People and Computers: Twenty-one Ways of Looking at Information Systems

Timo Järvi and Pekka Reijonen (Editors)

To Markku I. Nurminen on June 11, 2003
With friendship and respect from us to you.

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Tone Bratteteig
Claudio Ciborra
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TUCS

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Preface

To Markku I. Nurminen on June 11, 2003

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To the reader

This book has come about from the willingness of the friends of professor Markku I. Nurminen – from far and near – to honor him on his 60th birthday, June 11, 2003. The authors know Markku well, but the uninformed reader might wonder who Markku I. Nurminen is. For those who do not know Markku, his Curriculum Vitae and his list of publications have been added into the Appendix. In order to get his contact information and to see his picture placeholder, please visit http://www.it.utu.fi/english/henkilokunta/info.php?c=ope&id=28. In order to see his picture, please visit the pages of the IRIS 25 conference: In the picture http://www.iris25.cbs.dk/iris-pic/pages/234_jpg.htm Markku is the man wearing the hat and in the picture http://www.iris25.cbs.dk/iris-pic/pages/260_jpg.htm he is the man with spectacles, standing on the right. If you want to get a better picture of him and meet him in person, you can always visit the Department of Information Technology at the University of Turku or attend the annual IRIS Conference. Markku is one of the co-founders of this conference and he has attended it from the very beginning – for 25 years! You may also choose to attend a concert of the Akademiska Orkestern, or some of the other ensembles, where Markku plays the clarinet.

Foreword

This book celebrates the 60th birthday of Professor Markku Nurminen. Markku is both the subject and the object of this book. The authors would like to thank Markku for decades of splendid contribution to the research and teaching of information systems science. Any reader will soon observe what kinds of thoughts Markku's ideas have aroused and also which scientific "camp" Markku belongs to.

In order to describe Markku's contribution to the research society, we apply "the student's life cycle model". The student, of course, gradually matures and reaches other stages of life. He or she may also become Markku's colleague or friend. It is not an exaggeration to claim that this book is written by a bunch of both colleagues and friends. Let us look at the model:

Most "green" students who find their way to Markku's lectures have, most probably, already heard something about Professor Nurminen. There are mainly two sets of rumours circulating around the university corridors. Basically, the first one says that these lectures give you what you need if you aim at a decent profession outside the academy. If this is the situation, it is important to come up with good thinking tools that can be applied in business environments.

The second rumour appeals to students dreaming (or not *yet* dreaming) of an academic career. Already during the first meetings with this truly knowledgeable professor, you get sucked into a maelstrom of reflections. Later, you will notice how carefully the stepping stones of mind were laid, enabling you to cross the river and enter the harbour of research.

When both these groups simultaneously attend the auditorium where Markku is teaching, it may, indeed, appear crowded. In this context, Markku's tireless focus on the end user's perspective has always stimulated students' thoughts and judgements. He has always been able to illustrate how human collaboration and responsibility for work tasks take place through an information system. Markku has been, and still is, one of the foremost advocates of the "human component" as an essential analytic instrument and as a principle of system design. The concept of 'human-scale information system' (the HIS-model) still rings a familiar bell.

Students belonging to population number one exit the system – far too often and way too early. Students who stay, experience a demanding supervisor who both gives and takes. The demand is on the one hand connected to work load, such as reading, thinking and writing *enough*. There is no student or young researcher who can beat Markku in thinking or understanding. His knowledge is enormous, and his library is huge. A young student or researcher may find it hard to work enough, or fast enough, in order to climb up to an appropriate level of competence. Markku resides at the top of the ladder waving invitingly down to you. And you climb after, taking the bit between your teeth…

The other aspect of demand originates from the quality of Markku's intelligence. Being Markku's student puts you in a position where you struggle for reading, thinking and writing *well enough* (not just *enough*). You cannot cheat. You cannot choose quick and dirty solutions. You have to use your brain. Your writings have to demonstrate a very good grasp of facts or lines of argument – Markku actually *reads* what you write! Otherwise, Markku simply presses the reset button (over and over again). In other words, Markku is the true professor, the careful teacher, and the listening coach. There are large numbers of former students, at all academic levels, who would willingly acknowledge this judgement.

From time to time, students later become colleagues. Then, one meets a "new" Professor Markku Nurminen. The "suffering of minds" has vanished. The bad papers are burnt. Possible intellectual insults are forgiven. Any earlier ranking order is gone, too. Instead, mutual respect has entered the scene. In this setting, Markku shows his sharing and caring mind in a different way than in the earlier stages of the "student's life cycle model".

Multi-disciplinary research is close to Markku's heart. To him, it is not a cliché. During the last two decades, Markku's research team has been based on several disciplines. Markku is no happy amateur. Instead, he invites established researchers from other sciences to join his team. Research is planned, carried out and reported accordingly. Research methods are chosen appropriately, and the findings are analysed from many different angles. The team observes, measures, analyses and writes *together*, with the inclusion of Markku's former students. The 'Knowledge and Work'-project, running from the late eighties to the early nineties, was a superb example of this thinking. Action research was successfully combined with other sociological methods, and applied to research problems within computer science. In the background, there was the HIS-model. This mixture resulted in new perspectives on how users learn, understand and manage an integrated large-scale information system. Markku is not just a professor – he is also a bridge-builder!

Bridges start and end. At the other end of the bridge, there is another "universe". Markku also builds bridges between different environments: from the university to case organisations. There are hardly any projects in his portfolio which are *not* connected to business cases. We can easily see how this connection boosts the content of Markku's production. Academic papers and books authored by him show an inevitable relevance also for practitioners. This is exactly what was meant by good thinking tools earlier in this foreword. Markku does not just build bridges between different disciplines, or between academy and businesses, but also between research and teaching. Today, the LABORIS Information Systems Laboratory, initiated and led by Markku, represents this "philosophy" in a sophisticated manner. The mission of LABORIS is to uncover and disseminate new ways of improving the usability of information systems. The main focus of LABORIS is what a user of an information system is supposed to know. Again, we can witness an effort that tells about Markkus engagement to promote the end user's position. Also businesses seem to appreciate this enterprise!

At the final stage of “the student’s life cycle model”, many of us – students, colleagues and friends of Markku – find ourselves working all over the world, in different kinds of positions. Some things, however, never change. Who are we bound to meet at IRIS (Information Systems Research Seminar in Scandinavia) and at other important conferences? Right, Markku Nurminen. Who is often a member of different evaluation committees? Professor Nurminen is. Who keeps reading unfinished doctoral dissertations year after year? Professor Nurminen. Who still attracts large numbers of students? Markku does. In other words, we are privileged to know a very durable professor who believes in his business. And, his career is by no means over – he is just about to turn 60.

Thank you, Markku, for years of valuable service in the interest of science, and congratulations!

Oslo, April 2003

Riitta Hellman
Markku’s student, colleague and friend

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On Research Paradigms, the Humanistic Perspective, and Knowledge

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Abstract. In this paper some of Markki I. Nurminen's studies are reconsidered. When Nurminen corrects Hirschheim and Klein's mistaken classification of many information systems development methods into Burrell and Morgan's four paradigms, he at the same time proposes his own three perspectives. We bring Deetz's classification and relate it and its application to Burrell and Morgan's paradigms, too. The Nurminen's humanistic perspective is then related with Aulin's actor theory and his classification of dynamic systems. Many similarities have found. Nurminen's inseparability principle, information is not separated from its use, is found to be rather similar as Orlikowski's view that tacit knowledge is a form of "knowing", and thus inseparable from action because it is constituted through such action.

1 Introduction

For researchers it is important which presuppositions they accept concerning the part of reality they are studying. Burrell and Morgan (1979) presented four paradigms, which had a huge influence on studies in social sciences more than 20 years. The researchers in information systems also used those paradigms to locate their study. But the Burrell and Morgan's classification became outdated, and I shall here refer to two different critical articles (Deetz, 1996 and Nurminen 1997) and demonstrate their main criticism.

In the latter Nurminen (1988) refers his humanistic perspective, which triggers us to more carefully consider various characteristics of human beings. I shall consider Aulin's (1982, 1989) actor theory and classification of dynamic systems and relate them with the Nurminen's humanistic perspective. The fit between those structures seems to be extremely good.

In his consideration of the humanistic perspective Nurminen (1988) found the new role for knowledge. After my short summarizing of discussion concerning explicit and tacit knowledge I conclude that Nurminen's findings seems to be novel and early.

I shall apply the conceptual-analytical approach in my meta-analysis and I try to follow the recommendations given by Worren et al. (2002) who emphasize the pragmatic validity of researchers' outcomes.

2 Nurminen's views on research paradigms and their use

Nurminen (1997) corrects some (mis)interpretations how Burrell and Morgan's (1979) four paradigms should be applied to. He starts by presenting those four paradigms that are the four combinations of the opposite ends of two dimensions. The first dimension is about the nature of social sciences which divides into two approaches, subjectivist and objectivist ones. Four underlying subdimensions are recognized:

Table 1. Subdimensions of subjectivist and objectivist approaches.

Property	Objectivism	Subjectivism
Ontology	Realism	Nominalism
Epistemology	Positivism	Anti-positivism
Human nature	Determinism	Voluntarism
Methodology	Nomothetic	Ideographic

The second dimension is borrowed from the macro level of society. The theories are allocated within dichotomy between the sociology of regulation and the sociology of radical change. The combination of these two dimensions lead to four paradigms:

Table 2. The four paradigms by Burrell and Morgan.

	Subjective	Objective
Radical change	Radical humanist	Radical structuralist
Regulation	Interpretive	Functionalist

After presenting the four paradigms by Burrell and Morgan Nurminen (1997) remarks that Hirschheim and Klein (1992) have renamed two of the paradigms: The Interpretive paradigm is renamed as the social relativist one and the Radical Humanist paradigm is renamed as the neohumanist one. Nurminen uses the original names.

Nurminen's "first observation in the review by Hirschheim and Klein is that the Functionalist paradigm is very crowded. Practically all the traditional [information systems development (ISD)] approaches are allocated to this class. On the other hand, there is much more space, for example, in the Interpretive paradigm, and many items in this class are even characterized by the reflection of existing practices rather than by the formulation of alternative development methodologies. … The radical paradigms, on the hand, are practically empty. Some Scandinavian approaches seem to belong to the Radical Structuralist paradigm, even if, to a great extent, they share the objectives of socio-technical approaches, in which the Functionalist paradigm is said to be dominant. The Radical Humanist approach is not very rich in development methodologies."

Nurminen (1997) evaluates and re-interprets one paradigm after another. On the Radical Structuralist paradigm he writes:

> "The term *structuralist* in the name of this paradigm indicates that it deals with objective, even structural changes, and the term *radical* tells us that the change can be and should be sudden, perhaps even discontinuous. … This paradigm has its roots in dialectical thinking which assumes that contradictions (between the thesis and the antithesis) are the major driving force for development. There are often interest groups behind such conflicting interest: employer vs. employee or teacher vs. student."

Nurminen carefully analyzes the defensive and offensive design approaches. In the defensive one the main goal is to defend the position of workers. In the offensive approach the goal is to create innovations, IT-based tools for workers. Nurminen suggest that "the offensive part is moved to subjective side. The remaining part, the defensive one, has not presented an IS development methodology."

In his analysis of the Functionalist paradigm Nurminen (1997) asks: "What is the purpose of information systems development? Is it maintenance of status quo and regulation as Hirschheim and Klein indicate to be the case in most traditional approaches? Or is it radical change with the intention to make structural changes?" Nurminen continues that "the radicality seems to be dependent on the direction of the change. The change is radical if it is "progressive" and serves the class interests of the workers, but a corresponding structural change in the opposite direction does not count as radical." According to Nurminen "we have either to introduce another paradigm for reactionary changes or to elaborate a two-way interpretation of radical structural changes."

After some other arguments Nurminen concludes that "we have moved the majority of traditional approaches from the Functionalist paradigm to the Radical Structuralist paradigm. We must, however, recognize that the need for the redistribution made to a great extent has its origin in the work of Burrell and Morgan. The confusion between the macro and micro levels comes from their original paradigms, it has not been created in the interpretation by Hirschheim and Klein."

Nurminen continues his analysis as follows "In information systems research, the Radical Humanist paradigm – like the Radical Structuralist one – seems to be particularly underrepresented. We already observed that this is at least partly due to the particular class-conscious interpretation of radical change, borrowed from the macro level to the micro level without sufficient prolematizing." Nurminen does not very clearly conclude which approaches should located into this paradigm. I understand that he would like to accept some speech act approach and his own HIS approach.

To analyze the Interpretive paradigm Nurminen writes that

> "the major problem in this paradigm is that it spends so many resources on the tasks of understanding and interpretation. Within IS research, this paradigm originated during the growing interest in the impacts of computerization, starting from the 1970s. …

> Evolutionary approaches to ISD, as well as prototyping, belong to the Interpretive paradigm to the extent that we emphasize the concrete experience the user gets by means of the prototype instead of formal descriptions. ... The interpretive paradigm pays much attention to understanding ordinary work practices in all their richness. All three roles must be taken into account: expert, manager, and user. The paradigm reminds us that we cannot continue the expert-centered development strategy forever, because the IT cannot be the end in itself."

Nurminen summarizes his analysis as follows:

> "In the beginning the Functionalist paradigm seemed to be most crowded. We did, however, in the above regard a typical information systems development as voluntary action with intention of making structural and often radical changes. The crowd was thus moved into the Radical Structuralist paradigm."

Nurminen's analysis is surely correct and re-classification of ISD methods is a real contribution. I am asking: Which role do the paradigms play in a certain ISD method? Are they describing the function, activity or context where the new information system will function, i.e. are the paradigm and the presuppositions it contains supplementing the specifications of the new IS? First, I claim that the four paradigms of Burrell and Morgan were mainly intended to the studies where the past and present part of reality were investigated, not for building a new artifact. Secondly, the result of those studies which the four paradigms concern were assumed to be a model or a theory either justified or theorized, but not an instantiation. Thirdly, the criteria used in evaluation of a certain method traditionally are: operationality (the ability to perform the intended task or the ability of humans to effectively use the method if it is algorithmic), efficiency, generality and ease of use (March and Smith 1995).

During his analysis Nurminen (1997) identifies that "one problem throughout this discussion on the paradigms has been its generality. The concepts used have not been very specific to information systems. This generality has invited rather different interpretations, as we have seen throughout the discussion. Another alternative framework is given by the *three perspectives* of Nurminen (1988), which are formulated specifically to reflect information systems and their development. The systems-theoretical perspective emphasizes the role of the computer, whereas the humanistic perspective gives the primary role to the human beings. The socio-technical perspective looks for a balance between these two. They rather nicely fit into expert, user and management perspectives.

The novel perspective is the humanistic one. It has a strong subjectivist bias, but it also transcends the distinction between subjectivism and objectivism by stating that 'it is an objective fact that there are human subjects'. The other two perspectives give support with more objectivist aspect. Each perspective has its characteristic notions on epistemology and ontology as well as on the way in which information technology is integrated with business activity and work. The perspectives also live in peaceful co-existence: they are not incommensurable or exclusive."

2.1 Deetz’s four discourses

Deetz (1996) writes that

> “Burrell and Morgan (1979) invite reification by claims of paradigmatic incommensurability, by staying at the level of theory and reconstructed science, and by accepting Kuhn’s loose conception of paradigms. … But my concern here is not commensurability nor reification but rather the dimensions of contrast themselves. A deeper and more interesting understanding of contemporary research practices and debates is possible by focusing on other dimensions. The question is not: Are these the right categories or who fits in each? But: Are these differences that make a difference? Do these dimensions provide insight into genuine differences in research programs? I hope to aid rethinking the differences and similarities among different research approaches, hopefully making our conflicts and discussions more productive rather than simply replacing four boxes with four different boxes.”

Deetz (1996) continues that “the world can be constituted in many ways, depending on alternative systems of valuing. The most significant part of this contest for object constitution is the capacity to enact the lines of distinction producing some things as alike and others as different. Only secondarily is the contest over the positive or negative valence ascribed to the produced things. For example, feminist writers for years have shown how male dominance is maintained by the dominant group’s ability to define the dimensions of difference and position themselves at the positive end of each dimension. … In an analogous way, I believe that Burrell and Morgan (1979) largely accepted the conceptual distinctions from sociological functionalism and its supporting philosophy of science. From this dominant conception, they merely asked who else is ‘other’ and, from this position, in what way are they ‘other’.”

Deetz (1996) describes his own approach: “Accepting the ‘linguistic turn’ (thus locating research differences in discursive moves and social relations rather than procedures and individuals) gives us more contemporary look at alternative research programs in organization science. Two dimensions of contrast will be developed here. The first dimension focuses on the origin of concepts and problem statements as part of the constitutive process in research. Differences among research orientations can be shown by contrasting ”local/emergent” research conceptions with ”elite/ a priori” ones. - The key questions this dimension addresses is where and how do research concepts arise. In the two extremes, either concepts are developed in relation with organizational members and transformed in the research process or they are brought to the research by the researcher and held static through the research process – concepts can be developed with or applied to the organizational members being studied.

The second dimension focuses on the relation of research practices to the dominant social discourses within organization studied, the research community, and/or wider community. The research orientations can be contrasted in the extent to which they work within a dominant set of structurings of knowledge, social relations, and identities (a reproductive practice), called here a ‘consensus’ discourse, and the extend to which they work to disrupt these structurings (a productive practice), called here ‘dissensus’ discourse. I see these dimensions as analytic ideal types in Weber’s sense mapping out two distinct continua. – The consensus pole draws attention to the way some research programs both seek order and treat order production as the dominant feature of natural and social systems. – The dissensus pole draws attention to research programs which consider struggle, conflict, and tensions to be the natural state.”

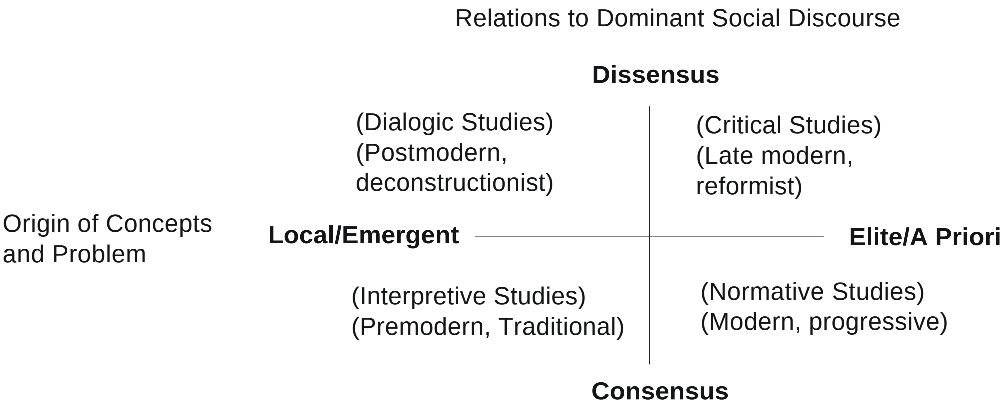

Figure 1. Contrasting Dimensions from Metatheory of Representational Practices.

To my mind, Deetz (1996) performed a *conceptual-analytical study* (Järvinen 2001, Chapter 2) where he first used *many arguments* to show how Burrell and Morgan’s (1979) four paradigms, especially dimension ”subjective-objective” was outdated and misleading. In his debate he utilized the results of earlier empirical studies and also logical reasoning. When Burrell and Morgan emphasized presuppositions made by a researcher, Deetz underlined the problem definition. Hence they paid attention to different aspects of the problem domain.

Deetz’s new dimension ” local/emergent vs. elite/ a priori” very well fits the differentiation between *theory-creating vs. theory-testing* research approaches (Järvinen 2001, Chapter 4 vs. Chapter 3), respectively. It is essential *where the concepts used* in the study *are constituted*, in interaction between the researcher and people studied or by the researcher alone.

My interpretation of Deetz’s discourses is the following one: The output of the dialogic study is two or more different stories or tentative theories describing differing views on the same phenomenon (cf. Buchanan 2001); the output of the interpretive study is a story grounded on the observations made on the phenomenon (cf. grounded theory, Strauss and Corbin 1990); the output of critical and normative studies either confirms or falsifies the theory tested. Kuutti (1991) describes how activity theory containing contradictions as a pre-assumption (in a critical study) can be applied to information systems research and development. Hann and Weber’s study (1996) is my example of normative studies.To me this dimension is clear, but for Schultze and Leidner (2002) it is was difficult to apply to. I (Järvinen 2003, p. 115-120) privately discussed with the first author, but at the end of the discussion we had differing views. In checking Schultze and Leidner's work I immediately found that the article by Virkkunen and Kuutti (2000) does not belong to the interpretive studies as Schultze and Leidner classified it but to the critical ones. To my mind, the articles classified by Schultze and Leidner must be reclassified in the similar way as Nurminen reclassified Hirchheim and Klein's ISD approaches.

