28 INNOVATIONS IN FIEFDOMS: DEVELOPING A COMMON STUDENT INFORMATION SYSTEM IN SIX FINNISH UNIVERSITIES

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Abstract

The dynamic and on-going process of developing a state-of-the-art student record information system by a consortium of six Finnish universities is both described and analyzed. Using a social process model as the basic framework to describe the development, the

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consortium's choice of a joint development approach with two software vendors is explored and the consequences examined. The article concludes by posing a series of research questions that the authors hope to address as the project unfolds.

Introduction

In 1995, an agreement was signed by five Finnish universities to begin a feasibility study to produce a common information system (IS) to replace a variety of outdated student record systems, most of which have the year 2000 problem (Y2K). This **S**ystem to **S**upport **T**eaching and **L**earning (SSTL) would support teachers and students with a state-of-the-art user interface and www capabilities, and should enjoy an operating life of at least 10 years. The consortium of universities is supported financially by the Ministry of Education, expanded to six members in 1997.

This article describes the dynamic process of SSTL development in its socio-political context consisting of six different universities and an alliance of two software vendors. The research project, which parallels the SSTL project, is to study the development of SSTL from its conception to delivery (expected in the summer of 1999) and deployment. The rarity of such consortia makes the project a particularly vital one for researchers and practitioners alike. With the pressures on financial budgets, consortia of this type may become much more common in the future. One of the pioneers in this area and a reference point for this project is the Swedish LADOK-consortium (http://www.ladok.umu.se/opendok/LaEnglish.html). The current article can be seen as research-in-progress, the first in a series of articles reporting on the project over the next several years.

We proceed by looking at the literature relevant to building common systems in a university context. We also look at the issue of procuring software from commercial vendors. This is followed by a discussion of the research methods we use for studying a project over several years. Because of the close cooperation in the project between academics and practitioners we pay particular attention to situating the authors. This is followed by a description of the background and history of the project from the early 1980s to date. The article concludes with a discussion of the findings and what research questions we shall attempt to answer in our future research efforts.

The Organizational Context: The Special Nature of Universities Affects IS Development

It is sometimes said that management in universities is like herding cats. Each participant is an individual willing and capable of independent behavior. Another often used metaphor is to say that universities are like collections of fiefdoms where barons and baronesses are in charge of their own, independent realms, making war on each other. It would seem that universities are fundamentally different from business organizations in their decision making processes. Consequently, the standard IS development strategies developed for business may not be appropriate in institutions of higher education. To develop a more analytical view, we classify universities as predominantly professional bureaucracies (Hardy 1991; Mintzberg 1983). Professors are professional bureaucrats who have a very special kind of relationship with their university (Mintzberg 1983, p. 207): "Professional bureaucracies are not integrated entities. They are collections of individuals who come together to draw on common resources and support services but otherwise want to be left alone."

The professional bureaucracy relies on specialization, hierarchy, rules and regulations that are thought to ensure the predictability of the behavior of the organization and to lead to efficiency and effectiveness. In universities, the professional bureaucracy has a "parallel" organization for routine administration (Mintzberg 1979, p. 361). The distinction between these two organizations, however, is not so clear in our case. Here, the heads of the departments are normally highly qualified scientists. This brings the concerns and the ways of thinking of the professors into the routine administration.

The problem of coordinating development efforts in loosely-coupled organizations like universities is well known (Hardy 1991; Noble and Newman 1993; Weick 1976). A clear example exists showing how these problems appear when developing an IS that spans organizational boundaries. The Thruway case concerns a U.S. university that developed a student admission system (Newman and Noble 1990; Newman and Robey 1992; Newman and Sabherwal 1989; Noble and Newman 1993). The Thruway case indicates that where there is a mismatch between an IS and its organizational context; the implementation demands special attention by management in order to prevent a dysfunctional outcome (Noble and Newman 1993). In the case of Thruway, the system was structurally integrated but the organization consisted of several autonomous units. The implementation of Thruway ended up with a less than optimal outcome from the point of view of the whole university. A single user group gained dominance in shaping the system's design, to the detriment of other users and potential stakeholders.

The development process of Thruway also seems to have been poorly managed. Two interlinked issues are relevant in this respect. The first one concerned design of the user interface. The second issue was the treatment of conflict between different user groups.

