top management, i.e., rectors, and included very little practical guidance. To support our interpretation, some interview quotes are included below. The project group become more important in coordinating of system development, but it worked mostly informally as the documentation of requirements was insufficient.

We formed a project group which had members from all five member universities and representatives from vendors (Project Manager from the consortium organization).

The requirements analysis was generally OK, but it was made on too general a level (Project Manager from the consortium organization).

The documentation was deficient, especially for the functionality of the system (Project Manager from the consortium organization).

Requirements Analysis Case 2

During the requirements analysis phase, four main coordination mechanisms were observed. A project organization was set up to coordinate system development toward clients and vendors. The project organization was relatively small (about ten employees), given that during coding there have been between 150 and 200 people employed by the vendors. Therefore, standardized methods and tools have been an important part of coordination during the requirements analysis and coding. Requirements analysis was made by the pension fund company representatives and the vendor representatives, using pair working teams and workshops. The approach to gathering requirements and documenting them was formal in Case 2. Coordination between different stakeholders was also systematic, as the quotes from our data indicate.

There is a core group of people that form the project organization (Project Director).

During requirements analysis we had workshops twice a week and pair working on other days (Project Director from the project organization).

If the Development Environment is standardized before the coding starts, risks can be reduced. Also, the quality improves; code becomes independent of the coder and similar. Therefore, it is easier to maintain. Uniform methods and tools also enable us to better manage the project and stay in schedule (Project Director, software vendor).

Coding Case 1

During coding the most influential coordination mechanisms were requirements documentation and consortium agreement. During coding the client (i.e., the consortium) was under the impression that the vendors would ask for further information about system features, but the vendor coded the system according to the available documentation, despite the fact that the documents were vague and the requirements were too general. As the customer waited for vendors to ask for further details, it can be interpreted that there was no formal process for coordination in coding phase.

The customer thought that the vendor would ask for more precise specifications, but the system was coded according to the original documents (Project Manager from the consortium organization).

Coding Case 2

During the coding phase, the project organization was coordinated also by extensive meeting routines and joint premises (project organization and vendors). The approach was more formal than in Case 1, as the system development platform and the development methods were developed before the actual coding started.

On Mondays change management managers of different projects gather … on Tuesdays a sub-group of the previous group gathers. On Wednesdays we have project meeting, and on Thursdays we have meetings with each of the projects (Project Manager, project organization).

Then on Fridays we have a coordination meeting, where we can gather all the projects around on table (Project Director from the project organization).

Mode of Coordination and Cross-Case Analysis

In Case 1 a mostly informal coordination mode was used (personal contacts, Informal feasibility studies, consortium agreement). In Case 1 the decision-making was many times done along the way, and documentation was deficient. As a result, it can safely be said that the coordination in Case 1 was informal during the studied system development phases. The informal mode of working may be due to the organizational context where the project took place. Universities are loosely coupled organizations (Weick 1976), and this may reflect on projects that are carried out in a university context. During the coding phase, there was very little coordination and communication between the software vendors and the consortium organization, which led to serious difficulties at the end of the coding phase.

Case 2 was under a tight time schedule and was organized more formally from the beginning. In Case 2 more control-oriented coordination mechanisms were deployed (standardized methods and tools, workshops, pair working, extensive meeting routines). The decision making and documentation in Case 2 was also systematic. Therefore, the mode of coordination in Case 2 is categorized as formal.

Even though the mode of coordination and coordination mechanisms were different in the cases, some similar things happened in both cases during the requirements analysis phase. In Case 1 most of requirements were already determined when the first university joined the consortium. Similarly, in Case 2, the public sector pension insurance companies joined the project at a time when requirements analysis had already started. In both cases this caused extra work to requirements analysis, and also, difficulties in the later stages of system development. Tables 6 and 7 summarize the coordination mechanisms and the modes of coordination.