Deetz (1996) himself writes: "Different orientations have developed specific ways of answering the types of questions they pose and do not work terribly well in answering questions of others". Does this mean *that some other researcher can develop a new dimension to replace*, for example, " local/emergent vs. elite/ a priori", and this new dimension can best answer to new questions?

Deetz does not very much consider *what is an application domain* of his four-discursive orientations. Can we apply it to studies concerning societies or groups?

2.2 Relating Nurminen's and Deetz's views

Both Nurminen (1997) and Deetz (1996) criticize Burrell and Morgan's four paradigms. Nurminen emphasizes both the role of the computer and the role of the human being in connection with information systems, their development, use and maintenance. Deetz underlines both the origin of concepts and problem statements and the relation of research practices to the dominant social discourses within organization studied. Hence, they stress on different aspects, they are therefore incommensurable. My classification of research approaches (Järvinen 2001, Chapter 1) differentiates them in such a way that Deetz's discourses are applicable to the research question concerning what is a (part of) reality and Nurminen's three perspectives to utility of information systems. Neither Deetz nor Nurminen did make the latter differentiation.

3 The humanistic perspective

Nurminen (1988, 125) writes in his famous book on three ways of looking at information systems: "In one sense, the humanistic perspective stands at the opposite extreme form the system-theoretical. In the latter we found the fundamental characteristic to be the integration of the system; in the former, integration is an evil to be avoided. It is thus natural that the ideal type that we select for our humanistic perspective is a system totally devoid of integration. I have discussed this ideal type already previously under name of the Human-Scale Information System, or HIS.

In this idealized HIS, the basic premise is that all the functions performed by the system (storing, processing and transmission of data) are carried out by human beings. The computer knows nothing and does nothing. We further stipulate in this model that the actor – the performer of a given action – must be a clearly specified individual; in this respect, a shared database or joint act of processing do not constitute meaningful concepts. In terms of the ideal type, it follows that these functions, due to their personal and individual character, are ‘deintegrated’ and distributed over the level of the individual personality.” – Gordon B. Davis (2000) appreciated Nurminen’s humanistic perspective and used it as the basis for a human centered view. Actually Davis accepted all the three perspectives proposed by Nurminen in his conceptual analysis.

3.1 The similar views: Aulin’s actor theory and the self-steering systems

3.1.1 The actor theory

Aulin (1982, 14) considers “human action as an interaction between a *subject* and an *object*, that is, between a conscious actor and some part of the real world, the latter being the object of the acts discussed. … Separating the subject from the object enables Aulin to regard acts as the tools of interaction between a subject and the world of objects. The interaction is a two-way traffic. Certain kinds of acts - the observations – cause some part of reality to be reflected in the subject’s consciousness, as a consequence of which he gets *information* about the world. The information is somehow processed in the consciousness and set in contact with the *intentions* that are pushing the subject’s acts to certain directions or goals. Making use of his directed acts the subject then is capable of impressing his intentions on the world and possibly changing it in some measure to some desired direction. In a closer analysis Aulin has to distinguish between three major categories of the contents of human consciousness:

1. *cognitive beliefs* expressing the information the subject has on the actual state of the world, mostly in form of some generalizations (the ‘is’);
2. *values* voicing the conception that the subject has constituted of what the world ought to be in order to be good (the ‘ought’); and
3. *norms*[1] telling the subject how to choose his acts so as to materialize his values in the actual state of the world (also a part of the ‘ought’).

The norms obviously are functions of values and cognitive beliefs. Accordingly Aulin has the preliminary scheme of the successive steps of human action shown in Figure 2.

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[1] To my mind, term ‘norm’ should be understood as procedural norms, not as collective norms as usually.

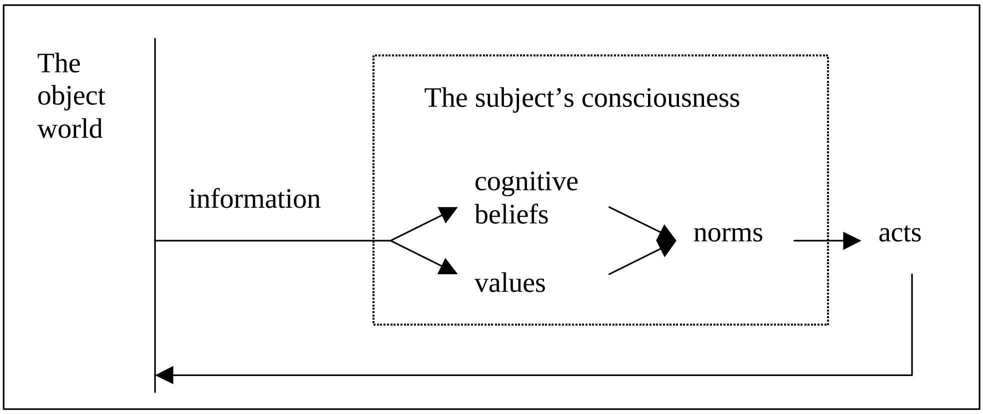

Figure 2. Human action as a subject-object interaction (Aulin 1982, p. 15).

To supplement the citation above a bit more I add two things: 1. Our beliefs contain the subjective probability component, how probable our world view is. When we receive more information, our world view becomes more valid, relevant and realistic. 2. Values are our preferences in priority order. The stronger a certain value is, the more eager we are performing acts to materialize that value in the actual state of the world.

3.1.2 The self-steering system

According to Aulin (1989, 18-27) the dynamical system can have either nilpotent or full causal recursion. The system with nilpotent recursion has the rest-state. The initial state is called the rest-state and the nilpotent dynamical system has the property that it comes back to its initial state after the finite number of units of time. We can say that an external disturbance (or stimulus) occurring at the beginning throws the system out of its rest state to a perturbed state, after which the nilpotent causal recursion conducts the system back in the rest state. During its return journey the system gives response to the stimulus. If the same stimulus is offered again, the system gives the same finite total response. Thus it is a memoryless system that does not learn from experience. (We shall here describe Aulin's classification verbally – you can find the mathematically exact expressions in Aulin (1989, 18-27).)

If the nilpotent system contains feedback, it is called a cybernetic nilpotent system. If a computer is programmed to solve a finite problem, i.e. a problem that can be solved in a finite number of steps of computation in the machine, it is the cybernetic nilpotent system. (But computers can also be programmed to simulate systems that have a full causal recursion.)

A dynamical system with a full causal recursion does not have any rest state to be reached in a finite number of steps (in a finite time). The causal systems can be classified to two categories: nilpotent systems with a constant goal function (in time) and systems with a full causal recursion with a continuous goal function in time.

```
causal systems
  |
  |--- nilpotent systems
  |
  |--- systems with a full causal recursion
```

The causal systems with full causal recursion can be divided into four classes depending on whether the system will disintegrate after a certain disturbance and its trajectory disassociate from the path of its old goal function, or the system is steerable from outside and its path goes in the constant distance of the path of its old goal function or it comes closer to the path of its old goal function in time. The latter can be either finite (self-regulating systems) or infinite (self-steering systems).

```
causal systems
  |
  |--- nilpotent systems
  |       |
  |  |---mechanistic
  |       |
  |       |---cybernetic
  |
  |
  |--- systems with a full causal recursion
         |
         |--- self-steering systems
         |
         |--- self-regulating systems
         |
         |--- systems steerable from outside
         |
         |--- disintegrating systems
```

It is important to note that Aulin´s classification of dynamic systems is exhaustive, i.e. it covers all the types of dynamic systems. In order to get definite views on the classes above we shall show, which real system belongs to each category.

Real-world examples of self-regulating systems are: a ball in a cup that has the form of a half-sphere, a room equipped with a good thermostat (self-regulating equilibrium systems); some living organisms like a heart (periodically pulsating self-regulating systems); etc.

A flying ball (the resistance of the air is negligible), a frictionless oscillator and a robot are examples of systems steerable from outside. A radioactive atom and a dead organism are disintegrating systems.

If the uniqueness of the states of mind, along with the goal-oriented nature of thought processes, is typical of human consciousness, the only thinkable causal representation of what takes place in human mind in an alert state is the self-steering process. According to Aulin (1989, 173) it is, however, necessary to limit the interpretation so that what is self-steering in human mind is the *total* intellectual process. All the partial processes needn't be self-steering.

3.2 Relating Nurminen’s view with the actor theory and the self-steering systems

By referring to above, I conclude that if some type of a system is the Nurminen’s HIS system, it is the self-steering system. Any other category has some features differing from the features implied by the humanistic perspective.

Aulin has shown that in the self-steering system the same state never returns. If we regard a human being as the self-steering system, we understand that users, managers and stake holders change their mind. This explains the great need for perfective maintenance of information systems reported by Lientz (1983), and Lano and Haughton (1992).

Lientz (1983) summarized the 1977-1979 surveys on software maintenance. A first result of the exploratory survey was that maintenance and enhancement were found to consume approximately half of the system and programming personnel hours. A second finding was that approximately 60 percent of the maintenance/enhancement effort was for perfective maintenance. This finding was somewhat unexpected since the literature had supported the belief that fixing problems and keeping systems operational were the major concerns. A third finding was that problems of a managerial nature dominated those of a technical nature in the view of the respondents.

Lientz (1983) paid attention to how to measure a system while it is undergoing maintenance. To explore sources of potential change, the environment of an application system must be considered. The environment consists of four factors, each of which can affect a system: user-external environment, technological change, managerial factors and marketplace. Lano and Haughton (1992) identified four main forms of maintenance activity:

- Corrective maintenance: eliminating errors in the program functionality.
- Adaptive maintenance: modifying the application to meet new operational circumstances.
- Perfective maintenance: enhancement (new operations and refinements to old functions)
- Preventive maintenance: modifying a program improve its futile maintainability.

By referring to Foster (1990) Lano and Haughton informed that the costs of maintenance activity have been estimated as being as high as 80% of the long-term cost of developing and maintaining systems; and this proportion is rising.

Eason (2001) studied impacts of computing systems and found that early predictions of the impact of computers on organizations ranged from ‘human-computer symbiosis’ to automation and the collapse of jobs. The findings from impact research showed that there was evidence for all predictions that were made. This demonstrated that the technology is very flexible and can be deployed to facilitate many different organizational outcomes. Impact research also came up with findings that were not widely predicted. One of the most important was the high level of systems that failed. The rate started at around 40 % and, despite vast improvements in the technology, has stubbornly refused to decrease through the many surveys conducted in the past 30 years.

According to Eason the fundamental fallacy of the early predictions was the belief in a simple cause and effect model. By using Aulin's classification of dynamic system the nilpotent systems follow a simple cause and effect model but the self-steering ones do not.

4 Nurminen's view on knowledge

Nurminen (1988, 127-8) continues to describe his humanistic perspective by the notion of knowledge as follows: "The most important difference between the humanistic and other perspectives is probably the fact that in the humanistic perspective knowledge and information always exist in relation to a subject, a person who 'knows' or posses that information. … The subject is also the person who is able to interpret the information; not only in the form of abstract or structural definition of concepts, but also a practical interpretation in terms of how he or she makes use of the information in performing the job. The interpretation is thus as authentic as possible, in the sense that the interpreter is directly involved in the situation in which the information is being used; information is not separated from its use."

4.1 On explicit and tacit knowledge

Brown and Duguid (2001) write "The distinctions of Ryle (1949) and Polanyi (1966), being widely cited in the literature, offer a good place to start and allow us to again take up the issue of sticky and leaky knowledge as two types of knowledge. Polanyi's most quoted line is probably 'We know more than we can tell' (Polanyi 1966, 4). This unspeakable knowing is what Polanyi deems tacit as distinct from explicit. His distinction is thus often used to justify the idea that there are two kinds of knowledge, one tacit and one explicit, hence one that sticks and one that leaks. The distinction also suggests that translating the inarticulate form into the explicit form, turning sticky knowledge fluid, would be a way to promote required fluidity (Nonaka and Takeuchi 1995).

Yet, while many discussions of Polanyi end with this point about knowing more than we can tell, for Polanyi it was only a beginning. 'I shall consider human knowledge', he writes, 'by starting from [this] fact' (Polanyi 1966, p. 4). He spends the rest of the first Terry lecture contemplating the relation of this inarticulate knowledge to what can be articulated, and he concludes that knowledge always has an inarticulate component. This component Polanyi calls the tacit dimension - a point sufficiently important that he made it the title of the published lectures. He is not, then, arguing for two types of knowledge, merely for two dimensions - two interdependent dimensions, it turns out, for the explicit dimension of knowledge relies on previously 'interiorized' (in Polanyi's terms) implicit or tacit dimension. Attempts to shake off this tacit dimension, buried as it is in personal identity, are in Polanyi’s view at best futile, at worst counterproductive. Though knowledge undoubtedly can be usefully articulated and explicated, in use the explicit nonetheless always possesses this other, implicit dimension.

Polanyi’s tacit/explicit distinction echoes Ryle’s (1949) famous contrast between know *how* and know *that*. Like Polanyi, Ryle insists that these are not independent types of knowledge. They are interdependent and cannot be reduced to one another. Knowing *how*, Ryle insists, ‘cannot be defined in terms of knowing *that*’ (Ryle 1949, p. 32). Acquiring know *that* does not lead to being able to use it. Knowing the rules of chess, in Ryle's running example, does not tell you how to play chess. Know *that* may be both explicit and free flowing, but from Ryle's perspective it is neither actionable nor useful on its own. To make know *that* useful requires appropriate know *how*, something thus very similar to Polanyi's tacit dimension. Know *how*, moreover, is not acquired like know *that*, which may circulate as precepts and rules. It is, Ryle insists, quite different. 'We learn *how*,' he argues significantly, ' by *practice*' - by, in Ryle's example, playing chess. Polanyi makes a similar claim when he argues that 'comprehension', which is for Polanyi the acquisition of knowledge from another, is 'both intellectual and practical' (Polanyi 1966, p. 48). In both of these well-known arguments, then, knowledge is two-dimensional and practice underpins its successful circulation."

		Tacit knowledge	Explicit knowledge
		To	
Tacit knowledge	*From*	Socialization	Externalization
Explicit knowledge		Internalization	Combination

Figure 3. The modes of knowledge conversion (adopted from Nonaka, 1994).

Nonaka (1994) claimed that organizational knowledge is created through a continuous dialogue between tacit and explicit knowledge. It is indicated that while new knowledge is developed by individuals, organizations play a critical role in articulating and amplifying that knowledge. The dialogue between tacit and explicit knowledge postulate four different modes of knowledge conversion: (1) from tacit knowledge to tacit knowledge (socialization), (2) from explicit knowledge to explicit knowledge (combination), (3) from tacit knowledge to explicit knowledge (externalization), and (4) from explicit knowledge to tacit knowledge (internalization).

Socialization as a mode of knowledge conversion enables to convert tacit knowledge through interaction between individuals. The key to acquiring tacit knowledge is experience. Without some form of shared experience, it is extremely difficult for people to share each others' thinking processes. The *externalization* mode is triggered by successive rounds of meaningful dialogue within a team, and the sophisticated use of 'metaphors' can be used to enable team members to articulate their own perspectives, and thereby reveal hidden tacit knowledge that is otherwise hard to communicate. The *combination* mode involves the use of social processes to combine different bodies of explicit knowledge held by individuals. Individuals exchange and combine knowledge through such exchange mechanisms as meetings and telephone conversations. The *internalization* mode bears according to Nonaka some similarity to the traditional notion of "learning".

Cook and Brown (1999) based their differentiation between *explicit* and *tacit* knowledge on the work of Polanyi (1966) and his example of riding a bicycle. They claimed that "it is important not to mistake using one form of knowledge as an aid in acquiring the other with one form being 'converted' into the other. Tacit knowledge cannot be turned into explicit, nor can explicit knowledge be turned into tacit". Cook and Brown's view is entirely different from Nonaka's (1994) view

Orlikowski (2002) relates her conception on knowing to other approaches.

> “The focus on skillful performance resonates with the rich examples of machine design, flute making, and paper handling offered by Cook and Brown (1999). Their explanation for the success of the designers, craftspeople, and engineers is grounded in what they see as the dynamic interaction of the knowledge (both explicit and tacit) possessed by the actors and the knowing that is an aspect of their work. As suggested earlier, such a separation of tacit knowledge from knowing in action is different from the perspective I propose here. I would suggest instead that it is through their recurrent practices that the designers, craftspeople, and engineers constitute and reconstitute their knowledgeability in machine design, flute making, and paper handling.”

In a recent paper, Cook and Brown (1999) introduce the notion of knowing into discourse on organizational knowledge, while maintaining the conventional distinction between tacit and explicit forms of knowledge. While this recognition of knowing is helpful, it nevertheless assumes that tacit knowledge is distinct and separable from knowing, and thus action. The perspective Orlikowski (2002) adopts rests on an alternative assumption – that tacit knowledge is a form of “knowing”, and thus inseparable from action because it is constituted through such action.

4.2 Relating Nurminen’s view with explicit and tacit knowledge

Referring to Orlikowski’s (2002) perspective Nurminen (1988) seems to find the same perspective already 15 years earlier. This similarity at least concerns the tacit knowledge. In the organizational literature Blackler (1995) identified the five types of knowledge: embodied, embedded, embrained, encultured and encoded knowledge. The embodied knowledge type satisfies the inseparability requirement presented by Nurminen, but the other knowledge types may not.

Billett (1996) differentiated declarative and procedural knowledge at work. *Propositional knowledge or knowledge 'that'*, also termed declarative knowledge (Anderson 1982), comprises facts, information, assertions, concepts and propositions. *Procedural knowledge* (Anderson 1982), also termed *knowledge 'how'*, enables skilful action and comprises techniques, skills and the ability to secure goals. It has been classified into levels or orders. The Nurminen inseparability principle can be valid for procedural knowledge, but may be not for propositional knowledge.

5 Discussion

My consideration of some Nurminen's studies shows that Nurminen's three perspectives really play an important role in information systems research. He has been the originator of many nice ideas provoking researchers' thinking. My critical remarks above mainly concern the studies performed by other researchers. I hope that I have succeeded to relate Nurminen's work with other studies.

My analysis does not cover the Nurminen's whole production but some few randomly picked exemplars. I am not quite sure whether I have interpreted everything correctly. I know that some differentiations are difficult to grasp because of weak definitions of classes. In order to achieve progress in research I wish that the colleagues would improve my work with more insightful classifications.

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Producers or Consumers: Two Ways of Looking at Technology

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Abstract. In *People or Computers: Three Ways of Looking at Information Systems*, Markku Nurminen discusses three perspectives: the systems-theoretical, the socio-technical and the humanistic. The three perspectives express a fundamental dichotomy between people and technology. Here I want to introduce a fourth perspective, the service perspective. And I will argue that in the early 21st century another dichotomy is appearing. In a society which is becoming more and more consumer oriented, technology is no longer only, or even mainly, a work tool but also a consumer object. Society itself is beginning to be divided along a new dimension, that of producers and consumers. Technology is used both for production and consumption of services.

1 Introduction

The last time I read Markku Nurminen's *People or Computers: Three Ways of Looking at Information Systems*, must have been about 10 years ago, and what I remembered was the three perspectives on information technology – the systems-theoretical, the socio-technical and the humanistic – as well as Nurminen's general arguments in favor of the last of these. Now, that I read the book again I was struck by the many interesting philosophical details on perspectives, science, society and technology that run through the whole book, and I appreciate very much the historical overviews of the development of computer technology use. But in spite of this, it is the perspectives I want to focus on here, and I shall argue that they have already lost much of their relevance. Today there are other perspectives on technology that are more important.

In the 20th century, technology was developing on a grand scale and was threatening humankind with extinction: atom bombs, chemical pollution, nuclear meltdowns, nuclear waste, global warming. We seemed to be faced, again and again, with a choice between people or technology. Computers threatened to turn society into a complex automatic system with no real use for people, but demanding powerful control of people in order to stop them from sabotaging the system. In discussing different perspectives on computer technology, Nurminen's choice was therefore obvious: people or computers. In *Computers in Context* (Dahlbom and Mathiassen 1993), we used the same dichotomy – the romantic and the mechanistic world view – to define the basic conflicts of our discipline.

2 Three Perspectives

Much of Markku Nurminen's research has been focused on the role of general perspectives, or paradigms, in information systems research. It is an important topic. Your paradigm will determine the sort of questions you ask, the sort of answers you accept, and in general what you find important to examine and investigate. The role of perspectives is particularly important in an area that undergoes rapid and radical changes. In order to acknowledge and deal with such changes you may very well have to change your perspective, something that is not easily done. Paradigms in science change, of course, but normally such changes demand a generation shift. Too much is invested in a paradigm for it to be easily abandoned. The social inertia of paradigms is a problem for a discipline having as its subject matter a technology the use of which develops rapidly enough to demand new perspectives almost every ten years.