The resolution of the conflicting requirements was given to the computer specialists. But they could not improve the organizational fit of the system because they had neither the resources nor the power to restructure the implementation situation. This restructuring would have meant that they could either have compelled the conflicting users to accept a common set of data collection forms suitable for a common user interface, or they could have designed dedicated screens for each user group. A third option might have been a socio-technical codesign of both the organization and the system (Noble and Newman 1993, p. 207). The chosen design, as well as inadequate hardware resources, manifested itself in a long response time which led to heavy user resistance, eventually resolved in favor of a single user group. The adopted development strategy meant that the developers became powerless middlemen between conflicting parties who only recognized that they disagreed with the middleman but did not recognize that, essentially, they disagreed with another user groups.

In the SSTL, we have additional complexity because there are several universities in the consortium. Thus it would be expected that the difficulty of building and maintaining a stable consortium of universities to produce and implement a common policy on student record systems would be magnified enormously. However, that is what is being attempted. The relevant issues related to this endeavor are discussed toward the end of this article.

Software Procurement Governance Models

IS development can be classified in three broad approaches: in-house development, contractual development with outside vendors, and software product purchase (Grudin 1991; Saarinen and Vepsäläinen 1994). The relationships between a software vendor and its client can be understood through several theoretical frameworks (e.g., Asanuma 1989; Bakos and Brynjolfsson 1993; Gurbaxani and Whang 1991; McWilliams and Gray 1995; Powell 1990; Richmond, Seidmann, and Whinston 1992; Whang 1992). We have chosen transaction cost theory as the basis for our analysis of the client-vendor relationships because this theory is well known, conceptually parsimonious, informative, and easily applicable in our case (cf. Heiskanen and Newman 1998). Transaction cost theory is targeted to the analysis of make-or-buy decisions. The essential question is whether the (client) organization should make a product or service internally, using a hierarchy to control actor coordination, or purchase the product or service outside, using the mechanisms of markets (Lacity and Hirschheim 1993; Williamson 1991). The client's problem is to decide which governance mode is the most economical one in a given situation.

Transaction cost theory has been used to propose an IS Procurement Principle (Saarinen and Vepsäläinen 1994). The Procurement Principle prescribes that routine applications (common to many organizations with well-specified requirements, like accounting) can best be implemented by acquiring a software package, i.e., through a market transaction. Standard information systems (shared functionality with a group of organizations but variety of detailed requirements, like personnel systems) require contracting with software vendors. Speculative systems (specific to one company or involving high uncertainty of requirements, like SSTL in our case) are best left to internal development, i.e., for a hierarchy.

The Procurement Principle is intuitively appealing. One of its strengths is that it identifies costly or risky approaches to software procurement. A costly approach is to develop software internally when it can be purchased. A risky approach is to base speculative systems on cooperation with commercial software vendors. SSTL seems to be a speculative system, especially with so many members in the consortium, and so it seems that a risky strategy has been adopted. The outcome of the development process will reveal whether the risks could indeed be managed.

The static stance taken by the transaction-cost theory is a serious problem when trying to describe and explain IS procurement, a dynamic process. In our earlier work on this area (Heiskanen and Newman 1998; Heiskanen, Newman, and Similä 1996), we added the dynamic dimension by using the Newman-Robey social process model (1992) and found some support to the IS Procurement Principle. Here we continue this line of research by describing how we could cope when we had to adopt a somewhat risky approach and the processes that can be constructed by the client to secure its interests.

The research process will enable us to document how the drama of systems development unfolds over time. Another complication is that transaction-cost theory is known to be a problematic predictor of actual IS sourcing behavior (Lacity and Willcocks 1995). As the derivative of transaction-cost theory, the IS Procurement Principle seems to make sense from a practitioner's point of view. We have found it important to investigate the meaning of these theories to our case, and so increase the common understanding of the complexities of software procurement.