Table 6: Coordination in Case 1			
System Development Phase	**Negotiations (Incl. Feasibility Studies)**	**Requirements Analysis**	**Coding**
The most influential coordination mechanisms used in Case 1	Personal contacts Informal feasibility studies Consortium agreement	Consortium agreement 10 member project team	Consortium agreement Requirements documentation
Mode of coordination	Informal	Informal	Informal
Major events in the project	Consortium Agreement	Selection of development tools Diffusion of the Internet Sixth university joins the consortium	Delayed schedule Unfinished system

Table 7: Coordination in Case 2			
System Development Phase	Negotiations (Incl. Feasibility Studies)	Requirements Analysis	Coding
The most influential coordination mechanisms used in Case 1	Project Group Extensive Feasibility Studies	Project Organization Standardized methods and tools Workshops Pair working	Project Organization Standardized methods and tools Extensive meeting practices Joint premises (vendors and project organization)
Mode of coordination	Formal	Formal	Formal
Major events in the project	Private sector companies agree to start developing joint system	Development of methods, development platform, and system architecture Public sector pension providers join the cooperation	Functionality of the system is cut, budget challenges

The requirements determination was performed differently in the cases. In Case 1 the requirements analysis was done by a ten-member project team with very limited end-user involvement. In Case 2 the approach for requirements determination was more systematic. Project organization was established and the actual requirements elicitation was done via pair-working (vendors and end-users from the pension insurance companies) and workshop sessions arranged for the key personnel. However, in both cases the requirements were too general, and the specifications had to be revised later.

The coding phase was also drastically different in the cases. In Case 1 the coding was done according to the documents made in the requirements analysis phase. There were some difficulties in the coding phase and there was a delay in the first release of the software. The client (i.e., the consortium) was under the impression that the vendors would ask further information about the system features, but the vendor coded the system according to the available documentation, despite the fact that the documents were vague and the requirements were too general . This was due to differences in the requirements of the consortium members. In Case 2 the approach to coding was more structured. The project organization was in charge of the system development and the vendors worked on the premises provided by the project organization. This co-location has made the coordination of system development more structured and easier to coordinate. Standardized methods and tools were an important part of coordination, while there were several vendors and the project organization was relatively small. In Case 2 the system development was also coordinated by extensive meeting practices among different stakeholders involved.

DISCUSSION

In this paper we studied coordination in multi-organizational system development projects in two cases. At first, we identified the coordination mechanisms used in both studied cases. There were major differences among the cases in requirements analysis and coding phases. In Case 1 the requirements analysis was done by a small group that communicated relatively little with the different stakeholders of the future information system. In Case 2 the approach was more structured, but still the requirements analysis phase was challenging because of the divergent needs of different end-users (pension insurance companies). In both cases during the requirements analysis phase new organizations joined the cooperation. This is something that usually does not happen in other tailor-made system development projects. However, such multi-organizational system development projects are becoming more common, and, therefore, other similar "external shocks" may happen in other multi-organizational projects.

Coordination during coding phase was nearly nonexistent between the consortium and vendors in Case 1. The coordination of system development in Case 1 can be characterized as non-coordination (Sabherwal 2003) whereas in Case 2 more consistent coordination (Sabherwal 2003) is employed. In Case 1, coordination was not even considered an issue, and that led to difficulties with schedule and the quality of the system as the implementation of the system approached. In Case 2 the coordination of the system development was considered relevant part of the process and it kept the project in schedule.

Theoretical Findings

This study makes a contribution to coordination studies, while to our understanding this is among the first papers on the evolution of coordination in multi-organizational system development projects.