Nurminen is well aware of this problem, identifying as he does three perspectives covering a period of only three decades of computer technology use. Early in the book, he points to the importance of the time dimension and a historical view on technology and its use. He notes that such a perspective is often absent in computer science and in social engineering attempts (p. 16f). He observes that the three perspectives that he discusses "fall into a certain chronological order." They have developed partly in response to problems actualized by the perspectives themselves and partly in response to the introduction of new technology.

Nurminen wants to convince us that there are indeed alternative perspectives available when looking at human beings using computer technology. If we develop our abilities to use different perspectives we will become better at developing the technology to suit our interests, better at understanding the consequences of introducing the technology, and better at communicating with others about the use of technology. In the book he looks closely at three perspectives: the systems-theoretical, the socio-technical and the humanistic. While stressing the importance of acknowledging all three perspectives, Nurminen wants to argue in favor of the last of these.

When computers were first introduced as calculating machines, in the Second World War, they invited a systems-theoretical perspective. Computers are complex technical systems with a number of different functional units operating together under the control of an operating system, making possible the implementation of a great variety of complex software systems. When people like Norbert Wiener realized the potential of these machines as control systems for other systems, the systems-theoretical perspective gained even more force. When later computers began to be used for administrative processing in the early 1960s, this perspective was adapted to serve the new use. The choice was obvious considering the intellectual climate of the time. The 1960s was a decade of operations research and systems engineering, and so people began to speak of information systems, management information systems, systems development, and so on.

As long as computers were calculating machines or control units for technical systems, this systems-theoretical perspective was unquestioned. But when computers began to be used as information systems, the role and place of human beings in relation to these systems became a topic of discussion. And when you want to acknowledge the role of human beings in the operation of technical systems, the simple solution is to extend the notion of technical system to include people. Thus people began to speak of socio-technical systems. In information systems research this is exemplified by Börje Langefors in his definition of information systems to include people interpreting the data of the computer systems turning data into information (Langefors 1995). This move created terminological confusion, of course. With Langefors's definition you cannot go on speaking of buying an information system, of the cost of an information system, you cannot speak of SAP as an information system. But people did.

When, in the 1980s, computers began to be used as tools for word processing, book-keeping, and playing games, the systems-theoretical perspective seemed even less attractive, and more radical revi-sions were necessary. Now, people began to speak of computers and software as tools. And they began to extend this perspective to the older use of computers as information systems. Nurminen calls this perspective the humanistic perspective, and introduces the notion of human-scale information systems, systems that are more like tools than systems. This adds to the terminological confusion, I think.

When most of your time is spent with office software, you are of course using technical systems, but not really information systems. If we want to speak of the use of information systems as tool use, why not begin to speak of information tools rather than information systems? The problem here is partly, of course, that it is easier to change the definition than to change the name. Once you have an important business developing information systems, you have to retain that name. And when in addition you have departments of information systems, journals of information systems, book series in information systems, conferences on information systems, and so on, it may seem like a good idea to keep the name but change the definition, but it makes it more difficult to convert people to the new perspective.

The use of technology changes. When computers began to be used as tools in office work, the discipline of information systems did not really take any interest in this new use. Instead, people like Nurminen were inspired by this new use to develop new perspectives on the old use. What we have seen happen since the late 1980s is rather the other way around. The use of computers as office tools have become standardized and the personal computers depersonalized. Today they are part of document management systems and the systems-theoretical perspective is still strong.

Of course, Nurminen wrote his book about ten years before the Internet revolution, and with that revolution, when computer technology converged with telecom and media, new perspectives were introduced. Telephones rely on what has been called “the world’s largest machine”, the telephone system. This system is incredibly important and fascinating to the engineers in telecom companies and telecom operators. But when you use a telephone you seldom worry about that system, and you nor-mally know nothing about it. In telephony the natural perspective on using the technology is to speak of telephone services. With Internet such a service was applied to the use of computer technology.

Today, in the early 2000s, if we were to choose a concept to characterize the use of information technology, system is not the first one we would come up with. In this time, when the consumer market dominates our thinking and everyone is focusing on business opportunities and customers, systems make way for services, and we speak of information services, networked based services, web services, Internet services, mobile services, and so on. Thus there is a fourth perspective on the use of computer technology and, indeed, it was around already in the late 1980s, when some people began to speak of computers as media. From systems to tools to services is quite a long journey. Where are we going next? Well, we shall have to leave that question for another occasion. Here I want to look a bit deeper into the service perspective, what it is and what it means.

3 The Scandinavian Approach

The three perspectives distinguished by Nurminen played an important role in the debate raised by the so-called Scandinavian approach to systems development (Bansler 1987). This approach had its origin in Kristen Nygaard´s work on action research in the early 1970s, working with trade unions, aiming at giving trade unions power in the development of information systems. To Nygaard´s many young disciples at Aarhus, this approach was very much a continuation of the 1960s revolutionary youth movement. For a couple of decades, in the 1970s and the 1980s, this approach continued to develop a romantic infatuation with the collective resources of industrial workers and the skills of the individual industrial worker. While industrial work was quickly disappearing in this part of the world, partly because of automation, partly because of lower salaries in the more recently industrialized countries of the Far East, the Scandinavian approach continued to cultivate a romantic idea of the working class and its struggle against oppressive technology. They were not alone in doing so, of course.

Nurminen developed an original theoretical position within our field, but it was a position that was in many ways close to the position of the Scandinavian approach. The humanistic perspective is close to the perspective of the Utopia project (Ehn 1988) with its defense of typographical tool skills and the importance of what Bo

Göranzon had called tacit knowledge. And Nurminen shared with the Scandinavian approach a romantic attachment to industrial work. Underlying his discussion in the book is a perspective on work, never really spelled out, as producing goods in factories. Computers are used by the workers in the production and in the administration of work.

I find it difficult to understand the attraction of this perspective on work. In less than 20 years we have definitely left industrial society for a service society getting more and more of its identity from the consumer market and less and less from the production factories of the 20th century. Indeed, we had left industrial society already in the 1980s, only that many of us, Nurminen included, for some reason did not want to acknowledge this. This was also true of the Scandinavian approach to computer technology use, called ”Computer support for cooperative work”, where ”work” typically meant just ”operative” work, as distinguished from communication, talk at work (Schmidt, 1994).

Nurminen comments on the ideas that were becoming popular in the 1980s that we were moving into an information society, but he is skeptical of these ideas. Commenting on the economic sectors agriculture, manufacturing, services and information work, he says: “Symbols themselves cannot satisfy our basic needs; a hungry person needs real food.” (p. 170). And he thinks it is a mistake to view information work “as a separate and independent sector of its own” (p. 171). Instead, one should treat information work as related to and serving productive and administrative work.

Looking back on our discipline in the 1980s, it is obvious how work oriented it was. And what an old-fashioned view it had on work! Nurminen is no exception to the rule. The three perspectives discussed by him are perspectives on factory work. The choice indicated in the title, between people and computers, is a choice between factory workers and computers.

4 Users

Computer technology was introduced into a society dominated by industrial work. In Sweden, in the 1960s, half of the working population was employed as factory workers. A great deal of this work was still craft like, involving the use of relatively simple hand tools. But in some industrial branches automation was already well under way. Machines were replacing tools and workers were either being laid off or being reduced to pushing buttons on machines. With computer technology this automation really took off as robots entered the industries in the 1970s. The critical discussion in these days was very much a discussion about dequalification of work as tools were replaced with machines.

The systems-theoretical perspective is a machine perspective, the humanistic perspective is a tool perspective. Both tools and machines invite us to think of technology as something we use. For tools this is obvious, for machines it is sometimes not so obvious. A tool is inert without the human hand that steers it into action. Machines are automatic tools and the more automatic they are the less of a user they need. When all we have to do is push a button, we can hardly be said to be users. Complex machines are systems which we overview, adjust the operation of, but since they are largely automatic they tend to manage on their own without a user to guide their action. The smaller the machine, the more like a tool, and the more natural it is to say that we use it.

The systems-theoretical perspective is primarily a management perspective on work. You are looking from the outside into the operation of your organization and the workers tending the machines are easily reduced to parts in the machine. With more automation they could be replaced by real machine parts. The tool perspective is a worker perspective from within the organization, attributing importance to the individual worker (yourself) and your cooperation with the other workers to a joint operation of some sort. In both cases we can speak of the workers as users of technology, but the systems-theoretical perspective invites a management attitude where really the technology is using the workers rather than the other way around. (Perhaps managers experience themselves as using the system, including the workers, like a tool to achieve the goals of the company strategy.)

When we raise our eyes to the longer historical development of technology use our understanding of that use will be more adequate. But Nurminen´s historical perspective is relatively limited. Even though he briefly comments on the larger historical changes brought on by information technology, they play no role in his book. He does not consider such larger historical changes as those brought on by the postmodern movement of the 1980s and the changes then going on in moving from an industrial, work oriented society to a postindustrial, consumer society.

5 Service Society

Thanks to technical evolution in the 20th century, our societies now have a fantastic capacity for well organized production. In most branches we produce more that we can consume. This ought to mean that we could work less, but in reality it means the opposite. The better we become at producing, the tougher the competition, and the harder we have to work to sell our products. In a market economy, companies will have to focus more and more of their attention on sales and services. Companies are forced further and further out on the market to protect old customers and hunt for new ones. When products flood the market, services will have to be invented to add customer value to the products. Industrial societies become service societies.

In the 1960s, sociologists like Daniel Bell (1973) began saying that we were leaving industrial society, moving into a postindustrial service society. Others pointed to the growing amount of information work, speaking about the information revolution. Something was obviously happening and looking back it is easy to see the role of computer technology in this “revolution.” Computers entered the factories of industrial society, automated work, emptying the factories of people.

People instead found jobs in the services, in education, healthcare, childcare, media, marketing, hotels, restaurants, and lots of new kinds of services. In a country like Sweden, more than 80 % of the working population now is employed in services, in education, healthcare, tourism, administration.

When computers helped automate factory work it also helped increase office work. People left the factories to go to the offices to work with information systems. Offices grew even more with a second wave of office technology: personal computers, laser printers, copying machines, and local networks. Office work consisted in the administration of both production and services. And office work meant a continuation of factory thinking. So, the first decades of service society did not mean the development so much of services and service work, as of administration and office work. And, information systems was the discipline developing methods and theories for this kind of work.

In a service society focus is on services and their consumption rather than on goods and their production. As service society developed, its focus moved from the offices of service organization to the market place and service delivery. Services are provided to people, goods are mass-produced in factories. In a society dominated by craft, work is more service-oriented than goods-oriented. The production of a tailor-made dress is more an example of providing someone a service – sewing a dress for someone – than of producing a dress. In the process of industrialization, the production of goods moves from people's homes to factories. Now, the production returns to people again, as goods are equipped with more and more services which are tailored to suit the needs and wishes of the consumers.

The richer a society becomes, the more it can focus on experiences. We use goods to provide services to cause experiences. With technical development and increasing competence, our society turns into an experience society. Machine technology brought on the industrial revolution by mechanizing agriculture and moving the focus of economic activity to the factories for production. Computer technology brought on the office revolution by automating factory production and moving the focus of economic activity to administrative office work. Information technology is now automating administration and initiating a service revolution moving the focus of economic activity to services in the market place.

6 Service Thinking

Information systems were something you developed or bought to serve as the infrastructure of your organization, the backbone of management control. In the telecom world, customers are provided with telephone services. First those are very simple and consist in simple telephony, an open line. Later, that open line will be taken for granted and it is the variety of things you can do with a telephone that attracts. With the convergence of computer, telecom and media technology the move towards services becomes stronger. Rather than using information technology to rebuild your organization, that technology will provide occasional services to be bought and consumed in a much more flexible way.

Information systems are based on the administrative idea of having overview, being in control, knowing what goes on. The idea is to build a storage where all the information needed is available, well organized and easy to find. Information services is the idea of being given the information needed at the time when you need it. It is the idea of having a servant who does all the hard work of collecting information, having overview, etc, so that you don’t have to worry about that. All you have to do is ask for and receive the services.

When organizations and administration grew, the assistants of more craft like offices turned into administrators, demanding information from professionals rather than supporting them with services in their work. The change from systems to services will reverse this development, administrators becoming assistants again. Information systems are systems for administrators. Information services are for professionals, managers, and consumers. When focus is shifting from administration to customer relationships, from office to market, when administration is more and more automated or outsourced, the company will focus on services rather than on systems.

Systems thinking (Checkland, 1981) is dominated by a focus on organization, structure, processes and administration. Service thinking is instead focusing on individuals, actions, results and support. Information systems are technology support for bureaucratic, factory organizations. Information services are technology support for individuals on a consumer market. Information systems are specified and developed in a complex process involving users, and the systems continue to rely on their users for their identity and maintenance. Information services are made available on the consumer market to be bought or discarded. The individuals using the services are not engaged in developing them; they don’t own them and they have no responsibility for them.

The Scandinavian approach to information systems was very much concerned with user participation, with working closely with the users giving to them the power and responsibility for developing their own systems. With service thinking this changes. The users of systems turn into consumers of services and they cannot be bothered with the development and functioning of their information technology support. This change is natural. Mature technologies tend to disappear from our view. Lighting a room used to be a lot of work. Now it lights up automatically as you enter. The service of light comes with the apartment. You take it for granted as you take the floor for granted.

Information systems play an important role in the bureaucratic organizations so typical of industrial society. Those organizations will not disappear in the 21st century, but their sales and service functions will become more dominant and information technology support will have to be viewed from their perspective rather than from the perspective of administration and management control.

7 Services

A service is something that someone does for you or to you. Services used to be provided by servants. A servant is someone who typically performs such tasks that you could do yourself but for some reason prefer not to do. You would rather pay someone to clean your house, wash your clothes, cook your food, nurse your children, manage your garden, and so on. Such household services constitute a huge part of our lives, but there are lots of other services, of course, such as healthcare services, educational services, administrative services, marketing services, and so on. Some of these services involve close interaction between provider and receiver, but this does not hold for most of them.

Digital services are more like products than other services. They are like the light you get when you press the button, or the cooling you get when you start the A/C unit. To provide a digital service means to design a system, develop software, and implement it on an appropriate hardware platform. The technical system will provide the service, often with some help from the consumer, unless the service is wholly automatic. The service may very well be interactive, but then only in the sense that the consumer interacts with the technical system. The consumer is then given standardized alternatives to choose from, but there is no possibility of getting a “personal” service, in the sense of deviations from the pre-programmed standards.

When you have a service perspective on digital services, then you don’t simply see them as output from the system you have in focus. On the contrary, the system is secondary and the services are in focus. Designing the services you try to see what they mean to the consumers, how they fit into their activities and lives. Designing digital services is more like designing products than providing services and we must learn from product design and development. Systems development changes into service packaging and our old systems development methods will have to be changed into service packaging methods.

Interactive services with human service providers normally demand cultivation, i.e., the service provider must adapt and develop the service in order to fit the changing wishes and desires of the receiver of the service. Digital services are like products in that they have no human service provider and they can therefore be designed and packaged like products. They can be mass produced and mass distributed even more easily than physical products. In spite of this, Internet providers and telecom operators have had great difficulties in packaging and distributing Internet services and mobile services. This has become a much debated issue, particularly as concerns mobile services. Telecom operators have been relatively slow in offering their customers simple, well defined services, preferring instead to establish more craft-like relations to them, opening up parts of their systems, asking the customer to build their own service packages.

Customer orientation means getting to know your customer by interacting with them enough to learn their needs and desires. But customer orientation does not mean constant interaction, not even when the customer demands this, but it means packaging your offering so that it plugs into the customer’s activities, solving customer problems, satisfying needs, without undue complications and bother. Customer orientation can be industrialized, standardized.

A craft society is dominated by services. Goods are produced manually as parts of services. When the manual production of goods is industrialized it is a long and difficult process. Standards have to be defined, machines have to be built, and products have to be designed, developed and packaged. Distribution systems have to be invented. And all of these things have to fit together in a huge, complex, well functioning system. In industrial society, services remain as crafts. To some extent they disappear, being replaced by goods, but except for that they remain relatively untouched. Education, healthcare, bank services, hotel and restaurant services, they all continue as before. We tend to praise this, shunning the standardized versions as less adequate. But services will go the same way as the production of goods, of course. And with information technology we have already come a long way. Services are beginning to be industrialized, standardized, and packaged. Soon we will look back on education involving direct communication with a teacher in the same longing way as our grandfathers used to remember the hand sewn shoes of their youth.

8 Consumers

Nurminen’s perspectives on technology are the perspectives of a work oriented society. The world is different now with a growing consumer market (now 70% of the GNP in the US). We continue to work certainly, but our role as consumers is becoming more and more important. Children, teenagers, retired people make up the majority of the population in most Western countries, and they are no longer invisible. In this world we need to develop new perspectives on technology.

Tools are used by craftsmen to provide services to their masters. When I cut your hair, sweep your floor, fry your eggs, I am a user of technology, but what is your relation to technology? You are a consumer of the services provided by my use of the technology. But even if I don’t have servants, I am a consumer too. I don’t cut my own hair, and when I want to watch television, I have to push a few buttons, but I cannot really be said to use the television. Lots of other people, however, have used complex technology, tools and machines, to produce the programs I watch and broadcast them to my television set. They are users of technology. I am only a consumer. In a consumer oriented society, we need to develop a consumer perspective on technology to complement the work oriented, producer perspective.

Sometimes these two perspectives, the producer perspective and the consumer perspective, merge as when I use technology to service myself, and self-service is something of a moral norm in a work oriented society. We all work to produce goods and then we use those goods to provide services to ourselves, self-service.

9 Producers or Consumers

Technology has made modern life incredibly comfortable. We get water by turning a tap, light by pushing a button, heat by turning up the thermostat. We are comfortably seated while traveling, there is always food in the refrigerator, and a meal can be put together in minutes using freezer and microwave oven. Tasks we had to perform ourselves in the past are now provided as services by technology. Of course, kings and nobility who can afford servants have always lived like this; have always been spared the boring everyday toils. But technology has now given us all (in the middle class) a life like kings.

It all began with tools. With tools we could solve everyday practical problems and increase our chances of survival. But the tools also gave us more things to do. The more tools we invented the more tasks we got. For a long time tools were mainly working tools. But then came the machines. With machines we could automate the tools, and liberate ourselves from work. The 20th century was a century of automation. With more and more automation, there will be less and less for us to do. Automa-tion has liberated us from physical labor. For health and well-being we now invent tools for playing with. We play soccer, lift weights, play golf and tennis – to stay healthy. But those tools can of course be automated as well. Eventually, we will be able to trim our muscles without using them and keep our heart and lungs in good condition without doing something special. It will all be done automatically.

Instead of playing soccer, we can watch soccer games in a world of experiences rather than activities. Instead of messing around with our own incompetent tool use, we can experience the very best professionals performing their, technologically enhanced, outstanding feats. In a world that is becoming more and more automated, there will be an incredible abundance of technologically advanced services providing exciting and rewarding experiences for all of us to consume. Already the experi-ence industry dominates computer technology and we have really seen nothing yet. (Most of the money to finance research and development of computer technology used to come from the American war machine. This changed in 1992, when the experience industry took over this role as leading financier.)

With more and more advanced and easy to use technology, we develop societies where we don't have to worry about the practicalities of life. We can focus on more interesting aspects of life, on experiences or ends rather than on the means for reaching those ends. The irony of progress is that in this process we run the risk of creating a society of consumers rather than producers, a society in which many of us have nothing worthwhile to do and thus find life more and more meaningless. The good life is a life of balance between production and consumption, between effort and rewards. It is a life of achievement, not just consumption. That balance may be different in different times and cultures, but it is difficult for us, in our culture, to believe that human beings can be happy without achievements.

We come out of a society in which most of us were active most of the time, using tools and experiencing the results of our activity. It seems as if we are entering a society in which we will spend more time being passive consumers of services providing us with experiences. Some of us will be producers, some of us only consumers. Automata are wonderful, but we need tools to live an active life. And, is not the good life an active life? Should we not develop better tools for activities rather than automata for experiences? Would it not be a better society if we had an activity industry rather than an experience industry? Or, do I only think so because of our heritage? Am I stuck in a romantic conception of activity related to the romantic view of work that we find in the Scandinavian approach?

Be that as it may. It is still true that the scene has changed in the 15 years since the publication of Nurminen's book. The choice then was between people or machines in a world where human beings were too easily reduced to factors in complex technical systems. The choice now is between producers and consumers, between using technology to produce something and using technology to consume something. It is not a choice between people and technology, and not really between different sorts of technology. It is a choice between different forms of life, different life styles. How that choice is made, and who makes the choice, is a much bigger issue (cf. Dahlbom 2003) and really needs a whole book. It is time for Nurminen to revisit his old theme and update it. I would look forward to read another book by Nurminen on perspectives on technology.