Situating the Authors as Practitioners and Researchers

The idea of doing IS research of this type grew gradually during the dissertation work of the first author (Heiskanen 1994, 1995). The research work began in 1987 as a rather positivistic inquiry to the implementation process of a new student record system of the University of Helsinki. In the early 1980s, the first author was a senior analyst developing the software and later a project leader for the decentralization of the system functions to the departments of the University. Over the years, he also became the chief information systems officer of the University and his responsibilities were extended to other areas such as financial and personnel administration systems. In the late 1980s and the early 1990s, he became more aware of the importance of organizational issues to the design of IS. In the SSTL project he acts as the vice chair of the directory board, the main task being to secure the smooth progress of the work.

The second author became a part of this process as the dissertation inspector and opponent of the first author in 1993. His special experience in longitudinal research has close parallels with the first author's study of university systems over a period of more than a decade. The second author has published several studies of system development projects covering five to 15 years. Using this empirical evidence and careful interpretations, he has developed a social process model of IS design (Newman and Robey 1992, Robey and Newman 1996). His role in the SSTL project is an "outside" researcher.

The third author was hired as an EDP analyst in 1995 by the University of Helsinki to make a feasibility study for the next generation student record system. Before that, he had acted in various positions in student affairs administration and pursued studies in computer science and in the social sciences. In 1996, he became the client project leader of the SSTL consortium. As a researcher, he is using the SSTL process for his master's thesis.

In our research, we explore the possibilities of presenting our direct experience from practice in a form that makes sense to the academic audience (Heiskanen and Newman 1997). Our task is related to has been called knowledge conversion from unarticulated practice to explicit knowledge (Nonaka and Takeuchi 1995). We rely on simple methods, tracing the flow of events and decisions in an organization (cf. Newman and Robey 1992). We use the notions of Reflection-in-Action, adopted from Schön (1983), who frames the work of design as a reflective conversation with the situation where the practitioners function as agents and experients.[2] Through their transactions with a

[2]By "experient," Schön appears to mean an experimentor who is at the same time also a target or part of the experiment.

situation, they shape it and makes themselves a part of it. Hence, the sense they make of the situation must include their own contributions to it. Yet they recognize that the situation, contrary to the intentions, may foil their projects and reveal new meanings. The situation comes to be understood through the attempt to change it, and changed through the attempt to understand it.

Schön criticizes "technical rationality" according to which professional practice consists of the application of standardized scientific knowledge that is instrumental for problem solving. In contrast, Schön sees practitioners as involved in personal relationships, situations demanding action, and value conflicts. In this practice, the practitioners develop knowledge that is often tacit and spontaneous. They will also develop a practice-oriented theory or rationale according to which they explain the situation and choose their acts.

The word "theory" has a special meaning in this context. According to Schön (1983, pp. 273-274), practitioners do not consider that they have formed a satisfactory account of phenomena in any practice situation until they have framed it in terms of their overarching theory, in terms of a rationale according to which they explain the situation and choose their acts. So theory has two intertwined meanings: first in action design and then in "after-the-fact" explanations and interpretations. It is this concept of theory that makes the Reflective Practitioner approach different from typical case descriptions in IS business journals. An overarching theory does not give a rule that can be applied to predict or control a particular event, but it supplies language from which to construct particular descriptions and themes from which to develop particular interpretations.

Our point of view in this article will predominantly be that of the University of Helsinki. There are three reasons for this choice. First, this keeps the article length reasonable without jeopardizing the results too much. Second, the consortium arrangements can be seen as a means by the University of Helsinki to secure the overall SSTL development. Third, because of its relative size, the University of Helsinki has a leading role and therefore most of the consortium issues can be discussed from its point of view.

Evolving Problems of a Student Record System

In this section, we describe the most important aspects of the development history of SISUH, the Student Information System of the University of Helsinki. We follow the evolving Student Record System from the late 1970s until 1998. The early part of this period was rather favorable for the University in general economic terms, because state funding was on the increase, especially in the late 1980s. There were some financial problems for IS development in 1986 and 1987, because the organizational "inertia" hindered the increase of IS funding with the pace of growing demands. The general situation changed dramatically in 1992 and 1993, when the decline of the Finnish economy induced cuts in the budgets of all Finnish universities.