Previous research has introduced several categorizations and conceptualizations to coordination mechanisms. Some of them aim to be universal (Adler 1995; Grant 1996; Mintzberg 1979). Desanctis' and Jackson's categorization (1994) discusses coordination of information technology management, and Sabherwal's (2003) categorization is a synthesis from previous research aiming to describe the coordination in outsourced system development projects. The mechanisms that we found in the cases were rather usual coordination mechanisms used in system development projects. The mechanisms that we found in the cases could be categorized with other prior conceptualizations of coordination mechanisms (e.g., Mintzberg 1979; Sabherwal 2003). However, given the uncommon nature of our case examples, we see that identifying mechanisms inductively was feasible. Coordination mechanisms are descriptive in nature, and they only describe how the organization is managed. Therefore, coordination mechanisms only provide us the means to study management of system development. After the mechanisms have been identified, we can analyze how they change, why certain kinds of mechanisms are used in certain contexts, and the consequences of the choice of certain kinds of coordination mechanism or modes of coordination.

The most influential coordination mechanisms changed across the different phases of the system development in both cases, but the mode of coordination remained the same. This is a rather interesting finding per se. In Case 1 there were serious difficulties during the coding phase, and one might expect that something like this would also change the mode of coordination (see Table 8). In Case 2, as the implementation approached, the functionality of the system was reduced. Still, no significant changes to the coordination mode can be found in this case. From Table 8 we can conclude that the same kinds of challenges can be found in multi-organizational system development projects as in system development projects in general. If the project is coordinated informally, (as in Case 1) there may be issues with vague requirements and schedule. On the other hand, if the project is coordinated formally (as in Case 2), the project is more likely to stay on schedule. However, staying on schedule may require reduced functionalities and issues with budget. It is interesting in Table 8 that no significant changes in mode of coordination can be found in either of the cases.

One plausible explanation for the unchanging mode of coordination is the size and complexity of multi-organizational system development projects. It takes time and energy to find and agree on common grounds of working, and, even though some problems are faced, it is too laborious to change the ways of working in several different organizations. Previous research has emphasized and focused on coordination mechanisms in coordination studies. We have also used the mode of coordination as a descriptive division to analyze coordination. We see that the mode of coordination could be used in other studies as well, and it is a particularly useful concept for large-scale system development efforts.

Table 8: Case Wrap-Up		
Conclusion	**Case 1**	**Case 2**
Mode of Coordination	Informal	Formal
Major Challenges	Vague requirements, Heavily delayed schedule	Functionality of the system was cut, budget issues
Changes in Mode of Coordination	No	No
Dynamics of Coordination	Non-coordination	Consistent coordination

Practical Findings

The research gives insights for practitioners as well, as our results provide understanding for the organizations involved or considering joint information system development efforts. In this paper we have analyzed two rather differently coordinated system development projects. In the university domain, the project was coordinated rather loosely, and in the pension insurance domain the system development approach was more formally defined. In addition to that, in both cases the mode of coordination maintained the same during the studied system development phases, even though the projects faced difficulties. Another managerial implication of this study is that although the actual system development project is coordinated well, problems still can occur. This is because there are many stakeholders outside the actual system development that can influence the actual system development. For example, organizational or strategic changes in client organizations may change how an organization invests in a joint system development project. A good example from both studied cases of this issue was the new organizations joining the cooperation during the requirements analysis. Thus, in these kinds of development projects there are lots of issues that are out of the control of the project organization. This finding is also reported in previous research (Brooks 1982; Scott and Vessey 2002) about system development in general. According to our results, this is amplified in multi-organizational system development cases.

CONCLUSIONS AND FURTHER RESEARCH

In this paper we studied coordination in multi-organizational system development projects. We studied two large scale projects in the public sector and analyzed the evolution of coordination mechanisms and the mode of coordination. It was found that mode of coordination was different in the studied cases and the chosen mode of coordination led to different outcomes. In both cases the chosen mode of coordination remained the same during the system development lifecycle, while there where changes in the coordination mechanisms.