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Searching Knowledge for Design – Nurminen's "Humanistic Perspective" Revisited

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Abstract. The paper compares three debates form different times and areas: the foundational debate within IS in 1980s (represented by books by Winograd & Flores, Ehn, and Nurminen), and the current debates in Design Research (represented by Buchanan) and in practical philosophy (represented by Toulmin). It is found that in the core of the two first debates is the question of the nature of the knowledge used and produced in design, and that the perspective presented by Toulmin who uses Aristotle's three types of knowledge (episteme, techne and phronesis) as his starting point can be used to explain the debates. It is found that the phronesis-component of design knowledge is growing in importance, and that we do not have suitable approaches to deal with it and to integrate different types for design purposes. It is also found that Nurminen in his book 15 years ago has been anticipating some important aspects of the current debates.

1 Introduction

About 20 years ago there was a certain foundational crisis in IT research. A number of researchers working in IT area felt that the existing paradigms to understand the relationship between information technology and human activities were too limiting and distorting to serve as intellectual foundations for research and design, and new directions were actively searched, resulting several books where the criticism against the existing paradigm was elaborated, and new foundations explored. Three good examples of such books are "Understanding Computers and Cognition" by Terry Winograd and Fernando Flores 1987, "Work-oriented Design of Computer Artifacts" by Pelle Ehn 1988, and "People or Computers: Three Ways of Looking at Information Systems" by Markku Nurminen 1988 (original Finnish edition 1986). These books have all been received very well: Winograd and Flores' book had almost a cult status in late 1980s, Ehn's book has been since its publication one of the foundations for Scandinavian Participatory Design, and also Nurminen's book is still in print after 15 years. So there has been a long-term interested audience for the ideas presented on all of the books. The aim of this paper is to revisit that debate that caused the writing of the books and to reflect the ideas expressed in them against the current discussions. In particular, the paper will take a look at Nurminen's book to see how well it has retained its actuality.

The reason for such reflection is that during the last years there has been increasing interest in the area of software design in broader issues of design, and the discussion what should be the foundation of design knowledge has become actual again. Design research is one of the central academic areas where issues related to design are discussed, for example in journals Design Issues (USA), Design Journal (UK) and Journal of Design Research (NL), whose audience is mainly among the design professions. There has been a vivid discussion about a perceived large change in the design in general, and about the need to rethink the foundations upon which the design research has been founded, and increasing interest in the nature of the knowledge used and produced during a design process. So there is an interesting parallel with the earlier discussion within IT research, and this parallelity is the starting point of this paper.

The paper will first review the ideas presented in the three books, then review the discussion within Design Research through an recent and interesting article, connect these with another discussion - epistemological discussion in philosophy - using the work of Stephen Toulmin as a guide, and finally draw some conclusions.

2 The 1980s foundational debate in IT research and design

There were in fact two debates within IT research that started during the 1980s. One is the foundational debate discussed for instance in the books mentioned above, and the other is a methodological one -- what are the legitimate ways to do academic research in the IT area? The latter is a reflection of a corresponding debate in human and social sciences, and a result of broadening object of research during the 1970s when researchers started to study also humans and organizations surrounding the technology, the methodological options available in human and social sciences opened to them as well. The methodological debate surfaced within the IS research in the famous Manchester conference (Mumford et al. 1984), and it has continued since then (for example Nissen et al. 1991, Lee et al 1997, Myers & Avison 2002). The debates are not independent, but for the sake of brevity we concentrate only to the former one, which does not often address methodological issues directly but it is asking more fundamental questions – what kind is the foundation, the knowledge that is used in both design and use of IT? After the heightened interest in 1980s these questions have been more dormant during the 1990s, but it seems that they may be surfacing again. The positions of the books to these questions will be next reviewed shortly.

2.1 Understanding Computers and Cognition

All of the three books are tightly related to the debates of their time, and this is probably most visible in the Winograd & Flores book, because its main argument is levelled against the AI conception of humans as cognitive machines, and the mainstream AI has meanwhile certainly lost its intellectual drive - opposing it now seriously would be like flogging a dead horse. The AI core ideas of modeling human intellect, however, have not totally vanished but still alive, although often in an implicit form. Winograd & Flores ground their attack against mechanistic AI thinking on the philosophy of Heidegger, who emphasises immediate, unreflected experience and living in a deeply personal life-world. This immediate personal experience and the tacit knowledge related to it makes it impossible to reliably model a use situation from outside.

2.2 Work-oriented Design of Computer Artifacts

Ehn's book can be seen as an attempt to create a coherent theoretical foundation for the Scandinavian Participatory Design school, that at the time of the book publication has been active already ten years. Ehn – like the whole PD movement – is critical against the then dominant system-theoretical view on system design because of its technocentrism and inability to see the "work ", and also critical towards one-eyed management oriented versions of sociotechnical design. During the 1980s there was active discussion about work organization, resulting the emergence of analytical interest in practical crafts (for example, Göranzon & Josefson 1988). In these works it was found that individual workers even in tayloristically rationalized workplaces are able to maintain some autonomy, and because of their skills this autonomy is considerable in some cases. It was this autonomy PD research set out to defend and even enhance with system design. The major legitimation for participation was the idea that workers have a lot of work related tacit knowledge no system development methodology "from outside" is capable to record, and so important possibilities will be lost in the process. This emphasis on individual, unreflected tacit knowledge led also Ehn to search foundations from Heidegger's philosophy. Ehn goes, however, one step further by embedding this individual tacit knowledge in local "praxises" by Marx and "language games" by Wittgenstein.

2.3 People or Computers: Three Ways of Looking at Information Systems

Nurminen has the same opponents than Ehn (system-theoretical and sociotechnical views on design), but his argumentation takes a different turn. Instead of starting from the importance of personal tacit knowledge Nurminen goes deeper: his starting point is the location of actorship in human-technology systems. According to

Nurminen the integrated system nurtured by both system-theoretical and sociotechnical view contains either explicitly or implicitly an idea that the technical system can be an active actor. He contrasts this with an idea of a "humanistic" system, where only humans can be actors. At the level of an ideal type this leads to a concept of highly personal systems containing just the information needed for the job tasks of a person, and then a network of communication between these systems – not automatically programmed, but enabled by mutual negotiation and decisions of participants.

Nurminen discusses at length about the concept of knowledge within the humanistic view. He states that a basic prerequisite for knowledge is that the there exists somebody who knows. The explicity of a knowing subject implies that knowledge is always purposeful, related to something to be done, and that the subject is competent to interpret a piece of knowledge practically, when it is applied in his or her practice. The problem is that computers are capable to store only a limited spectrum of the knowledge needed in practice. Drawing on Nordenstam 1983, Nurminen classifies the knowledge needed to be a competent actor to three types: "claim knowledge" (påståendekunskap), "aquainted knowledge" (förtrolighetskunskap) and "know-how" (färdighetskunskap). Nurminen sees that our society has overemphasised the theoretical (claim) knowledge at the cost of practical knowledge, to which he reads the two other types. The first type is also more readily formalizable to be put in the computer, and Nurminen sees a danger, that more intuitive parts of knowledge will get too little attention in system design.

2.4 A "turn to design" 10 years later

10 years after these books were written a very interesting turn happened. Both Winograd and Ehn had changed their orientation and instead of searching help from philosophy were turning towards the roots of the design profession proper, Winograd in the book "Bringing Design to Software" (Winograd 1996), and Ehn with his "Manifesto for a Digital Bauhaus" (Ehn 1998). The motivation of both of these is very similar: both regret that the connections between software design and other, older design professions have been lacking, and think that the design tradition can make valuable contributions to the design of software. The question is to find the areas and ways how these contributions can best be assimilated. The book edited by Winograd and Ehn's article are not alone, but more like indicators of a larger movement towards design in the 1990s, resulting for example the Designing Interactive Systems (DIS) series of conferences and the emergence of forums shared by software designers and representatives of traditional design professions, like the 2002 founded Convivio network connecting people interested in design across disciplinary boundaries, initiated and financially supported by EU. It is also interesting to note that IS design as a research area – a central application field for the 1980s debate – does no more play a significant role in the attempts to open doors towards design, but the IT people involved are almost purely from software engineering and human-computer interaction design.

When parts of the IT community are searching new connections and possibilities for cooperation with design professions, it is interesting to take a look how the situation is perceived in the design side.

3 Changing idea of design

In this short paper it is impossible to make a coherent review on the whole discussion that has been going on in design research. Instead of that I will concentrate on only one paper R. Buchanan's article "Design Research and the New Learning" that has been published in Design Issues 4/2001, and use that as a representative of the discussion. The paper gives good possibilities for this: without being a review article itself, it summarizes and thematizes the larger debate in the field, and the author himself has already long been one of the editors of the Design Issues journal and so well-positioned as observer what is happening in the field of research.. The major point Buchanan makes in the paper is that design is currently undergoing a deep change where both the area of design is expanding and also the values and norms are changing.

Buchanan starts developing his argument by a review of the history of design broadly conceived, in particular with respect to its relationship with science and academic world in general. He opens with a passage from Galileo Galilei's "The Two New Sciences", where the character representing the author tells about the importance of the practical engineers in the Arsenal of Venice to the development and sharpening of physical thinking. After this practically oriented opening the book, however, Galilei turns away from practice and concentrates in purely theoretical explorations. According to Buchanan, the passage shows the emergence of a rift between practical design and theoretical knowledge. Buchanan then continues by discussing about Francis Bacon's "Project" -- people learning to master Nature and build artificial things to serve them better and better – and characterizes that as a clear design-oriented venture. Buchanan contrasts Bacon's design project with current conceptions about technological development and notices that although there was a certain hubris in the way Bacon was praising the technological progress, his Project had still a clear connection with humanistic knowledge, emphasising rhetorics, culture and learning. This humanistic undercurrent has been lost under the "new scientificity", but the need for the connection is still actual in current design.

Buchanan continues his review by examining the disciplinary development of universities, and points to the rise of the value of science, as founded by Galilei, Newton and Descartes. He notes that the construction of artificial things did not belong to the objects of learning in universities, and in general human doings were in general excluded, and tolerated only in a very limited way in fine arts and literature, where it is difficult to escape the fact that the objects are produced by humans. In the beginning of the modern times the actual practical side of arts was studied in art schools outside the university system, and design in general was not accepted in universities, besides already mentioned fine arts and architecture. But even with them the practical side was seen to belong to a lower echelon of practical artisans who possessed practical skills and intuition but who were lacking the deep understanding, founded on “first principles”. Buchanan mentions here the “Battle of Books” where the new “neoteric” knowledge based on the application of both methods and concepts developed in the rising natural science and corresponding setting of the questions to be solved were contrasted with the old “paleoteric” knowledge, based on experience and non-scientific principles. In the Battle of Books design definitely belonged to the paleoteric side with its principles like harmony and such.

Jurisdiction, medicine and theology had originally been in the core area of the universities, but the in the forming new universities their status started to decline because of the lack of scientific approach. In the 19th century the practical importance of engineering became so significant that it was necessary to start university-level education, but usually new technical universities had to be founded for that. And usually it was made (and often still is made) clear that these technical universities are only of secondary importance, because they only apply the results of science that are actually produced in elsewhere, by “pure research” in universities.

After the Second World War the situation has started to change and other proactive disciplines as decision science and computer science have appeared to the side of engineering in universities. During the 20th century design itself has been recognized as a specific discipline of its own, and it has finally made its way to universities as well, although still only a few universities are offering a doctorate in design. Anyway, times are changing, and Buchanan sees that a new Battle of Books may be emerging.

According to him, the new Battle of Books is fuelled by the fact that although the scientific thinking that has been the foundation of universities during the modern times has indeed lead to great advances in theoretical knowledge, but on the other side it has led to a severe fragmentation of knowledge, so that the theoretical advances have only very limited usefulness in understanding larger issues, and in particular making informed changes in the world. New problem fields are constantly opening that do not fit with the old divisions of knowledge. In the new situation the old Battle of Books is turned upside down: the former new is now grown old, and some parts of the former old are now the new challengers. Design in particular is developing into a major force in the new neoteric learning, because it must deal with emerging new areas and solve their practical problems, and for that it must be able to integrate the fragmented knowledge.

As the conclusion part of his analysis Buchanan makes an attempt to characterise the change that he sees is going on in design, and reflects the change against changing conceptions what is the object of design – the product. He identifies four fields of design, a kind of successive phases in the enlargement of the object of design. The two old fields are graphic design focusing on visual symbols, and industrial design focusing on fabrication of things. Besides these two new fields are emerged: interaction design focusing on human interaction with his or her surroundings, and human system design focusing on human relationship with his or her environment. Buchanan is perceiving a shift of importance from “old” to “new”, not so that the old will disappear, but that their importance as independent design areas will decrease, while they will still needed as essential elements in larger objects of design. Another change which according to Buchanan is also taking place is a shift in a way how objects of design are viewed: a shift from the “external” perspective of designer towards the “internal” experience of the user of the product of design. This means that instead of traditionally seeing the product from the point of view of its elements like form, function, manner and materials, it is seen from the point of view of the end user – how useful, usable and desirable the product is in his or her own context.

Buchanan’s position can be summarized as follows: both the object of design and the basic position how design is understood are undergoing a change, and stakeholders are attempting to find new bearings. The change is driven by the development of both individual and social needs and also by technological possibilities that set new challenges to design. The change can be characterized by movement from general towards contextualized particular, from simple towards complex, from timeless to again contextualized timely, and from isolated artifacts towards the world seen from an actor’s point of view.

There are interesting similarities and differences between the 1980s critique towards IT design and what Buchanan sees happening in the field of research. Both of them are interested in knowledge, and both of them are critical towards the established systematic or “scientific” way of producing knowledge needed in design, accusing that it is incapable to grasp essential qualities of the phenomenon to be studied and changed. But their emphasis is markedly different: when the main grist of the 1980s critics is in absence of personal tacit knowledge of “users” from design, Buchanan sees the problem that analytical scientific approaches to design are lacking contextuality and integration. Also Buchanan is interested in personal knowledge, but he brings it in the different context and at a different level: a personal, momentarily experience as an object of design. In the next section an attempt is made to find an unifying perspective for both of them, based on the philosophy of S. Toulmin.

4 From rationality to reasonableness– the philosophical view of Stephen Toulmin

In debates related to knowledge it is reasonable to search help from philosophy, and there is indeed an epistemological discussion going on, highly relevant to the issues discussed in the first part of the paper. In this section we take a look at this discussion, using Stephen Toulmin’s book *Return to Reason* (2001) as our guide.

The British-American Toulmin has had a long career of half a century, and he is one of the major figures among the ranks of currently living philosophers.

Toulmin's work has raised discussion and controversy, and he has neither joined any existing "schools" of philosophy nor established one of his own – he has been an "odd duck", like characterized by M. Wartofsky (Toulmin, 2001). Toulmin has been a productive author in many areas, and also active as a historian of science, but a connecting theme in all his work has been the importance of practical, worldy knowledge and reasoning as opposed to abstract, formal logic and theorizing so valued by the dominating school in 20th century philosophy of science, analytical and logical rationalism. Toulmin's book Return to Reason contrasts abstract analytical philosophy and formal logic with thinking in practical world – against formally logical rationality he sets practical reasonableness, hence the name of his book. For him the "Cartesian revolution" in scientific thinking has been a harmful 300 years diversion that should be corrected. In the book he studies the issue from the perspective of the history of philosophy and integrates several philosophical debates of the 20th century into a larger, continuing movement to correct the Cartesian diversion, and to "return to reason".

Here it is impossible to do justice to the way Toulmin presents his argument in the book, and in the following I will only partially illuminate one central line of his thought – that there is a long tradition emphasising the practical knowledge, "knowing in the world", which is specific, local and temporal instead of general and timeless knowledge so highly valued by the dominant philosophy of science.

Toulmin starts with Aristotle, who in his Ethics of Nichomachos defines three forms of knowledge. Aristotle calls the first form "episteme", which is positively known and transferable "book knowledge" – highly valued by his disciple Plato, for example. The second form is called "techne" – the skill how to do something, the practical know-how. Most interesting from the point of view of this paper is the third form of knowledge that Aristotle call as "phronesis". It is knowledge that enables a person to act in the world wisely and "right", *pros ton kairon* – according to the situation. It is really interesting to note, that the two first types of knowledge are well known to the extent that the terms used for them by Aristotle have been a basis for related terms in the vocabularies of many current languages, but the third one has not such a continuity. Thus we are for example in Finnish vocabulary the words "epistemologia" and "teknologia", but there is nothing based on Aristotle's phronesis. It is this third form of knowledge that Toulmin believes has been neglected by the scientific thinking and which now must be resurrected.

According to Toulmin all the three types of knowledge were equally valued until the end of medieval times, but the beginning of the "Cartesian revolution" brought with it the separation of episteme over the two other types. In the book Cosmopolis (1990) Toulmin connects this change also with the turbulent times in Europe in the end of the 30-year war. The war had brought a misery and chaos, and there was no justition for it –human reason had failed. Neither was religion to be trusted as a source of ultimate judgement, when killings and robberies against people having a different faith were equally practiced and justified by proponents of both catholic and protestant doctrines. The was a search for certainty, a need to find a firm ground upon which to construct such arguments that must be true irrespective of any background differences discussants might have, truths that cannot be falsified. This ground was found in mathematics and formal logic, and in axiomatic closed systems, which became the norm for scientific knowledge against which all other knowledge was gauged.

This meant that knowledge of techne and phronesis type was devalued, and the process has been very efficient. A good example is the status of rhetorics, which has long been an esteemed discipline in universities, highly valued as a representative of practical logic, but which term currently is usually used almost as a synonym of cheating – something is “just rhetorics”.

After hundreds of years dominance in science the ideals of Cartesian thinking have filtered down to shape our thinking and everyday experience and judgement as well. In the course of time the superiority of Cartesian thinking and epistemic-only knowledge has, however, become more and more difficult and finally impossible to maintain. Toulmin traces in Return to Reason the emergence and strengthening of opposition in philosophy against the Cartesian rationality. This opposition has never been unified, but more like a stream of different, often “life”-oriented philosophies, each attempting from varied starting positions develop an alternative to the too limited Cartesian worldview, and it is interesting to note, that Toulmin positions Heidegger firmly among these opposition approaches. Toulmin’s champion among the opposition is not Heidegger but Dewey, who in his study on the relationship between theory and practice “Quest for Certainty” (1929/1988) has according to Toulmin developed the best founded and most convincing criticism against Cartesian thinking. In the core of Dewey’s argument lies the difference between the positions of an external observer vs. a participant actor, and between the potentiality of holders of these positions to acquire relevant information.

Toulmin sees that we may be witnessing a recovery of practical philosophy: in many areas there is development towards balancing the former overemphasis of formal rationality with practical reasonableness, and increasing and increasing recognition of the importance of phronesis-type of knowledge. He characterizes this movement as

- Return to the Oral (from written and symbolically codified).
- Return to the Particular (from abstract and general).
- Return to the Local (from universal).
- Return to the Timely (from timeless and infinite).

Toulmin demands that philosophy must address questions relevant to its time, and addressing questions like this needs a philosophy whose subject area are worldy practices in all their messiness and ephemerality.

It is clear that Toulmin is here offering a perspective, under which both of the discussed debates can be subsumed. While the former debate was more interested in actor’s personal knowledge and the current discussion in design emphasises more contextual factors, both of them are geared towards the need in design to produce and use phronesis to act wisely in particular, local and timely situations.

5 Conclusion

As noted, the view on the development of philosophy by Toulmin gives a plausible explanation to both the emergence of 1980s IS debates and the current discussion in design research (and there is a clear connection with the debates in human and social sciences in general, although it is not possible to elaborate this perspective further in this paper). Design is one of the constitutive forces of the society, and as such feels clearly the pressures of its time, and as a field it is heavily dependent on the existence and production of phronesis-type of knowledge, episteme and techne alone are not sufficient. Information technology as an object of design is particularly interesting, because the contribution of all three types of Aristotelian knowledge is clearly visible. A development of a working software means the development of a correct (enough) formal system in a closed world of computers and system software and thus the knowledge needed in the development is partially epistemic. On the other hand, a considerable amount of technical know-how and skill are needed to put the system together, and so another part of the knowledge needed is inevitably of techne-type. Finally, the utility and usefulness of the system will be heavily dependent on the phronesis-type knowledge to understand both future use situations and the situation in the development and implementation. Within the research on information technology we have subdisciplines which address each of the levels – computer science, software engineering, and IS design/HCI, respectively, but the fact that the very nature of the knowledge they each use and produce is deeply different has perhaps not yet been fully understood and elaborated. So we are lacking efficient ways how the different types of knowledge can jointly contribute in design, and obviously the phronesis-type knowledge – how to act wisely in design situations – has a key role also here. We have managed this far by using tacit phronesis knowledge by the designers involved, but when the design objects become more and more complex and the need to take the insider actor's view into account becomes more and more burning, the tacit phronesis knowledge of individual designers is not enough, and also phronesis knowledge should be systematically studied and collected, and this is calling for a vitalization of discussion on nature and origins of knowledge used and produced during the design process and perhaps a redefinition of the perspective – exactly something what Nurminen was suggesting in his book.