The University of Helsinki currently has nine faculties, over 100 teaching departments, about 33,000 degree-pursuing students, and about 6,000 full-time equivalent employees. The Student Register Office or the Enrollment Office (formerly called the Actuary's Office) is the unit responsible for the University's centralized part of SISUH and the student database. The EDP Office (founded as an independent unit in 1984, formerly being a part of the Actuary's Office) has been in charge of the software development for SISUH and responsible for the management of the development project as well as for the purchase of services from outside software houses. Both offices are located in the central administrative bureau of the University. The department is the basic administrative unit for teaching and research in one or several subjects of study or fields of research. The decentralized user units of SISUH are the departments and the faculty offices.

Data problems with the Student Record—missing or erroneous credit data—were apparent during the 1980s. The Credit Record was at that time largely a means to produce statistics. The system suffered from a vicious circle. Many teachers felt that the system demanded unproductive, extra work in sending study credit data to the Actuary's Office. There were delays in data sending. Some data was not sent, leading to poor coverage. Poor coverage, in turn, made the system inadequate, and the inadequacy felt by its indirect users led to carelessness, etc. This all was seen by the departments as an inability of the system to produce timely statistics. The data problems were related to many other problems. The credit recording system entailed double work, especially for departments and teachers. The signing of the personal study books of the students was tedious but necessary because they formed the official credit record. It was unclear to many teachers which record was the official record: the study book or the Student Record. The Actuary's Office was understaffed for its duties as the centralized registration bureau.

The development history of SISUH can be divided into **four** main phases from the point of view of this study. The **first phase** started in 1981. The syllabus reform performed in all Finnish universities in the late 1970s also required changes in the Student Record System **CERS** (**Ce**ntralized **R**egister **S**ystem) used by the Actuary's Office. A more detailed credit registration became necessary, thus increasing the amount of recorded data in the Credit Record. The software developed in the 1970s and run on the University's mainframe was revised in line with the new circumstances. This first revision, however, did not remove the basic technical and organizational flaws. The direct user functions remained in the Actuary's Office. Technically, the system was still batch oriented with add-on files for on-line terminal data entry and inquiries. The mainframe was also used for research and teaching applications and it suffered reliability and performance problems. At the end of this first phase ,**CERS** was revised for the second time during the years 1985-1988. The new system was real-time, based on a relational database, and ran on a VAX dedicated to administrative systems. This marked the beginning of the **second phase** in 1987.

As a result of an outburst of the organizational frustration toward the problems of SISUH, inspired by the emergence of personal computers, a decentralization process of the functions of SISUH started in spring 1986 in the form of an experimental project for departmental data processing. The experimental project, although it suffered from staff resignations, made a prototype of **DERS (De**centralized **R**egister **S**ystem), a PC-based system for student data processing in departments. In March 1988, the Senate approved a project called **DIRE** (**Di**stributed **Re**gistration) to turn the prototype of DERS into a real system and to explore the possibilities for decentralization as a means of solving the data problems.

One of the duties of the DIRE project was to produce a plan according to which all of the departments could adopt EDP in the student data processing. This plan was formulated to be the 1989 decentralization strategy. The birth of this strategy entailed a conflict between the Actuary's Office and the EDP Office because the Actuary's Office considered it too risky to decentralize the use of CERS to the departments. Only indirect updating, e.g., file transfer of data from DERS to CERS, was approved.

During autumn 1987, the EDP Office had decided to make DERS a real alternative at the department level. The anticipated capacity problems with the VAX running CERS favored the inclusion of the PC option, as did the lack of connections to the University data transmission network in many departments at that time and the resistance of the Actuary's Office toward the decentralized use of CERS. The Actuary's Office reconsidered, however, its view regarding decentralization and gave permission for departments to use CERS in May 1988. So in the battle between the EDP baron and the register baroness, the view of the EDP baron came to prevail. The development of both CERS and DERS was considered necessary, because the size and personnel capability varied greatly over the departments, as did their perceived needs. DERS provided a more user-friendly interface while CERS could integrate the data from all departments.

The success of the decentralization strategy in the early 1990s marks the beginning of the **third phase**, during which the data problems have disappeared and the decentralized data entry has been generally approved. According to three surveys (performed in 1992, 1994, and 1997), the direct users of CERS and DERS show high satisfaction scores toward these systems. The use of DERS has gradually diminished. Currently only five departments use it as the main option; at its peak, the number was well over 60. The faculties have decided to cease to mark the credits into the personal study books of the students; the Credit Record Excerpt is used instead. The students can inquire the state of their recorded credits via e-mail.