Our study has some limitations. We have analyzed only two cases, which will prevent us from statistically testing our propositions. However, given the nature of multi-organizational system development projects, a qualitative research approach seems feasible. Complex system development projects are path-dependent (Gallivan and Oh 1999), and they all have their own special characteristics. As a consequence, it would really be difficult to find enough examples of such multi-organizational projects that could be compared. Case 1 was studied partially in retrospect. However, we had a lot of documentation, and we interviewed key personnel who had been involved with the system development from the beginning of the project.

Implementation and maintenance phases are missing from our analysis. The nature of system development changes after the system has been implemented, and, therefore, different coordination mechanisms would be used as well. We have excluded the analysis of the implementation phase for two major reasons. First, our unit of analysis is the "organization in the middle," i.e., the coordinating organization. The implementation of the system will be mostly done by the user-organizations, so, in that sense, the implementation phase is partly out of the scope of our study. Second, we do not have sufficient information about the implementation of the Case 2.

Our theoretical lenses to approach the cases have been coordination theories. Coordination is a relevant factor in large-scale system development efforts, and its importance is emphasized in multi-organizational development projects as the number of interdependencies increase. We acknowledge that there are some issues outside the scope of our study that have influence on the success of these kinds of development projects. However, we see that coordination theories provide a feasible way of analyzing management processes in a multi-organizational system development environment, where control is fragmented to several organizations. We call for the use of other feasible theories in further research.

In this study we have presented and compared two multi-organizational projects. In one case the system development approach was rather loose and the other more formal. However, it is not straightforward which approach will lead to better results in different contexts. This is something that we want to investigate further.

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APPENDIX: SOME DETAILS ABOUT THE DATA COLLECTION

As we interviewed in different organizations (client, vendor, project organization) and in different hierarchical levels of organizations, we had to modify our questionnaire to fit the view-point of the interviewee. However, in semi-structured interviews the following broad areas were covered:

1. Background of the Interviewee Toward the Case Project

What is your current position? How long have you worked in this project? Have you previously had positions in the same field? What and who are the focal organizations and persons that you mostly work with? How much do you see the actual system development in your work?

2. Background of the Organization / Information System

When did this project start in your organization? When did your organization join the joint system development project? How many people does your organization have on this project? How is this project organized within your organization? Who are the relevant stakeholders to your organization? How many users will the information system have, and what are the roles of the users? What is the size of the system in lines of code/man-months? How does the new system relate to your current system? How much work has to be done with the old systems? What are the implications of the new system? Can you think of other similar projects, where you have several client and vendor organizations?

3. Role Toward the Other Organizations in the Cooperation

What is your role in this cooperation/system development project? How do you communicate with other clients/vendors/project organization? How are there differences among different organizations in how they cooperate in terms of power, involvement, etc.? What other relevant stakeholders have influence on the system development?

4. Communication, Coordination and Control in Multi-Organizational System Development?

What are the most important events that have occurred during the project, and how have these events changed the organization/system development? Have methods and working routines used in this project changed your own processes? What meeting routines do you participate in? How are things coordinated between other organizations in this project? How do you communicate with other organizations involved in this project? How do the methods used guide the process? How do the tools used influence the development process, and are there differences among participants? What have been the key coordination mechanisms toward clients and vendors in each system development phase (meetings, tools, etc.)? How consensus is found in meetings? What mechanisms are used in case of problems?

5. Integrating the Processes of Different Organizations / End User Feedback

How much do clients (end-user organizations) have power over decisions whose features will be implemented? Are there differences among participants? How do the client organizations influence? How were the requirements gathered from the clients? How are the different requirements prioritized? Who chooses, and how the implemented features are chosen? How much have the current systems been utilized? How are the different processes in different client organizations modeled, when, and how are these processes integrated? What other stakeholders will integrate the new system to their systems?

6. Future

Where are we going now? Have there been, or will there be, changes around the project (in organizing, etc.)? What happens after the system is implemented? What impacts will the new system have? What have been the biggest challenges in this project? What has been good, and what would you change if the project would start over? Is there something we haven't asked, but you would like to comment on?

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