There is no doubt that Nurminen with his humanistic perspective was anticipating debates that start to actualize in mainstream design thinking just now, 15 years later. Unlike Winograd and Ehn, his perspective has not needed any reorientation, but it is still in this respect a fully relevant starting point for further discussions.

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From Information Systems to Information Services

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Abstract. Scandinavian research has contributed to the human and social perspectives and to systems approaches within the Information Systems discipline. The highly interactive and diversified nature of contemporary information and communication (ICT) artefacts further strengthens the importance of human and social understandings. But they also question the dominant role played by systems thinking. This paper builds on the socio-technical tradition while at the same time replacing systems thinking with service thinking to theorize ICT artefacts. We combine general notions of services with well established concepts of human activities in organizations to form a task-based theory of information services. The resulting contingency theory distinguishes between computational, adaptive, networking and collaborative services and it relates these ideal types of services to basic technologies, such as server, client, infrastructure and workspace technologies. We also discuss how different types of services standardise process, information, connection and material and we argue that their use can lead to dysfunctional overload in terms of structure, information, interaction and transaction.

KEYWORDS: ICT theory, use, tasks, technological diversity, overload.

1 Introduction

The Information Systems discipline explores the complex relationships between human behaviour and technological support, primarily in organisational settings. The field has attracted researchers and practitioners from various reference disciplines, such as computer science, information science, psychology, sociology, organisational behaviour and even philosophy. This diverse global community has through the past 30 odd years struggled to understand and perhaps even predict

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1 The two authors have contributed equally to this paper and are listed in alphabetical order only.

developments. Scandinavian researchers have played important roles in this process. First, Langefors' Theoretical Analysis of Information Systems (Langefors, 1966) and Nygaard and others contributions to object orientation (Dahl et al, 1975) and systems thinking (Holbaek-Hanssen et al, 1975) helped establish systems approaches as the dominant paradigm within the Information Systems discipline. Second, a number of researchers made key contributions to the human and social perspectives on information systems. Nygaard and Bergo's (1975) research collaboration with trade-unions broke the ground for critical thinking involving conflict, power, and emancipating knowledge creation as key elements. Other researchers like Rolf Høyer, Niels Bjørn Andersen and Mats Lundeberg made important contributions to socio-technical approaches to information systems. These different attempts to emphasize the human and social aspects of information systems are well described by Markku Nurminen (1988) and further developed in his own concept of human centred information systems (1988, 1996).

Contemporary Information and Communication Technology (ICT) artefacts are quite different from traditional information systems. They are highly interactive, each situation of use typically involves a number of quite different artefacts, and new functionalities related to human communication and interaction has come to play important complementary roles. While these developments further emphasize the importance of human and social perspectives in understanding ICT artefacts they also question the dominant role played by systems thinking and perspectives. The debate on how to characterise the field illustrates this. Leavitt (1964) offered a much-cited framework highlighting the interconnectedness of issues related to organisational structure, people, task, and technology. Many researchers have studied these contextual aspects of ICTs, and in particular focused on the extent to which particular technological characteristics match or fit the needs of the users (Goodhue and Thompson, 1995; Dennis et al., 2001; Grover, 2002).

The rapid technological changes have also been expressed in terms of historical eras of systems development from the mainframe Era, over the PC Era to the Global Networks Era (Mathiassen, 1998). Considering the ICT artefact at the centre of attention the focus is gradually shifting from systems thinking towards consumption or use of software products and services. Whereas organisations 10 years ago would hire a project team if they wanted software, they would in the 1980ies increasingly consider picking packaged standard software off the shelf. With the emergence of the Internet, along with wireless communication infrastructures, software can increasingly be seen as a service (Braa et al., 2000). People do not buy or download a specific piece of "book-purchasing-software", they simply go to Amazon.com. Neither do they necessarily spend their time making a simple homepage where they can interact with friends, when they can call upon the services offered by Blogger.com. Dahlbom (1996), consequently argues for a general shift in perspective from development towards use of ICTs, and offers the four stages of: mainframes for transactions, personal computing, collaborative computing, and Internet infrastructures. Even from within computer science there has been indications of shifts in the way the artefact is perceived. Dijkstra (1989) represents the classical view that computing is all about symbolic manipulation and logic. Algorithms transform data by means of sequence, selection and iteration. But Wegner (1997) argues that the ICT artefact no longer should be characterised by simple algorithms, which based on input, will provide an unbroken process to produce output. He argues that the context of users interactively changing the state of the ICT artefact provides a more precise explanation of how ICTs are used.

Today, we rely as a discipline heavily on social and psychological theories of organisational and human behaviour, philosophical theories of human existence as well as technical theories of computation and design. We do, however, implicitly rely on systems thinking as the basic vehicle for understanding ICT artefacts and only to a very limited degree do we formulate or rely on explicit theories of the ICT artefact (Orlikowski and Iacono, 2001). Orlikowski & Iacono (2001) conclude from their analysis of 188 articles from the first ten years of the Information Systems Research journal that around a quarter of all the papers did not have any explicit view of the ICT artefact, and that there generally is a need for further theorisation of the centre point of our discipline.

The aim of this paper is to respond to Orlikowski and Iacono's (2001) challenge by suggesting a framework characterising the diversity of contemporary ICT artefacts in organisational contexts. Allen Lee (2001) interviewed MIS Quarterly Senior Editors, and Richard Watson argues that one of the key principles of the MIS field is that "*the extent of an information system's use is determined by the degree to which it improves task performance*". We therefore forward a task-based theory that combines classical organizational insights with general theories of services. The resulting view of ICT artefacts as information services should be seen as a further elaboration and systematisation of Orlikowski and Iacono's (2001) "tool-view". We consider the artefact situated in a situation of use where it supports the performance of tasks and we characterise from that perspective the diversity of information services. This implies that we exclude ICTs that do not contain an essential element of information processing, such as computer games and simple productivity tools such as a word processor.

It is essential for us to suggest theories characterising the ICT artefact because it is at the centre of both practice and research within our discipline. A theoretical understanding of how ICT artefacts relate to human activity in general and a characterisation of the essential aspects of the artefact in particular is exactly the area in which we are supposed to be the experts. Theoretical efforts like these could potentially offer contributions from within Information Systems to the surrounding reference disciplines from which the IS field frequently borrow theories (Jones, 2000). Orlikowski & Barley (2001) suggest that greater interaction between the fields of information technology and organisation studies can benefit both, and that organisation studies can benefit from taking the material properties of technologies into account.

The theoretical basis for this paper is primarily threefold. In Section 2 we introduce Mintzberg's (1983) notion of organisational effectiveness in terms of the two dimensions task complexity and task uncertainty. Section 3 present Gutek's

(1995) characterisation of services in terms of encounters, relationships and pseudo-relationships. Section 4 presents earlier attempts to characterise the diversity of ICT artefacts (Kakihara and Sørensen, 2001; Sørensen and Kakihara, 2002). In Section 5 we synthesise the frameworks presented in a task-based theory of information services. Section 6 presents a number of example information services and discusses those in relation to the suggested theory. Section 7 illustrates some implications of the framework by discussing types of standardisation or codification of knowledge, basic technologies, and unanticipated consequences. Section 8 concludes the article.

2 Tasks

In order to understand the relationship between task and environment we draw upon Mintzberg's (1983) theory characterising information processing and decision making tasks and how these can be organised. This theory of organisational forms is based on the relatively simple and also simplistic assumption of organisational effectiveness as an inherent equilibrium between the information processing and decision making demands of the environment, and the organisation of tasks meeting these external demands. We have chosen to base our characterisation of ICT artefacts on Mintzberg's framework because it is both simple and elegant. In particular we relate to Mintzberg's hypotheses 9 and 10 (pp. 137-138) that relate to the dynamic and complex aspects of the environment. Mintzberg's idea is that organisational information processing and decisions ideally must be standardised and centralised, and his framework explains the conditions under which this is possible. His framework also outlines how to organise information processing in situations where we cannot rely on standardised and centralised decision making.

Mintzberg's (1983) framework is based on two dimensions, complexity and uncertainty. The degree of complexity relates to the information available in the situation and is a reflection of a number of aspects, for example, situations with many interacting parts, a large group of interdependent actors, decision making that spans a long time, and time and safety critical decisions (Woods, 1988; Mathiassen and Stage, 1992). The degree of uncertainty relates to the availability and reliability of relevant information in a given situation (Mathiassen and Stage, 1992), for example in terms of uncertainty of the grounds for which a decision has to be made, or the need for generating new information in a design situation.

Mintzberg argues that in situations characterised by both low complexity and low uncertainty it makes sense to standardise and centralise information processing and decision making and organise it as a *Machine Bureaucracy* (See Figure 1). However, if we encounter situations characterised by a high degree of complexity, then it is no longer possible to centralise the decision making process. If there is still a low degree of uncertainty, then all relevant information will be available in the situation, but the degree of complexity makes it necessary to delegate decision making and program information processing through skills. Distributed experts can make the decision as and when needed, but their discretion will be needed as a direct result of a highly complex situation where the exact configuration of decisions cannot be predicted beforehand. We must therefore organise information processing and decisions as a *Professional Bureaucracy*. If we encounter situations with a high degree of uncertainty, then the primary challenge is to generate information and we must apply an organic form of organising where processes are not programmed but emerge. The *Simple Structure* support decision-making where there is a high degree of uncertainty and a low degree of complexity. Here we can rely on a centralised organic process where decisions emerge through communication and direct supervision. If we encounter situations where there is both high degree of complexity and uncertainty, then it is no longer feasible to centralise and standardise, and we find the *Adhocracy*, which is an organic and decentralised organisational form where decisions emerge through mutual adjustment.

		Uncertainty		
		Low	**High**	
Complexity	**Low**	*Machine bureaucracy* Bureaucratic Centralised Program through process.	*Simple structure* Organic Centralised Emergence through communication	*Simple*
	High	*Professional bureaucracy* Bureaucratic De-centralised Program through skills	*Adhocray* Organic De-centralised Emergence through mutual adjustment	*Complex*
		Stable	*Dynamic*	

Figure 1: Mintzberg's (1983) characterisation of four organisational forms depending on the level of complexity and uncertainty of information processing and decision making.

3 Services

In order to characterise information services we draw upon Barbara Gutek's (1995) general theory. She does not characterise information services as such, but more generally, the types of services organisations and individuals offer customers. Gutek argues that organisations can offer two distinct types of services, namely the *encounter* and the *relationship*. An encounter is a straightforward service that spans a short period of time and has a predefined context. It is an encounter when we enter a shop and buy a bottle of milk and bread. Encounters ensure efficiency, speed and uniformity of services. Opposed to the encounter we find the relationship, which is characterised by context and duration aimed at more complex service needs. Relationships serve the purpose of creating bonds of trust. Gutek (1995) characterises relationships and encounters as follows:

> "Relationships happen in the context of an ongoing series of transactions in which a particular service provider and particular customer become known to each other and expect continued interaction in the future. In encounters, by contrast, each service interaction is complete in itself, and service providers are, in the eyes of both customer and providers, interchangeable. Relationships and encounters not only describe the two fundamental ways service and goods are delivered but, at a broader level, they represent two basic forms of social interaction, exchanges between strangers and ongoing exchanges between people known to each other." (p xviii)

Most people have a relationship with their doctor or perhaps their solicitor. The person or organisation with which we engage in a service relationship knows who we are, what our previous history with the service provider is and frequently the provision of a single service can span a considerable length of time. Gutek (1995) also argues that organisations may attempt to convince people that they are provided with a relationship, where in fact most aspects of this relationship is taken care of by automatic or semi-automatic systems. This particular type of service is characterised as a *pseudo-service*.

The conceptualisation of the encounter service versus the relationship service and the generalisation of these into two basic forms of social interaction relate to Grannovetters (1973) social network theory of strong and weak ties. We will use and adapt this distinction between encounters, services and pseudo-services to the discussion of organizational information processing and decision making in order to characterise significant differences between ICT capabilities.

4 Artefacts

Before we proceed to combine Mintzberg's view of how information processing and decision aspects of tasks are best organised with Gutek's notion of services, we briefly review some related attempts to characterise the ICT artefact with a view to integrate these into a framework of task-based information services. Much of the research in the use of information systems, for example the Task-Technology Fit research, primarily focus on quite specific technological functions and study how these match specific organisational tasks. It does not provide analytical characterisations of the diversity of the functionality offered across different ICTs. Dennis et al. (2001) argue that Group Support Systems (GSS) fundamentally provide support for communication and information processing. Communication enhances interaction among participants. Information processing supports "*the evaluation, gathering, aggregation, structuring, and analysis of information*".

Orlikowski & Iacono (2001) applied open coding to research papers from Information Systems Research and arrived at five ICT conceptualisations in these articles. First, there is the nominal view accounting for 25% of the papers with an absent view of technology. Second, there is the computational view perceiving technology as algorithms or models. Third, the tool view perceives ICT as a labour substitution tool, a productivity tool, an information processing tool, or as a social relations tool. Forth, the proxy view focuses on perceptions of ICT, the diffusion of ICT or ICT as capital. And fifth, the ensemble view studies technology as development projects, production networks, embedded systems, or as structure.

Dahlbom (1996) argues that our understanding of ICTs often emphasises a particular type of technology or technology use. He provides four perspectives on technology use in general: 1) technology identified with *tools*, small machines or instruments facilitating work or entertaining; 2) technology as complex large scale industrial *systems* and infrastructures; 3) technology as *media* connecting people; and 4) technology as the human-made *interface* in the foreground.

Sørensen & Kakihara (2002) characterise the diversity of ICT artefacts supporting the management of knowledge by adopting four perspectives on knowledge and discussing the technologies that each perspective can inspire. The four perspectives on knowledge are drawn from Kakihara & Sørensen's (2001) characterisation of four knowledge perspectives: 1) knowledge as *object* based on the assumptions of knowledge as objectified and transferable representations of a pre-given world resulting from human intelligence processing information; 2) knowledge as *interpretation* emphasising that knowledge remains tacit and personal to some extent and involves particular properties that cannot be appreciated when decomposed into parts but is inherently associated with human subjective interpretations and dependent upon the point of observation of the interpreter; 3) knowledge as *process* views reality as a whole and knowledge in particular as processes and knowledge is therefore not a static entity but the manifestation of a dynamic process of 'knowing' by which human beings make sense of the world and reality; 4) and knowledge as *relationship* emphasises that knowledge intrinsically is relational to its surrounding world and does not exist in an isolated state in the objective world, but resides within a variety of contextual factors that are inseparably connected with the knowledge. Knowledge as object is a representational perspective and the three others can be characterised as anti-representational.

The four perspectives on knowledge outlined above, give rise to four perspectives on knowledge technologies, as argued by Sørensen & Kakihara (2002), namely technologies supporting: 1) *transacting* emphasising the production, distribution, and general management of information; 2) *interpreting* where ICT support the individual user in interpreting, navigating and producing of both structured and ill-structured information; 3) *collaborating*: where collaboration is supported in terms of providing mutual awareness, shared workspaces and through codifying and embedding collaborative processes; and 4) *connecting*, where ICT support establishing and maintaining inter-personal connections.

5 Theory

The purpose of this section is to synthesise the theoretical elements presented in the previous sections. Based on Mintzberg's (1983) notion of information processing and decision making tasks, Gutek's (1995) distinction between types of services, and the four technology discourses presented by Sørensen & Kakihara (2002), we suggest a task-based theory characterising four analytical categories of information services. The framework mirrors the structure of Mintzberg's (1983) framework, but instead of characterising organisational measures, it characterises information services. The theory characterises the diversity of information services by matching information services with information processing tasks in terms of complexity, uncertainty and type of service provided. The following outlines the four analytical categories of information services (See Figure 2). Section 6 will in more detail discuss examples of information services.

Computational service: In situations where people face tasks with low degrees of complexity and uncertainty, they can rely on programmed processing of information and a service that supports an encounter. The computational service is, as the organisational form of the Machine Bureaucracy, standardised and centralised.

Complexity \ **Uncertainty**	**Low**	**High**	
Low	<u>*Computational service*</u>: **Information**: Programmed processing **Service**: Supporting encounter	<u>*Networking service*</u>: **Information**: Emerging processing **Service**: Supporting encounter	*Encounter Service*
High	<u>*Adaptive service*</u>: **Information**: Programmed processing **Service**: Mediates relationship (Pseudo relationship)	<u>*Collaborative service*</u>: **Information**: Emerging processing **Service**: Mediates relationship (Pseudo relationship)	*Relationship Service*
	Information Processing	*Information Generation*	

Figure 2: The diversity of task-based information services characterised by four analytical types.

Adaptive service: In situations where the task at hand is characterised by low degree of uncertainty but high degree of complexity, we cannot rely on centralisation of information processing and decision making, and the corresponding information services must therefore mediate a relationship or a pseudo-relationship in order to support the local adaptation of the programmed decisions. The information processing can still remain programmed as in the computational service. However, the complexity of the task necessitates that the service mediates a relationship between its users to allow the distributed experts to interact with the service and thereby address the complex situation

Networking service: If an information processing task is characterised by low degree of complexity and a high degree of uncertainty, then an information service in the form of an encounter is needed to support the user in generating new, relevant information thereby coping with the uncertainty at hand. Such information services support emergent decisions through provision of relevant information.

Collaborative service: In situations where people are facing both high levels of complexity and high levels of uncertainty, the information service must offer new information based on collaboration between distributed experts. The information processing is emergent and the provided service should mediate relationships. Here decisions emerge through collaboration and mutual adjustment.

6 Illustrations

In order to further highlight how the suggested framework characterise the diversity of information services we discuss examples of information services. Figure 3 summarises some of the examples discussed below.

Computational service: A traditional transaction system, for example supporting the processing of transaction requests and producing output reports is an example of an information service supporting tasks of low complexity and uncertainty. This type of information service also includes simple rigid workflow management systems implementing a non-malleable coordination mechanism, such as a simple timetable stipulating where and when students and teachers meet to engage in what subject (Carstensen and Sørensen, 1996; Schmidt and Simone, 1996). A third example of a computational service is a simple web-based e-commerce transaction, for example a customer buying a book on Amazon.com. Here, the task is simple, and assuming that the customer already has decided on a particular book, also certain. The encounter of searching for the title, ordering it and entering the credit card details is all conducted by an information service supporting an encounter through programmed information processing. Generally, we can characterise a user’s request for a web-page from a web-browser as a computational information service.

Adaptive service: Adaptive services are needed when it is not possible to fully program the process in advance. The complexity of the task makes it necessary to rely on services mediating relationships. In the case of the simple workflow system above, the service is not adaptive. However, in most collaborative situations unexpected combination of events makes it necessary for individual experts to make informed distributed decisions (Schmidt and Simone, 1996). This implies the need for adaptive information services such as in the case of the Kanban Just-In-Time production management system reported by Schmidt & Simone (1996). Here the individuals involved in manufacture of reprographic equipment, such as the forklift driver or the production line staff, would respond to complexity in the surroundings by overriding the programmed processing in intelligent ways thereby ensuring the overall performance of the information service. In this category of information service we also find adaptive information filtering services, such as the web-navigation support agents discussed by Sørensen et al. (2001). Here, the filtering set-up must be adapted to shifts in navigation interests, for example the Y2K agent system that would pre-index Y2K web-portals and allow the user to specify particular interests within the general topic of Y2K. A third example of an adaptive information service is an extensive and complex e-commerce transaction, for example the purchase of groceries on the Internet. Here, the core of the information service may very well be characterised as a computational service supporting a centralised programmed encounter. However, recurrent transactions will allow the user to view previous purchases on a list of favourites to be adapted in each situation a purchase is made. Also, because of the critical aspects of ensuring that someone will be around to receive the groceries, the exact delivery time must be negotiated. As an example, Tesco.com, which is one of the World's most advanced and extensive on-line grocery stores, will allow the specification of an alternative delivery address. To the extent that users entering their choices maintain all of these elements automatically, and the system generating lists of previously purchased items, this can be characterised as a pseudo-relationship. However, since there quite often are discrepancies between what is ordered and what is delivered, either because of human errors when picking goods, or because of lack of availability, there will be the need for further negotiation with the delivery van driver or with a person at a telephone call-centre in order to ensure that the customer only pays for the items delivered. Here, we see how relatively straightforward electronic commerce transactions rapidly become complex and therefore need to be supported by adaptive services. The Amazon.com example discussed above as a computational service is also from a more holistic perspective an adaptive service. If the user logs on the Amazon server generates particular suggestions to interesting books based on previous purchasing or website navigation behaviour. Also, in cases of users purchasing a number of books with different availabilities, the user need to negotiate if he or she wants to wait for the last book before delivery or to pay for each batch to be delivered separately.