The third phase was a calm one with steady progress. The University of Helsinki ended up with a common student records system, CERS, which seems to be popular among its users, but is technically outdated (a Y2K problem) and entails high dependency risks on personnel and software tools. CERS has disappeared as a topic from the public discussions of problems. In the **fourth phase**, which began with SSTL development, we anticipate much more turbulence. However, we try to use our prior experience for coping with the turbulence. This means that we have adopted a proactive approach instead of the reactive approach that characterized SISUH's development in the 1980s. Reactiveness showed itself as failures of resource arrangements in the early 1980s, in the emergence of the experimental project, in the dispute over decentralization, and in the change-over of work from a software house to the EDP Office.

Proactive efforts include the university consortium formation, fund raising from the Ministry of Education, careful contracting with the vendor alliance to secure a workforce, retaining ownership of the software by the consortium members, keeping management of the process within the key EDP personnel of the consortium, and management of the mismatches of the development process. The two mismatches are, first, between the loosely-coupled nature of universities and concerted development of software and, second, the mismatch indicated by the IS Procurement Principle: a speculative system is developed with commercial vendors instead of a hierarchy, i.e., internal personnel. Key issues in the fourth phase will be to find the right functionality of the system, the managing of the development and adoption processes, the choice of the proper software tools, and the adaptation of the system over the years of use according to changing and conflicting demands.

As a brief summation, we identify some key events from the transition period leading to phase 4. A bidding competition of the SSTL requirements analysis for software vendors was arranged in May 1996 after the consortium had completed the feasibility study. The contract was awarded to the two-member vendor alliance in August 1996. The requirements analysis, ready in January 1997, was followed by a bidding competition for development. The chosen vendor alliance won the contract again, and the development contract and a frame contract of cooperation were signed between the consortium and the alliance in April 1997. The software tool choice was important to the consortium, so the decision took time and was made in April 1997. The application delivery is planned to be in April 1999.

To summarize the SISUH history, we have experienced phases of stability and phases of instability and turbulence. Phase 1 represent stability and stagnation; phase 3, stability and progress. Phase 2 was a turbulent one during which the shape of the system for the 1990s emerged. We anticipate phase 4 to be a turbulent one, but we also anticipate some social inertia, because several key players in the University of Helsinki were participants in the 1980s. The problems and issues of SISUH's history have been collected in Table 1.

Future Research

This article is a report of research in progress. Studying SSTL *in situ* is an opportunity to observe directly how the process is linked to the resulting information system. Several research issues can be identified:

- Consortium governance, the future ownership and responsibility of the software. Who has the right to change the software? Who owns the system legally and who controls it in practice in each university: the vendors, the consortium, the university, the faculties, the departments?
- Which forces have kept and will keep the consortium together?
- How can such different units agree on the specifications and cost-sharing?
- The evolving relationships between the university consortium and the vendor alliance.
- Comparison of different ways of adopting the new system in different universities. The order of adoptions is problematic: too many units may want the system installed in 1999 because of the year 2000 problem.
- Can the participant universities learn from each other in implementation problems? How can this knowledge be disseminated?
- What happens when schedule slippages occur?
- What are the specific structures for adoption success?

We expect that we will have a good opportunity to analyze how the governance of the development process evolves over time. The four first bullet points above are related to this governance or control issue: how the consortium is able to control itself and the vendor alliance. Earlier, we studied the dynamics of the mechanisms of market, hierarchy, and an intermediate hybrid form of organizing IS development work (Heiskanen and Newman 1998; Heiskanen, Newman and Similä 1996). Now we think that we can study the evolution of a clan governance mode (Beath 1983, 1987; Kirsch 1997) that seems to prevail within the consortium. Ouchi (1979) describes a clan as a group of people that have common goals and are dependent on each other. Clan control entails common values, philosophy, and approaches to problem solving within the clan. Careful selection of members and socialization propagates common values and beliefs, resulting in a strong sense of identity and commitment to the group. Rituals and ceremonies serve to identify and reinforce acceptable behavior (Kirsch 1997, p. 3).