Networking service: When faced with tasks where there is a low degree of complexity but high degree of uncertainty, we need support from a service that connects you to relevant information sources. The obvious examples of ICT artefacts that can be viewed as such networking services are email systems, mobile phones, and SMS messaging. These technologies offer immediate support by providing the user with immediate access to relevant information. There are also emerging types of networking service, namely Instant Messaging such as ICQ, AOL Messenger, and MSN Message Service, where groups of users can connect and carry out on-line text-based discussions (Whittaker et al., 1997; Nardi and Whittaker, 2000). One interesting aspect of the Instant Messaging services is that they offer the possibility for users to publish their interaction status and therefore support the negotiation of the interaction itself, or the outeraction as termed by Nardi & Whittaker (2000). Given that these services increasingly are available on wireless platforms, they open for a more general discussion of location based services as a particular networking service. These are services that not only establish connections between people, but also contain information about the geographical or any abstract topological location of the user or of the relationship between the user and places of interest.

Collaborative service: If a group of people are to design a new car the task is simply too complex to be supported only through mobile phones and email, and too uncertain to rely solely on flexible workflow systems. In such complex and uncertain situations, we turn to collaborative services that support emergent information processing and decision making through mediated relationships. Collaborative services such as applications using the Lotus Notes development platform offer a combination of shared workspaces, support for flexible coordination as well as mutual awareness of activities conducted and decisions previously made (Sørensen and Kakihara, 2002). This type of information service can support the group of car designers in negotiating the design, jointly creating the necessary information, as well as recording the decisions made through the process.

		Uncertainty		
		Low	**High**	
Complexity	**Low**	*Computational service*: Traditional transaction system for administration. Simple rigid workflow management system.	*Networking service*: Mobile phone, email, SMS, Instant Messagingr	*Encounter Service*
	High	*Adaptive service*: Adaptive agent based system for filtering web-page contents based on individual needs. Highly flexible workflow management system.	*Collaborative service*: Collaboration platform supporting shared workspace, awareness and flexible coordination	*Relationship Service*
		Information Processing	*Information Generation*	

Figure 3: Examples of the four types of task-based information services.

7 Implications

The framework presented is an analytical instrument facilitating theoretical and practical discussions of ICT artefacts. An analysis of specific ICT artefacts will reveal a complex mixture of potentially all four types of information services. The presented framework falls within the “tool view” in relation to Orlikowski and

Iacono’s (2001) categorisation. This illustrates the slightly inappropriate naming of their five categories and perhaps also an inherent weakness of applying grounded theory (as they did). In the following we illustrate the implications of the proposed framework by relating the four categories of information services to three cross-service issues: standardisation, unintended consequences, and types of technologies implied by the four information services. Other interesting relations that could have been explored include ease of learning, efficiency and other usability issues. Figure 4 summarises the issues discussed in this section.

7.1 Standardisation

Technology relies on standardisation of some kind. As argued by Latour (1991), technology is society made durable. It is therefore essential to characterise how the four types of services suggested in this paper offer standardisation, or put differently, what knowledge each service codifies (Sørensen and Snis, 2001). The computational service standardises the process and therefore allows for a centralised and standardised service. The adaptive service can due to the high degree of complexity only rely on standardising the information, thus providing malleability of the process. Networking services standardise connections, thus enabling emergent decision making through interaction. Collaborative services standardise the material that mediates the collaboration thus enabling emergent decision making through mutual adjustment.

7.2 Overload

If the assumptions behind the design and application of a certain information service do not match the experienced realities of the service in use, the users may experience unintended consequences of using the service. We will here only discuss one small aspect of the richness of unintended consequences possible when people and information services meet, namely the “functional dysfunction” of the services. Obviously, there can additionally be serious issues related to power, privacy, gender, organisational politics etc. Since we in this paper aim at characterising a task-based theory of the ICT artefact in use, we are involved in the act of carefully balancing the organisationally naïve techno-centred view and the technologically naïve organisation-centred view.

Issues such as *information overload* have been discussed extensively as one of the possible consequences of the application of ICTs (Hiltz and Turoff, 1985; Mackay, 1988). However, it is important to recognise that the issue of unintended consequences is influenced by human agents’ adaptive behaviour so that what in one situation may be characterised as unintended consequences, at some later stage may be perceived as a normal situation (Schultze and Vandenbosch, 1998). Information overload generally characterises the last stage in the innovation diffusion process that starts with the perception of potential benefit of adopting a specific information service, followed by the diffusion of the technology and potential domestication. Subsequently the use may be so widespread that the consequences may not be the ones intended initially. A good example of this concerns the consequences of adopting and domesticating email technology, and is elegantly expressed in the title of Palme's (1984) article "*You have 134 unread mails! Do you want to read them now*?". Ljungberg and Sørensen (2000) argue that information overload only is one way of characterising unintended consequences, and that this perspective focuses on the consumption of information as opposed to a focus on the desire to engage in connections. Consequently, they suggest the concept of *interaction overload* as a complement to information overload. The framework for analytically characterising task-based information services suggested in this paper can potentially support us in more closely understanding the types of unintended consequences of information services.

The design of a computational service can be a great support for centralised and standardised tasks. However, relying on a computational service when the tasks at hand requires an adaptive service simply because the problem turned out to be more complex than originally intended will result in *structure overload*. The user is being subjected to structural constraints restricting or directly obstructing the flow of work activities. This relates to the extent to which the co-ordination of distributed interdependent work activities can be stipulated through the information service. One side of this debate claims that the contingent nature of everyday co-ordination work activities imposes fundamental barriers for ICT support (Suchman, 1994). Another side argue that although strict automation clearly is not desirable, devising flexible and malleable co-ordination mechanisms can be a viable option (Winograd, 1994; Schmidt and Simone, 1996). Several problems have been identified when studying the implementation of workflow management systems. One of the central issues relate to an emerging deeper understanding of the roles of social classification and relationships between formal and pragmatic aspects (Bowker and Star, 1999). Increasingly workflow systems stipulate the flow of increasingly complex work activities, leading some people to feel stressed or to under-perform simply because the process assumptions made by the technology does not match the reality as played out by the users.

On the other hand, if we apply a networking service in situations where other accompanying services are in place, we may experience *interaction overload*. That denotes a mismatch between the demands on the individual to interact and the co-operative preferences of that person. At first, we are thrilled by the prospect of using advanced state-of-the-art connection services where "all" communication is desirable. We engage in a process of utilising the potentials of the technology. Later on, chances are that we use many different networking services, experience dramatic increases in the amount of communication, and the novelty of using all these technologies quickly languishes away. By then, we experience that we spend time on communication which is undesired, and feel that it had been more appropriate if we could have put these efforts into other, more important activities. We also experience that communication is carried through an inappropriate medium; we are subjected to telephone calls when emails had been much better, and so on. Experiencing these problems in the everyday accomplishment of work, we are forced to manage our interaction with others by, for example, prioritising, excluding, postponing and redirecting communication.

If we engage in an adaptive service and the service is not designed properly, or the problem at hand demands a more sophisticated human intervention (a proper relationship as opposed to the offered system-based pseudo relationship) then we may experience *information overload*. This implies that the system too frequent require the user to absorb too much information with the intention of making informed decisions. This, of course is the classical concept normally defined as the only aspect of overload (Hiltz and Turoff, 1985; Maes, 1994). The framework presented here provides us with the possibility to classify information overload as one out of four types of overload related to adaptive services.

Finally, in situations where collaborative services are employed to support distributed collaborative work amongst mutually interdependent actors, one of the unintended consequences of technology-use could be *transaction overload*. This could be the direct result of the problem at hand being too complex and too uncertain, the team being too large, or the collaborative service being inappropriate. In this case, the strain of attempting to have a collaborative service mediate the work could result in transaction overload where the actors will have to engage in excessive transactions, which more effectively and appropriately could be conducted in face-to-face situations.

		Uncertainty		
		Low	**High**	
Complexity	**Low**	*Computational service*: **Server** Technology Standardising **Process** Potentially **Structure** Overload.	*Networking service*: **Infrastructure** Technology Standardising **Connection** Potentially **Interaction** Overload	*Encounter Service*
	High	*Adaptive service*: **Client** Technology Standardising **Information** Potentially **Information** Overload.	*Collaborative service*: **Workspace** Technology Standardising **Material** Potentially **Transaction** Overload	*Relationship Service*
		Information Processing	*Information Generation*	

Figure 4: Summary of the type of technology, the type of standardisation and the type of unintended consequences of the four information services

7.3 Technology

The four types of task-based information services imply different types of ICTs. The computational service offers standardised and centralised processing and therefore implies some element of server technology. The adaptive service must necessarily offer the possibility of individualised interactions, and will therefore need to incorporate some element of client technology. The networking service standardises connections and therefore rely on the establishment of connection infrastructure technology enabling the propagation of connection standards. The collaborative service offers the standardisation of shared material and will therefore rely on workspace technology.

It is important to note that our use of the two forms of services, the encounter and the relationship, is appropriated within the context of studying the ICT artefact in use. This implies that we have characterised the diversity of *information* services and not services in general, i.e., services supported by some information processing artefact. Clearly, the engagement in a relationship service with ongoing interaction leading to mutual trust can partially be supported by a networking service such as the telephone. However, what the framework suggests is that a networking service in itself in particular supports encounters. If, for example, a networking service is relied upon as the primary support mechanism for establishing and maintaining a relationship service then this may, as we have argued above, lead to either the service provider or the service receiver experiencing interaction overload.

8 Conclusion

The presented framework is a response to Orlikowski & Iacono's (2001) challenge to theorise the ICT artefact. The contribution continues a Scandinavian tradition for emphasizing human and social dimensions of ICT's while at the same time challenging the implicit assumption of a systems perspective. The key idea is to move from conceptions of information systems towards information services to better capture the interactive and highly diversified nature of contemporary ICT artefacts. The presented task-based theory of information services relates four ideal types of artefacts, i.e. computational services, adaptive services, networking services and collaborative services, to different types of organizational tasks defined by their level of complexity and uncertainty. We have shown how this conception offers a structured understanding of key issues related to standardization, overload, and underlying technologies related to ICT artefacts.

The research is argumentative in nature and more research needs to be done in several areas. Firstly, we need to relate the framework more closely to the research on task-technology fit and information systems use. Secondly, further explorations should use the framework to characterise multiple complex information services and issues related to the use of ICT's in order to test its validity. Thirdly, we intend to apply the framework in a study of empirical data to test the operational aspects of the framework as a vehicle for characterising complex organisational use of information services. Finally, we must further explore the four overload dimensions and relate the characterisation in this context to the existing debate on overload.

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Integration of Personal Knowledge Creation Processes in an Information Resources Strategy Generation

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Abstract. The paper studies the process of integrating business objectives and effective use of information and communication technology (ICT). The conclusion is that final integration is a knowledge creation process, which aims at integrating individual's knowledge into a shared vision of the organization. This process can be supported, but not replaced with formal planning methods. This view is supported with a longitudinal case study, which has lasted over fifteen years. The researchers have been active participatory facilitators, and their role has been more grounded than in typical consultation assignments. The research methodology has been a combination of constructive and action research. The constructive part is implementing a framework to promote interactive planning processes. Action research is used both in the case study both as a method of designing an information resources strategy and in collecting evidence and experience from the case study example. Additionally there is a conceptual analysis to interpret the knowledge creation processes.

1 Introduction and Research Problems

Major changes and transitions are under way in the context of organizational life such as transition of industrial work, increasing globalization, turbulent competition and needs for organizational redesign demand efficient business processes. Information and communications technology (ICT) is needed to master and maybe foster these changes. Organizational learning is needed both to understand these external changes and to explicate internal core competencies.

Latest turbulence in the ICT sector does not change the fact that ICT will be one of the driving forces also in the future. New cycles of ICT growth will emerge and consequently planning of the use of this potential is still very relevant competitive factor. Information resources (IR) strategy has been and is of the most challenging areas to be improved. Different terms have been used for the strategy such as Information Systems strategy, Information Management strategy, Information Technology strategy and Information Resources strategy. Galliers (1991) has presented an overview of these concepts and their interrelationships. In this study we have chosen to use the term Information Resources strategy as it best describes the nature of the strategy creation process. The objective of the IR strategy planning is, first, to create a comprehensive perspective for managers and, secondly, to produce a holistic, written plan for utilizing information as a resource in the organization.

Gupta (1996, p. 546) defines information resources management as “ the process of managing all the components of an information system that collect, store, process, retrieve, and disseminate information. These resources include hardware, software, networks, systems, and personnel.”

For a long time surveys to IT/IS executives have indicated the need to improve IR strategic planning and lately to improve responsiveness of the created IT infrastructure (Dickson et al.1984, Brancheau & Wetherbe 1987, Niederman et al. 1991, Brancheau et al. 1996). Research has also shown us that resources of the planning process, mainly people, affect the final outcome of the process (Lederer & Sethi 1996). Earl (1993) noted that strategic information systems planning (SISP) need more organizational approaches, which are based on mutual understanding creation and organizational learning. IR strategy processes are also increasingly processes with multiple stakeholders and multiple views, which make the process complicated and difficult to manage (Ruohonen 1991). So, practically there is a high demand of IR strategy planning approaches, which address these requirements.

Reponen (1994) describes strategy creation as a mental process in the minds of managers following the idea of strategy crafting. Furthermore Kerola and Reponen (1996) emphasize the role of both managers’ and researchers’ joint knowledge creation processes in strategy creation. Sanchez and Heene (1997) proposed the idea of double-loop learning of both managers and researchers within an interactive process of strategic management. These findings also support our objectives in this study.

Knowledge management (Davenport & Prusak 1998), intellectual capital evaluation (Edvinsson & Malone 1997) and investigation of critical resources and competencies of the organization (Prahalad & Hamel 1994) have also changed the focus of IR strategy and information systems development to explicate both competitive pressures and internal learning and knowledge resources in parallel. Organizations are competing with balanced combination of these two competing views. Knowledge creation is therefore one of the key processes to be observed and managed in the context of prevailing business changes.

Knowledge creation is inevitable in the IR strategy process, while all the stakeholders need commit themselves to joint objectives, find out linkages of business and IR opportunities, then decide on IR investments along the business strategy and finally evaluate the outcomes. This demands a new breed of managers, which create a new way of thinking the role of information resources in the context of business.

The objective of this study is to get a deep understanding on how personal knowledge creation influences in the strategy processes and on how these personal processes may be integrated. The strategy generation itself was designed to meet the integration goals of business objectives and ICT potential. The research work has been realized in an empirical context, where researchers have involved into a development process over fifteen years. This is exceptionally deep and long research period.

Action research has been used as a research methodology, but its features have also been used in the planning process. We refer action research as Hult and Lennung (1978) has defined it:

> "Action research simultaneously assists in practical problem-solving and expands scientific knowledge, as well as enhances the competencies of the respective actors, being performed collaboratively in an immediate situation using data feedback in a cyclical process aiming at an increased understanding of a given social situation, primarily applicable for the understanding of change processes in social systems and undertaken within a mutually acceptable ethical framework."

This definition very much defines also the nature of our research work. The research questions are the following:

- How to create an interactive IR strategy-planning environment to promote integration of business objectives and ICT potential?
- How to implement an interactive process in practice?
- How to understand problems of commitment and implementation and their solutions in an IR strategy process?
- How to integrate personal knowledge into the strategy process?

The IR strategy creation has been tackled with developing a framework to guide the process, called Evolutionary Model of Information Resources Strategy (ref. EMIS-model, Reponen 1994). The other problems have been studied with a longitudinal case study, drawing conclusions from that example.

Reporting a long case history is difficult and we have chosen a way to tell shortly a story what has happened in practice and then we draw conclusions from the empirical material. Some of the changes may be shown with facts, like business success with the growth of market share and advances use of ICT with application portfolio. In addition there are "tacit" internal relationships and factors, which we also try to describe, but which – due to nature of knowledge - we are not able to proof.

2 Different Approaches in Information Resources Strategy Processes

Schools of strategic thinking have been noted to emphasize different views and perspectives of the process of strategy making. Strategic planning can be seen as a rational process for searching means to ends. On the other hand strategy can be described as a perspective making process (Mintzberg 1987, Boland & Tenkasi 1995).

According to Chaffee (1985) three different models exist for strategy planning and management. First is the well-known model from 1960's i.e. a rational strategy planning, which attempts to ask the question: "what should we do" and find out the contents of the strategy. However, the process approaches, such as Quinn's (1980) incrementalism, emphasize adaptive or political features of strategy creation and try to produce a fit between organization and its environment. The third is interpretative strategy creation model, where joint meanings and metaphors play a significant role. Chaffee (1985) says that: "Strategy in the interpretative model might be defined as orienting metaphors or frames of reference that allow the organization and its environment to be understood by organizational stakeholders." Interpretative strategy creation fits well with our objectives when facilitating a specific, but business strategy based, information resources (IR) strategy creation and implementation process.

In our view also IR strategy planning should be interpreted as the process of using compass or navigation process in open sea. That compass will show how data, information and knowledge is used and managed in the organization. Computers offer the platform for ICT-based business processes. IR strategy planning process is a mutual interaction process steered by organizational stakeholders. Stakeholders create social reality of strategic planning and in an IR strategy process different stakeholder views should be integrated. Managers construct joint meanings for IR strategy issues by interactive learning process to create a shared vision of linking business and ICT (Reponen 1987, Ruohonen 1991).

IR strategy is created in the minds of the people and the written document is only to support the outcomes of the process. Perspective making and taking (Boland & Tenkasi 1995) is important when implementing strategy into processes and systems. However, many of the organizations are struggling with strategy implementation and especially with transformation of organizational processes and structures. Perspective making is needed for organizational learning and perspective taking is needed to implement strategies.

The implementation of the IR strategy is even more demanding while understanding of the basic assumptions of the strategy is mandatory. Many implementation efforts have been so painful even after an excellent planning phase. In our view, effective IR strategy implementation is not possible without increased organizational learning. Strategy creation should be executed both as learning and a planning process. Joint meanings are important i.e. perspective making is needed in order to foster and cope with all problems during the implementation process. However, a communicative and well-grounded plan i.e. a written document, is also needed in order to deliver key points of the strategy to all who have not participated in the strategy creation process (perspective taking). If the strategy plan fails to do that it is very difficult to ensure guided long-term evolution of information resources strategy. Constant change and turnover of personnel (especially key managers) will slowly disregard the visions and perspectives created in the original strategy process. Only updating processes will avoid some of these problems.

Nonaka and Takeuchi (1995) consider knowing as a dynamic human process of justifying personal belief towards the "truth". In a strict sense, only individuals create knowledge. However, the main essence of Nonaka's theory of organizational knowledge creation is the integration of individual, team and organization orientations (Nonaka 1994, Nonaka and Takeuchi 1995). Their theoretical approach has raised a lot of scientific discussions (Brown & Duguid 1991, Cook & Brown 1999, Brown & Duguid 2001). Currently it is suggested to emphasize community of practice level studies and their knowledge processes. This study presents some consideration on how this personal and individual knowledge creation influences in a strategy process.

3 Introduction to the Case Company and its Business Strategy

The following text first describes the case company and then tells a story on how its strategies were developed and implemented. The concepts of NT-model have been used in the description.

3.1 S-group in a nutshell

The organization. *S-Group* is the second largest Finnish retailer chain with a market share of over 31 % in daily goods (2002). Its total annual sales are near 6,5 billion euros and it employs almost 20 000 people. The group manages different businesses, such as super- and hypermarkets (50% of the turnover), department stores, discount shops, agriculture markets, hotels, restaurants, car stores, service stations and some special shops and boutiques. The multidimensionality of the company has increased during last fifteen years making the strategic planning and decision making very complex.

The management structure. The cooperative structure of the S-Group is such that the country has been divided into 23 districts which all have their own independent area cooperatives. They have a national central body called The Finnish Center of Cooperatives (SOK). SOK was earlier the wholesaler for all the cooperatives, but now its operations have been re-engineered from the wholesaling function to the information and logistics center. S-Group is the joint name for all area cooperatives, companies owned by cooperatives and their central cooperative SOK.

Business model. All the businesses are now logistical supply chains from suppliers to the customers. SOK itself runs some of the chains such as department stores, agriculture markets, some restaurants and hotels. However, area cooperatives manage and operate most of the supermarkets, local shops, service stations, car stores and some restaurants and hotels. Although the ownership is somewhat diverse the objective of the whole group is to strengthen the chains and the traditional wholesaling function is diminishing. Business chain operation model means that many of the decisions on selections and assortments are made centrally and the purchasing power is collected together.

Decision making. The strategic challenge of the S-Group is to combine the effectiveness of centralized decision making to the expertise of local area cooperatives. The management structure of the company is such that the highest decision making body is the administrative council where the local cooperatives have their representatives. The council nominates the board of directors that makes the actual planning and implementation work. This model is replicated in each area level. The council controls and coordinates the work of the board and managing director. In addition to this all business chains have also their operative boards, which decide on assortments and logistics.

Customer relationships. The nature of the cooperative organizations is such that the households may join as a member of an area cooperative and become an owner-customer, which will produce member benefits. That will cost a certain amount of money and give all a share of the cooperative. All members can then participate in the decision making of the local cooperative by electing representatives to decisive bodies of the organization (board of representatives, supervisory board and the board of directors). However, all cooperatives have professional managers for running business operations. The total number of these owner-customers is currently over 1 million households. The number has increased for several years, and this is first due to the active development work in the S-Group and recently also due to growing importance of customer and loyalty programs in Finnish retailing industry.

3.2 Business Strategy Process from 1986 to 1998

Next follows a short description on the strategic development of S-Group comparing its decision to the general management trends. This chapter offers an overview of the business development of the case company during the years of this longitudinal action research. The objective of this section is to describe to the readers the business moves of S-Group in order to give background understanding for the decisions in the IR management.

In early 1980’s Porter (Porter 1980, 1985) published his books on Competitive Strategy and Competitive Advantage, which emphasized the need to analyze the competitive forces and to select a generic strategy. At the same time McFarlan

(1984) studied the use of information technology as a competitive weapon. Both of them emphasized an increasing competition, the need for closer links to customers and better service. In this thinking better service was almost equal to more service or more automated service.

The traditional operation model in retailing business had been centralized and therefore inefficient, due to the time-lapse between the finished manufacture of goods and their retail, during which time capital lies in store. The role of middlemen such as wholesalers was seen very threatened and difficult. The manufacturing industry had plans to start direct supplies to customers or retailers, the idea of electronic commerce was introduced and discussion started on decreasing too many steps in the logistical supply chain. There was even some kind of battle starting between manufacturing industry and wholesalers on who controls the material and information flows.

The main competitor of S-Group in Finland established area distribution centers to overcome too much centralization. S-Group had its traditional model of wholesaling which was not very competitive. Its main competitive edge was the group itself because it was very difficult for the area cooperatives to buy from other sources. But this model did not guarantee the price competitiveness.

In 1987 a new managing director was appointed, from inside the Group. In his earlier position he had been already responsible for business strategy development and one of his first operations was to finalize a new strategy for the group. The challenges described above were evident, and new operating forms were needed. The socialization process was in the strategy generation process internal within the top management of SOK. They visited several other countries to find ideas for new innovative solutions. They looked for new development paths both with external influences and internal consideration. The ideas matured with both interaction and personal thinking. In this stage the methods of socialization were internal discussions and meetings.

On the basis of these idea-generating processes the management became convinced that the traditional wholesaling should be replaced with nationwide chains. These strategic plans were generated mainly within the top management of SOK with only some participation from the area cooperatives. Therefore, the suggested model was very centralized, where the decisions on the assortments and supply channels were made in the chain management. The objective was to create very cost effective distribution model to compete with the existing structures.

Another idea was to link customers closely to the area cooperatives. Some pioneering examples of customer bonus systems already existed and in some cases they had contributed in increasing market share. S-Group was, however, very early adopter of this thinking. In a cooperative this is a very natural way of operating, as the members of the cooperatives are also owners of the organization. The objective was set to strengthen the customer links.

The socialization process resulted in strategic plans, which were new and advanced. The role of wholesaling would consequently change dramatically, there would be fewer steps in the delivery chain, operations would be faster and customer contacts would be closer than earlier. The basic ideas of the strategy were based on earlier experience of the management, outside influence, and interaction.

This strategy was decided early 1988 and implemented in the following ten years. The managing director clearly had a vision on how wholesaling should be developed to meet the requirements of the future. Implementation requires naturally making of the plans explicit and acceptable. The two cornerstones of the strategy have proven to be very essential for the whole business: integrated logistic wholesale-retail chains and customer bonus system.

In the early implementation stage of the strategy the overall impression strengthened that the traditional wholesale-retail business model was old-fashioned, and some new concepts are needed. This increased understanding supported CEO’s efforts in making the market-oriented chains acceptable. The objectives were to reduce one level of the delivery chain, to reduce costs and fasten the operations with a holistic management system. The idea was also that the purchasing power of all units might be collected in order to utilize the economies of scale.

The concepts “chain operations” and “customer ownership” are such that their names already indicate the way to develop the operations. The managing director used them in the internal meetings of the Group and SOK. In this way he introduced new operating models to all the personnel, and started the discussion on the consequences of the new models on the decision- making and also power structures.

The role of the central body SOK would in that model be to act as an information and logistics management center collecting orders and sending them to industry. The material flows could then be organized as directly as possible from producers to markets. Thus SOK would be the key information broker, not a material handler, and it could partly avoid the threats on the traditional wholesaling.

The main problem with this model was the discussion on the decision power in different parts of the organization. The main idea of the new operating system was a relatively centralized decision concept, which was difficult or impossible to accept in many of the area cooperatives. Thus some discussion has been going on all the time on the right balance between local and central decision-making. In the implementation of the model the level of centralization has even somewhat changed. But altogether this chain concept was a very advanced way of thinking in the business areas concerned.

Another concept was to change the owners of the cooperative from a passive ownership to the active patronage. Introducing the concept of customer bonus in a very early stage compared to competitors did this. The owners have received bonus from the very beginning of their purchases from cooperative businesses. Earlier this bonus could be received in the end of each year by sending all the receipts of the annual purchases to his/her own cooperative. The extension now was to have the bonus automatically from all purchases from any cooperative of the group, as well from supermarkets as hotels and restaurants, and then transferred it to your own owner account managed by the local co-operative i.e. a cooperative version of a merchant bank.

These two were the main competitive moves decided in the business strategy process in 1987. In the late 1980’s a general discussion begun on the business process redesign and radical cost savings. The group strategy was supported in 1991 with a merger of the main wholesale unit with another wholesale company. With this operation the volume of the new company increased average delivery costs decreased considerably. This merger was very similar to the principles of business process redesign, which concept was introduced in late 1980’s.

In the1990’s the strategy implementation process has continued on these similar lines. The concepts of market oriented chains and customer bonus has been developed in the spirit of the earlier strategy, but all the time considering the balance between the economies of scale and local expertise. The business strategy calls for proper information systems to meet all the business requirements. Thus in 1988 an information resources strategy creation process was carried out.

Recently S-Group has gained more market share than competitors and it has been very profitable after many recession years. It is still a cooperative with a customer ownership but its business operations are very modern and far from what might expect of a traditional, inefficient cooperative company. This change has been received with a broad-minded strategy and operations. As will be described below the Group has turned the ownership as one of its strengths.

4 The Information Resources Strategy Plan and its Interpretation

4.1 Applying EMIS Model in S-Group

In the following the longitudinal IR strategy creation and implementation process will be described. S-group decided to use EMIS model in the planning process and therefore two facilitators from academic life were invited to participate in the strategy project. The same researchers have so far involved in the strategy activities in almost fifteen years. The sections below, description and conclusions are thus based on long on-hands experience of linking business needs and ICT together. The researchers have influenced on the decisions of the company with their own views and comments. This has been an action research experiment in a very pure form as researchers’ involvement has been active and essential.

During the last decade there has been four different stages in the strategy process of S-Group, but all of them are based on the work done during the first stage in 1987-88. These stages and their essential features are reported below in a chronological order. The business development described above forms the basis for ICT plans and decisions. One of the main targets of the IR project was to ensure the coordination between business and ICT. Interpretations through theoretical lenses of Nonaka and Takeuchi (1995) will be provided.

4.2 Creating New IR Strategy

S-group started the process of transformation in 1985 because of poor profitability and increasing competition. From the beginning of the transformation process the new CEO of the company emphasized in public business journals the role of ICT as a challenge and he was highly committed to the use of ICT. According to his view the business chains - the logical units of S-group businesses - should be more independent. He also noticed the demands for new leadership and management qualities in IS area.

As expressed in the business strategy a task force was nominated in 1987 to create the information resources strategy for the whole group. The assignment to the task force was " … to improve the competitiveness of S-Group by directing ICT development projects to support business strategy". The goals of the strategy were the following: "The final result of the project should be a development program on ICT utilization for the years 1989 – 1992, total ICT architecture and a cultural change to increase the commitment of all parties into the new strategy".

The focus of the strategy should be on the strategic business chains and on their support functions, but also the common features of other information systems should be chartered. There was also a clear drive to distribute information systems and to obtain independent systems for each business chains.

The parent-organization was interested to create synergistic IS activities in the area of customer and marketing database and logistical activities. This objective indicates the need for joint network architecture for the whole group. Business chains and their stores were investing in European Article Numbering (EAN) - based Point-of-Sales (POS) terminals and back-office information systems, in order to integrate with the basic ICT architecture of the company. The retailing business in general was in a turnaround situation (McFarlan 1984).

With these objectives in mind the strategy creation process was carried out in 1987 with the participative learning process in accordance with the principles of EMIS-model. The process consisted of lectures, interviews, brainstorming, teamwork, meetings, reports, questionnaires, and consulting. The following topics were covered: The business strategy implications to the ICT, business information needs, new software needed, the status of the existing software, ICT architecture, organizing IS function and an investment analysis. In the planning organization there was a high representation from different parts of the Group. Additionally most of them were business representatives, not from data processing unit.

The process ended to propose a strategy, which included the following issues:

Competitive objectives. The main objective of the information resources strategy was to support the change from wholesale structure to market oriented chains. The existing software had been built for wholesale operations and logistics. The new intended operating model was very much different and required new software generation, which supports these market-oriented chains. The challenge was to create the technological base for implementing new business structures.

ICT architecture. The strategic objective, a new simplified operating model was created and new marketing and customer-oriented chains were designed. The business model was operationalized with a totally new logistical architecture, which included manufacturer alliances and new logistical arrangements. In order to develop customer relationship management a customer card and bonus information system was designed for the whole Group nation-wide. This was a pioneering system in Finland and very advanced thinking globally.

Applications portfolio. A proposition was made to direct the new software development towards strategic chains, owner-customer marketing and logistical systems. The ICT architecture was proposed to be decentralized in a communications network with a multivendor policy. This suggestion, to gradually move from mainframe architecture to a more decentralized model, was a result of high business management involvement into the planning process. Most of the data processing professionals were skeptical of this move.

The strategy proposal was presented to the Board of S-Group in December 1988. The proposal was accepted with some minor changes. The objective of CEO of S-group was to create a modern and competitive nation-wide business model. But its realization required support from the area cooperatives. Some of them thought, however, that the IR strategy had been designed mainly for the central organization, not enough starting from their own interests.

The progress of the strategy was to be followed by the following measures:

- The productivity of data processing function should be on the level of the competitors,
- EDI should cover 90 % of product range,
- customer bonus registration should work in all units,
- teleshopping should be in test use and electronic mail should cover all users of the organization.

These measures cover some of the main targets of the strategy either directly or indirectly. These are concrete measures and therefore very usable. During the planning process it became evident that it is difficult to find or create operational and concrete measures for strategy development. The measures decided indicate, however, the progress of the strategy in such a way that it could be followed.

4.3 Implementing the Strategy

After the strategy was decided in December 1988 its implementation started immediately. Coordination of the strategy was located in the corporate management where information systems manager was responsible of carrying out the plans. A small information systems department of a few people was founded. Its main role was to implement the strategy mainly by buying services from multiple suppliers. Much of the systems planning were, however, made within the Group’s organization.

The new applications were built in the following order:

- Cashier register systems for the stores (1989-1991)
- Department store systems (1989-1995)
- Customer bonus systems (1990-1991)

Rethinking IS organization. The history of IS services reveals some interesting views. The IT Service Unit, which was a separate profit-center working mostly for the parent-organization, had been unable to serve efficiently i.e. offer IS support for day-to-day business operations. The Unit had mainly processed financial data and produced reports and statistics. Now its role had to be redesigned, since business chains required a markedly different IS service than before. The operating costs of the IT Service Unit had also been on an unacceptable level from the viewpoint of more independent business chains.

Therefore IT department was outsourced 1985 into a separate IT company, but with a full ownership of SOK. This resulted in somewhat estranged position from business management groups. In the IR strategy the critical problem setting was how this outsourced unit will be able to fulfill the IS needs of business chains and 'headquarters'. The objective was to distribute and tailor IS services according to the needs and interests of chains. One of the most important questions asked at the beginning of the strategy planning process was: "What will the future IS organization and IT architecture be?”

The objectives of the outsourced company were to increase cost effectiveness and productivity, lower total data processing costs and direct professionals’ work to the most important targets. One of the objectives was also to sell service outside the Group to collect experience and generate income.

These objectives were very similar which have been later on presented in the outsourcing literature (Lacity and Hirschheim 1993). Starting a new company is somewhat exceptional form of outsourcing, but in Finland there were several very similar cases in the mid-1980’s. This indicates some kind of bandwagon effect on following other companies’ examples.

The Data Processing Company was growing to almost 200 people with orders from both the Group and outsiders. Its strategy was to concentrate on the mainframe applications and network management. At that time SOK had only one manager coordinating its information systems services, but services were bought outside. In the new strategy a decision was made on decentralizing the architecture. This was somewhat conflicting goal with the strategy of the data processing company (Reponen, 1997).

Resulting from the new business strategy he S-Group had further to reflect the new role of IS services. Information systems played an important role for business and that demanded new qualities from the IS/IT staff. Some external changes also increased the speed of transformation (i.e. merger in in-bound logistics, joint-manufacturing agreements, decrease in “internal invoicing”).

4.4 Updatings of the IR Strategy

The first update in 1990. As there were some delays in building and implementing the new software, area cooperatives presented their doubts on the whole strategy. Therefore, a decision to update the strategy was made in 1990 to make sure that it meets the changing requirements. However, implementation according the IR strategy 1988 continued. The same “control act” happened again in 1992 when a special report was ordered from outside consultant on the status of the IR strategy implementation and on the service level of the information systems. After carefully going through the situation the consultant came to the conclusion that the strategy plan was very appropriate and up-to-date. His view was that implementing the strategy would be extremely important for the future success of the Group. This gave support to the IS professionals to continue their work, but there still remained some conflicts between central and local decision- making.

The reasons for the revision were uncertainty among management on the relevance of the plans made a few years earlier and on the relationships between area cooperatives and SOK. Economic recession had also started and some screening of the investment program had to be made. The objective to decrease total costs by re-engineering operative processes was more emphasized. EMIS approach was used in trying to find out business management’s opinions and attitudes towards IS function. This was done so that university facilitators interviewed some twenty (20) management level persons in the organization.

In the new strategic plan very much emphasis was put on the ICT architecture of the new software generation. The plan was a technical advancement of the earlier strategy. The business objectives remained almost the same as earlier, but the role of operational chains was crystallized. The needs of area cooperatives were taken more into consideration, which caused changes in the software design.

One of the main decisions in that period was additional outsourcing of ICT operations. SOK had already earlier before this strategy process made some very pioneering decisions in the area of data processing. They had a relatively large data processing department with around 120 employees. Its main task was to run the mainframe applications and the communications network. In 1991 because of the merger with another wholesaler the load of mainframe applications decreased by 40 %. This further emphasized the need for considering the role of data processing company in the environment of new operating model. It wanted to concentrate on the mainframe applications also in this situation, with very little interest on the decentralized solutions. Therefore, a second outsourcing decision was made later that year. The data processing company was sold to a large IS services house with the intention to gradually withdraw from mainframe solutions.

The second update in 1993. The second revision of the strategy was made in 1993. Again the new strategy built on the earlier plans and their realization. The main reason for updating was the concerns on the implementation of the new software. In the planning process the integration between business and ICT worked very well, but during the implementation phase the interaction was not high enough.

The business managers did not take the ICT questions deeply enough into their agenda of important decisions. The support of top management was, however, evident all the time and made the implementation easier.

Both business and IS management felt that the progress was not fast enough, and something should be done. The reasons for this situation were not clear and therefore a new project was needed. The area co-operatives felt also that the systems development had been done in a too centralized way.

The facilitators interviewed top management to find out their views on the ways strategy implementation could be improved. They also interviewed managers of area cooperatives to charter their opinions on the role of information systems from their perspective.

On the basis of these interviews and the discussion in the project group more emphasis was put on the development of applications needed in the local supermarkets and department stores. The quality and costs of the project work was emphasized. Also an integrated approach to the earlier decentralized information systems was introduced. The following applications were developed:

- management information systems
- chain management systems (1993)
- home shopping test system (1993)
- logistical systems (1994)
- management accounting systems (1995-1997)
- office systems (1997)

At the moment the software fits the needs for new operating model, and offers a basis for the development of group’s structure. ICT has been the key driver in making the organizational development.

During the implementation process there has been a lot of discussion on how S-Group’s information systems serve users and how competitive they are compared to other systems. Business managers have not been totally convinced on the quality of the information systems work. With an interactive planning process it was however possible to create a good starting environment for the new IS/IT investments. The problems arouse when all the systems did not work according to the schedules all did not meet all the wishes presented.

One reason for this may be that the information systems function has a twofold task. Its role was to serve the other partners in their data processing needs, but at the same time also to coordinate the building of common ICT architecture. This situation easily results in conflicts of some degree. Some managers of the area cooperatives think that the systems development has been too centralized while the others see the need for economies of scale and lower operating costs.

4.5 Tension Between Individual and Organizational Knowledge

The method of creating IR strategy was very participative, but still very SOK-centered. The strategy was aimed at supporting the operations of the business chains, and the role of area cooperatives management remained too limited. Because of the very special governance structures there is all the time some tension between area cooperatives and their central organization (SOK). As described earlier, area cooperatives own SOK and have their representatives in the highest decision-making bodies.

ICT development causes changes in the power structures of the organization. If it comes from back-office routines directly to customer operations, then managers of different business chains will thus gain more power (and also responsibility) to develop their own information systems, despite the need to fall in line with general architectural principles. Division of IS decision power creates also learning challenges. The relationships between business managers of two chains were good, due to synergy. The third business chain was very independent in its business activities except for purchasing operations and the fourth chain controlled even its own purchasing operations. However, each business chain is competing somewhat with the other; this is due to the different business idea of each chain.

IR strategy has been revised twice during the last decade. The revisions are based on the original plan created in 1987. It has been updated to meet new challenges appeared. The role of researchers has in these stages been less intensive than in the strategy generation. However, some parts of the EMIS model have been used also in the revisions. The researchers have used mainly thematic interviews and lecturing in their work. The researchers have concentrated on promoting the socialization process in updating the strategy.

The main empirical objectives of the researchers have been to continuously follow the business relevance of the IR strategy, to find out the main obstacles slowing down the implementation and to develop new innovative ways of utilizing technology. The researchers had a supportive role to both the CEO and the IS manager.

The main finding was that the interactive and participative nature of the process has suffered in later stages of the development. According to the interviews the main reasons have been too centralized decision-making and forcing the implementation of some solutions. This has been important to guarantee a progress in the structural development, but has caused unsatisfaction and doubts among area cooperatives. The importance and role of power structures and their changes could be clearly seen in this example.

The influence of researchers has been the following. The strategy implementation became more decentralized than in the early stages of the process. Consequently S-Group was an early adopter of combining national efficiency with local expertise. Other consequences of this part of analysis were reorganizing the IT function and outsourcing further IT services. A manager for logistical and IT services was nominated and the responsibility of IT on the board level was reorganized.

5 Interpretations

In the following there is a short interpretation of the IR strategy processes with the Nonaka and Takeuchi model. The NT model has the stages of socialization, externalization, combination and internalization, which are both successive and parallel. In almost all knowledge creation processes you may recognize the main stages of NT model, but at the same time there are within each stage and between stages several feedback processes. Knowledge creation is thus a multistage and multiple process to increase shared knowledge.

In the following there is an interpretation of the whole IR strategy creation and implementation process over a decade. The purpose is to offer a holistic view on the strategy development. EMIS model has a similar background philosophy than the NT model. Therefore, it is possible to interpret the stages of the strategy process with NT concepts. In the following we try to identify, if there exist, or don't, basic SECI- subprocesses, their most essential relationships and contextual features.

Socialization. Socialization process was used most clearly and strongly in the early stages of the strategy development, in clarifying the business requirements for the use of IT. In the commencement and surveying stages a wide participation was aimed at. Numerous stakeholders had an opportunity to influence the planning process. Socialization was also two-directional so that information was both collected and offered in the planning sessions. The tools of socialization were interviews, teamwork, lectures, discussions and meetings. The objective was to obtain relevant and business-related guidelines for IT implementation. At the same time it was aimed at moving some of the responsibility if IT projects to users and business decision- makers.