Table 1. A Chronological Summary of the Practical Problems and the Strategies Used to Solve Them

Year/Phase	**Problem or issue**	**Solving strategy**
1981/1	Software change because of the syllabus reform. More hardware resources are required.	The maintenance of old software. Estimation of the hardware requirements and preparations to purchase new hardware.
1982/1	No new hardware because of the failure of purchase strategy.	No explicit strategy.
1984/1	Data quality and service level appeared to be poor.	More hardware and systems software resources, more personnel, the establishment of the EDP Office.
1986/1	Dissatisfaction increases because the emergence of PCs create expectations.	Experimental project for departmental data processing.
1987/2	Confusion over how to proceed when the experimental project stalled and the Actuary's Office considered CERS to be too risky to be used in departments.	The completion of DERS.
1988/2	Actuary's Office reconsidered its view about the risks of decentralization, but are the departments ready to do their share of decentralization work?	The establishment of the DIRE project.
1989/3	How the decentralization is implemented.	The 1989 decentralization strategy according to which the departments could adopt CERS or DERS if they so choose.
1989/3	Personnel problems in the software house.	The change-over of the development of CERS/DERS software to the personnel of the EDP Office.

Table 1. A Chronological Summary of the Practical Problems and the Strategies Used to Solve Them (continued)

Year/Phase	Problem or issue	Solving strategy
1993 - 1998/3	Was the development process a success or a failure?	The construction of an assessment system to be a part of the management control of the administrative ISs of the University.
1995/4	How to find funds for developing a new version of the software?	Cooperation within a university consortium to share the costs, application for monetary support from the Ministry of Education.
1995 - 1997/4	What would be the process to develop and implement the new system?	Scenario drafting. Interaction with IS academics in several seminars in order to apply research results.
1996 - 1998/4	What would be the core functionality of the new system?	Thorough discussion in the project group of the various features included in all of the old systems. Perceived needs in different universities.
1996 - 1998/4	How to make contracts within the university consortium and between the consortium and the vendor alliance?	Analysis of the long-term goals of the stakeholders, identifying risks through the IS Procurement Principle.
1997/4	The choice of software tools.	Analytic comparison using weighted factors, confirmed through ex post discussions in the project group.
1998/4	What actions are needed for the successful adoption of the new system in different universities?	The analysis of the gaps between the current state and the desired state in each university.

Discussion

The IS Procurement Principle of Saarinen and Vepsäläinen would strongly suggest that a speculative system with high specification uncertainty and many and varied stakeholders in several independent organizations would best be served by a hierarchical solution. As in the Swedish LADOK case, we would expect that the high costs of communication, coordination, and management would be reduced by creating an internal solution.

The hybrid solution chosen by the SSTL consortium, involving the six universities and two software vendors, would imply high transaction costs and a consequently higher risk of failure. The software procurement model would predict greater needs for the consortium to communicate and coordinate and to manage the development process more closely. This would manifest itself in many committees, boundary spanners, a frequent need to renegotiate contracts, and increased budgets and time delays. Some of this is what we have already observed in this case. There are several committees; a delay of approximately one year has occurred; there have been renegotiations with the software vendors. Increases in budgets have been met by grafting onto the consortium an extra member in 1997. It is a fact that many projects face similar problems and it is untestable to ask whether the situation would have been improved with a hierarchy solution. What we can see in this case is the real need to “structure for success” by building in coping strategies to compensate for these increased transaction costs.

A further compensating factor in favor of SSTL is the evident goodwill between the consortia members. There is a high degree of trust and a belief that the new system will be delivered and produce the benefits claimed. Although it could be argued that this goodwill has a sound economic basis in that no one consortia member could afford to build such a system alone and that they need to cooperate, this is perhaps missing the point. There is a stereotypic notion in Finnish culture of cooperating when facing a crisis. In the summer of 1999, at least four of the six members “need” to replace their existing systems with SSTL due to Y2K problems in their current software. This will put a heavy strain on the project group to meet this deadline. The consortium members’ goodwill and trust could be severely tested in the lead up to this period.

To conclude by playing with metaphors, the Y2K problem and lack of resources can be seen as a fierce dog that has frightened the university cats to cooperate. But it soon will be seen whether these cats turn out to be barons in disguise that only wait to disclose their weapons to secure their individual interests and to usurp some of the common catch to be enjoyed as their private property in their own fiefdoms.

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