Socialization of strategy issues was supported with a series of seminars during the whole process. Those seminars tried to gather key business and IT people from all over the organization and provide key concepts and “language” for their development efforts. Seminars were organized both in headquarters and other more locally based regions. Originating Ba was unintentionally functioning in-group meetings which were that key activities besides expert lectures. However, knowledge sharing was not very systematic and it did not ensure diffusion of joint views through the organization. It was an experience of few people and their responsibility was to share it in their own business units. However, this was not guaranteed.

Externalization. Based on the surveying stage the project group planned directions for the use of IT. These directions were still on a very general level and therefore it was easy for everybody to accept these objectives. The real test was later, when the plans were implemented and the changes were made to the earlier operations. CEO clearly used IT as one of the tools to make relatively radical structural changes of the Group. Some of them were implemented with technology pull, but with clear background reasoning on what to do.

The goals of the strategy are actually far more demanding than just creating a plan. Deriving an applications development portfolio is the concrete externalization of the strategy vision. This was achieved through expert discussions and with a large comment-and-revision round after strategy workshops. The process was more or less committee-type of working during which the wordings and structures of strategy document was evaluated. However, no assessment of understanding of strategy meanings was executed.

Definition of application portfolio was more ICT centered, and the IT manager was one of the key persons. The project group followed and supervised the development; own and outside IT experts made the actual planning work. The final result of this definition stage was an IR plan with an implementation schedule. Using NT terminology this was making the tacit knowledge explicit.

Combination. The next step was to develop concrete action plans to start realizing the intended objectives of IT business use. This was a stage of combination to make the changes happen. Architecture planning requires for a stable view of the grounding of IS operations i.e. long-term development of information systems. The IT department started to prepare IS infrastructure in order to add and develop strategy-based applications. This was rather complicated due to distributed regional decision-making structure. The Group could not command all their area cooperatives to invest in new integrated information systems while all of them had independent area activities. Selling the idea of new architecture and software generation to all stakeholders was the challenge. This was done with a combination of the influencing power of CEO and with discussions and seminars.

The situation was problematic because of the different maturity of existing information systems through the S-Group. Some business chains naturally preferred to use their own systems and the others had their own IS culture. It means that some of the chains had to unlearn and relearn some IS features and some had to learn both new business and IS activities (see more Ruohonen 1991).

The period after accepting the first IR strategy was clearly dominated by ICT experts who built new business chain oriented ICT architecture in 5-6 years. This included a number of difficult phases. Some application development projects failed and some totally new start-ups had to be made and some technological platforms had to be changed due to the evolution of ICT. However, the key ideas of the strategy plan remained and made it easier to stay in the development path in a coordinated way. The highest risk in long-term development is to forget or neglect previous strategic thoughts just for the case of new technological innovations. Diffusion of any technological innovation takes years and therefore it is important to ground the development ideas carefully before starting.

Internalization. The third objective, a cultural change, is the most far-reaching while it includes the learning of social system of the S- group. This was not really clear to S-group people while human resources development was centralized and concentrated on training programs for daily business needs. However, some IT-oriented issues were included to the programs. Some of these challenges were noted during the strategy process workshops. Key managers were invited to discuss and clarify their views in executive meetings. Executive interviews also revealed some of these internal, cultural contradictions. However, more work should have been done to prepare the organization to cultural change, which was waiting after ten years development time. We must remember that the final outcome of the strategy was the cultural change and not necessarily the first draft of the strategy plan.

In addition to this there was a learning challenge for area cooperatives, too. They had to rethink their own IS activities and interfaces with the joint ICT architecture. This part of the development was partly neglected due to the independent nature of these organizations. Some of the area cooperatives started fast, some were skeptical and careful in their development and some resisted the Group activities. This was naturally reflected in IS education and recruitment activities in the field. The Group could only offer IS education and consultation services but those were not so heavily used due to skepticism towards new IS ideas.

6 Conclusions, Results and Evaluation

The case described above is an example of a project, which as such was a successful ICT planning and implementation process resulting in increasing competitiveness. The objective of shared vision and common knowledge base on individual members of the organization was not, however, achieved in a full range.

In the case company ICT has been used intentionally to open new roads and to redesign processes. Internalization of new objectives and procedures has been one of the main objectives. Interactive strategy generation process has been one of the mediators to create shared values in ICT utilization, but something was missing in that link.

We can show many positive business results with facts, like increasing market share in slowly growing markets, improved profitability, and increasing number of members of the cooperative. We can also see the radical development in the ICT sector like very advances customer bonus system, new point-of-the sales systems in the markets, redesigned logistics, and early trials with e-commerce. S-Group has developed highly integrated information system with flexible reporting features. It has also been an early adopter of outsourcing IT services. Operations have been so convincing that some competitors have imitated them. The use of different bonus systems has increased and chain models became stronger than earlier. S-Group has with its pioneering example strengthened these trends.

We have also observed some mental change in thinking the role of ICT in business operations. We have interviewed managers and personnel in different parts if the group to find out their attitudes in using ICT in competition. We have clearly noticed that their conceptual thinking has changed and understanding has increased in integrating business objectives and ICT potential.

Despite this success it is difficult to show and prove a change in their internal “tacit” thinking. We are convinced that the interactive strategy generation and implementation process described above has clearly contributed to the learning effect on ICT’s potential. Even after all these processes there are still signs of different views, language, terminology and lack of confidence on IT professionals.

This may be due to several factors, like the changes in the people's minds happen unexpected slowly, they do not necessarily notice them by themselves or there are no changes.

In implementing the new software there has been conflicts and disagreements, mainly concerning the decision power and the degree of decentralization. The socialization process of implementation was not as impressive as in the planning stage. An interesting question is that how the interaction in the implementation stage should be organized?

The role of IS function has been reorganized twice during the whole process. First, a new company was founded from the IS department and later on it was further outsourced. The reason for this was that its services did not fit to the need of the parent company. Instead, a small group of IS professionals were hired to coordinate the development. Software development was bought from outside suppliers.

This new IS group was used as a "wall breaker" to introduce new operating models. In designing and implementing new software you have to make concrete choices and decisions on how to make the new models to work. In this stage all the decisions become also visible, perhaps the first time. Therefore, the possibility on conflicts between IT and business representatives is evident. The situation has been balanced by later on decreasing the power of IS group by reorganizing also its position. S-Group is an example of a combination of interaction and power. In many situations interaction was used to get a wide acceptance of the plans, but power has also been used to implement the plans.

Behind the success of the strategies there is a shared enough vision on the objectives and measures to obtain them. In the beginning of the process the use of EMIS model increased believe into the possibilities of IT in supporting business. At the same time the shared objectives of utilizing IT were accepted.

Using action research approach the researchers have had an opportunity to influence on the decision-making and to experience themselves the changes, conflicts, and learning. With this paper we are able to share these experiences with other researchers.

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“Otherwise Good:” 3 Ways to Use Information Technology for Competitive Disadvantage

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Abstract. Since the mid-1980s, there has been considerable focus on enterprises using information technology for competitive advantage. But, there have been a number of instances where quite the opposite has occurred. Such applications of information technology have produced negative unintended consequences that have ended up benefiting one’s competitors. Here, we identify and provide examples of three ways to use information technology for competitive disadvantage. The ways to achieve negative unintended consequences include: (1) doing something essentially good, but doing it quite poorly; (2) doing something really silly with information technology, but doing it well; and (3) failing to recognize the role of technology in one’s competitive environment and doing nothing at all.

1 Introduction

Both authors of this chapter are Emeritae Professors. Inger Eriksson is Professor Emerita from Turku University whereas Gary Dickson is Professor Emeritus from two universities, The University of Minnesota and North Carolina State University. We start with these facts simply to demonstrate that both authors have been involved with information technology (IT) for many years and, over these years, have studied the organizational application of IT. These years of involvement and observation have allowed us certain insights regarding the use of IT by organizations, including the development and installation of larger, more complex systems that are intended to provide competitive advantage for the enterprise for which they are created. The insights we wish to share with the reader in this chapter are, perhaps, different from what one might expect as they are directed toward achieving results from applications of IT that are precisely opposite what the funders and developers had in mind when they set out. In other words, what we will focus on is achieving competitive DISADVANTAGE through the use of IT.

So, in a sense, we are going to be dealing with the "dark side" of the application of IT. What we intend to do is to go beyond the context of IT systems failure when desired benefits are not achieved, or the systems do not work quite as well as intended. We will focus on dramatic and significant failures as our domain of interest. Additionally, we will include a type of systems failure not often encountered in the literature. Such failure is associated with doing things well with IT, except for the small problem that what one is doing is really stupid. In the discussion that follows, we will illustrate our points with specific examples. One of our examples is a hypothetical example because we have been unable to locate tangible evidence for it (but, it is still safe to imagine it really happened). For our other examples there is documentation of what happened. Before going into more detail, it is useful to make some major points early in order that the reader can keep them in mind as they encounter the specific situations.

Our first point, and one that practicing managers in our experience do not want to hear and often deny, is that the underlying cause of disastrous IT applications is managerial not technical. Our second point is that there is nothing new about this managerial failure, it has been happening for virtually the entire 50 years IT has been being applied in organizations. The third point we make is that managers have been and are, by and large, unaware of what they must know and do in relation to the application of IT in their enterprises. In short, an overwhelming number of managers consider IT as a "magic bullet" that, if used, is always good and always hits its target (see Markus and Benjamin, 1997). Before going on to look at ways to achieve competitive disadvantage using IT (the beneficiary is your competitor rather than your enterprise) we will begin by providing a brief background on the general topic of competition and how IT is related.

2 Achieving competitive advantage and the role of IT

Much of the credit for the understanding of competition in an industry goes to Michael Porter (Porter, 1980, Porter, 1985). One of Porter's key notions is that the intensity of competition in an industry is related to the power of suppliers and customers, the threat of new entrants to an industry, as well as the threat of substitutes. It was not long after Porter's ideas surfaced that his colleagues at Harvard in the IT area began to consider ways IT could be applied to the Porter model (see, McFarlan and McKenny, 1983). In particular the Harvard authors suggested using IT in a competitive situation to: (1) provide barriers of entry to new competitors in the industry; (2) reduce the bargaining power of a firm's buyers and suppliers; (3) reduce the threats of product or service substitutes; and/or (4) build in costs of switching to a competitor (Applegate, McFarlan, and McKenney, 1996). These authors illustrate how IT can be employed for competitive advantage within an industry, and indeed, can even change the basis of competition in the industry.

There are many examples of exploiting IT using those factors in an industry that form the basis of completion. A notable one we will use several times in this chapter is how American Airlines and United Airlines developed and used reservation systems (the Sabre and Apollo systems respectively) to gain advantage over other airlines. These efforts were so successful that other airlines operating out of American and United hub cities (such as Dallas, Texas and Denver, Colorado) were virtually driven from the market. How IT can even change the basis of competition in an industry is illustrated by Amazon.com who introduced the concept of buying books and CDs without the inconvenience of visiting a physical store as well as the package delivery industry in which all the players can deliver a package, but it is those who can provide information about the delivery that have become most successful.

The early applications of IT for competitive advantage tended to have an efficiency orientation. This focus is to provide attributes such as lower cost, better service, and the like. More recently, IT applications directed toward competitive advantage have tended more to have an effectiveness focus. In such cases, IT capabilities are provided that allow an enterprise to gain advantage over the competition by operating according to an entirely different paradigm. The "dot.coms" such as Amazon, E-bay, and online brokerage firms represent uses of IT to do things entirely differently through the use of IT. Perhaps a less well known example is how Cisco, the networking equipment manufacturer, was able to exploit the Internet and World Wide Web to connect to their suppliers and buyers. Such use of IT allowed Cisco to change the entire process by which their business is conducted.

There have been many examples of how enterprises have benefited through the application of IT for competitive advantage. Several well known examples include:

1. The aforementioned airlines, American and United, using reservation systems to obtain and retain customers. Not only did these systems provide increased efficiency through seat reservations, ticketing, and the like. They also enhanced effectiveness through their ability to identify and attract the industry's most desirable customers. Attracting and retaining this set of customers became possible through frequent flyer programs offering incentives in terms of free tickets from flying the airline (which also built in costs to switch to another airline). In addition, data maintained in the reservation system database allowed the airlines to schedule their flights in better ways and according to when best customers wanted to fly. Another benefit derived from the data contained in the system was the ability of the airline to price tickets according to future load factors in order to utilize available capacity most profitably (lower capacity flights could have cheaper tickets than those where seats were in short supply). More detail will be provided as to how this was done in a later section of this chapter.

2. American Hospital Supply, a company that substantially increased their market share by connecting hospital purchasing agents online. The system provided two user seductive benefits. First, the ease of ordering by the purchasing agents was much more efficient than using the telephone or mail. Second, hospitals were able to save money using the system by reducing the amount of supplies inventory they had to

keep on hand. Being able to quickly enter and receive orders from American Hospital Supply rather than holding safety stock inventory at the hospital level (the system was more effective as well as being more efficient) brought this about.

3. Otis Elevator, a company manufacturing elevators and providing service for their elevators and those of competitors, using IT to centrally dispatch service rather than decentralize the service dispatching to many geographically dispersed dispatch centers. The centralization was much more efficient in terms of service time and use of service resources. Thus Otis, as well as their customers, benefit from the system. The Otis share of the elevator service market increased and their profits improved accordingly. But, the company went one step more and started analyzing repair data for their elevators as well as those of others and was able to further enhance their service to customers by anticipating service difficulties prior to their occurring. This was a capability not offered by the competition for some time (an example of the effectiveness of Otis vis-à-vis their competition).

The reader can likely think of other examples of IT being used by an enterprise to either do something better than the competition or to offer some capability not available from others in the industry. But, this is the bright side of using IT for competitive advantage. Is there a dark side? Indeed, can unanticipated consequences lead to using IT for competitive disadvantage? The naïve person would answer, “surely not.” These persons would contend that enterprises certainly would not intentionally set out to spend lots of effort and money to not only provide no benefit to themselves but, indeed, to benefit their competition. They might even add, “managers are not so stupid nor are they inept.” When it comes to dealing with technology and, in particular information technology, our experience causes us to, “Do not be so sure.”

3 Using IT for competitive disadvantage: The 3 ways

Essentially we can identify three conditions under which the employment of IT can have results that can be classed as “unintended consequences (see Benjamin and Eriksson, 2001).” In this instance, the outcome involves providing competitive advantage to one’s competitors. Our three ways of achieving the above outcomes employing IT is explained as follows:

1. **Doing Good Things Badly**. In this instance, the enterprise sets out to do something with IT that is a good idea and should provide competitive advantage. Unfortunately the enterprise, for a truly astounding number of reasons, ends up doing things so badly in developing and/or implementing the IT application that it ends up hurting rather than helping themselves. This is, by far, the most frequent way to achieve competitive disadvantage using IT.

2. **Doing a Bad (or Stupid) Thing and Doing it Well**. Under this condition, an enterprise does something with IT that is, simply, a dumb idea. Unfortunately, they do it well and end up with a result that should have been anticipated and avoided had level headed managers evaluated the application and what would be its result. This outcome, generally we think, tends to occur when one (or just a few) managers get overzealous regarding IT and its application. In some cases, they may be acting due to the hype of a new technology or, in other cases, may be trying to push good applications too far.

3. **Burying One's Head in the Sand Regarding IT**. In such cases, managers tend to be unfamiliar with the implications of IT or simply tend to ignore IT all together. Under this scenario, an enterprise can be "blindsided" by IT. What we mean is that managers think they are not in the IT business or that IT will not be a major factor in what they believe to be their competitive environment.

Below we present a simple model that explains the relationship of Ways 1 & 2 above of yielding negative or unintended consequences from the employment of IT for competitive advantage. Way 3 will be discussed later.

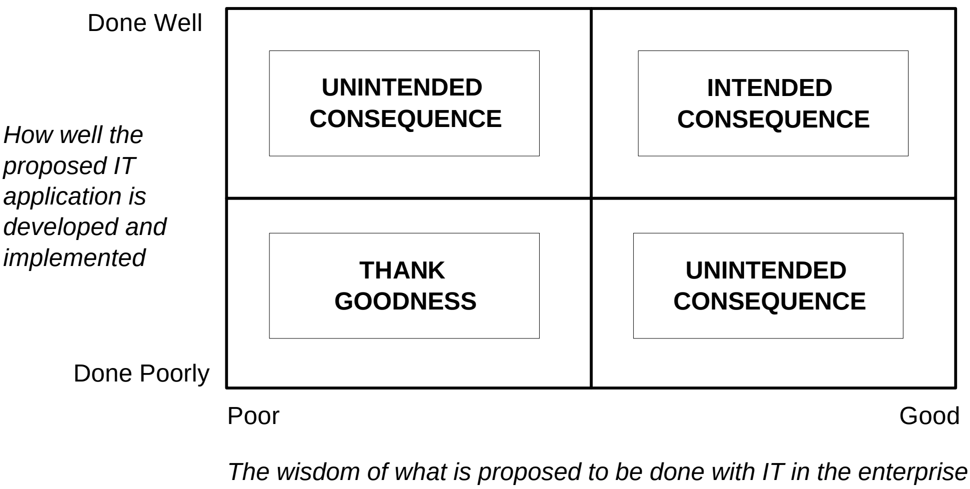

Figure 1. The Wisdom of IT Applications Intended to Achieve Competitive Advantage and Their Implementation Quality.

We can quickly dispense with the upper right hand quadrant in Figure 1, achieving the intended consequence of the IT application. Descriptive of this application and its result would be the aforementioned development of very successful airline reservation systems, the hospital supply application, and Cisco linking to customers and suppliers by way of the Internet and World Wide Web. Here are examples of picking a very good thing to do with IT from a competitive standpoint and doing well in the application's development and implementation. But, this quadrant represents what many others have discussed.

Another quadrant that can be quickly dismissed is represented in the figure's lower-left hand quadrant. What this quadrant represents is a bad or stupid thing done poorly. We say, "Thank Goodness." Because of two negatives, we never see this outcome achieved. Now let us turn to the two quadrants for which unintended consequences are indicated. First, we will give examples of the lower right hand quadrant.

3.1 Way 1: Doing good things badly

Perhaps the most dramatic example of this sort of unintended consequence of IT application is the case of Fox Meyer Drugs (Bulkeley, 1996). Fox Meyer Drug Company was, in 1995, a $5.1 billion drug wholesaler supplying pharmaceuticals and related products to chains of pharmacies and drug stores in the United States and a major player in this industry. Fox Meyer, at the time the fourth-largest drug wholesaler in the United States, expected IT to cut costs, speed up inventory turnover and provide a way to serve its customers by giving them better information about their ordering patterns. A year later the company filed for bankruptcy protection from creditors and eventually the drug wholesaling part of the company was sold to their major rival, McKesson Corporation. To a large extent, the cause of Fox Meyer's demise was the introduction of an ERP system. The company spent $65 million on the system and its implementation and ended up wasting most of this money, and in the process, bankrupted the company as well.

In essence, what happened was that Fox Meyer attempted to process a volume of transactions through the SAP software that was far in excess of what had ever been done before. Fox Meyer managers created more problems for themselves by betting that the ERP system would work, be on time, and would allow significant efficiencies. Based on these assumptions, the company priced contracts with customers at levels that were not achievable when the system failed to be implemented properly. According to reports (Bulkeley, 1996), "The companywide system, which was supposed to cut costs by $40 million per year, was completed late and saved less than half that amount. For a company in a low-margin business with a heavy debt burden, the shortfalls were overwhelming." We seriously doubt that the managers of Fox Meyer Drug Company, when they set out to increase the competitiveness of the company with an ERP system, intended to bankrupt the company. Yet, this is precisely the result that was achieved. They ended up using IT for competitive advantage, but it was for their competition and not for themselves. Here we have a case of trying to do something good, but doing it so badly that the consequence was negative and unintended. Of course Fox Meyer ended up filing claims in court naming its suppliers (SAP America, SAP, AG, and Anderson Consulting--now Accenture) in suits totaling $1 billion in damages.

As a second example of the sort of situation where IT is used to an enterprise's competitive disadvantage, we describe the situation of the Hershey Foods

Corporation. Hershey is a major producer of chocolate candy and chocolate products for the North American market. One of their major competitors in North America, Mars Candy, is probably better known than Hershey outside North America, Europe for instance. After Christmas, the major holiday in North America in terms of economic impact is Halloween that is celebrated October 31. On Halloween the major activity is for children to go in costume about their neighborhoods knocking on doors and saying, “Trick or Treat.” The idea is that, if not given a treat, they will play a “trick” on the household. Naturally, all are rewarded with treats, frequently in the form of candy. The Halloween holiday is a major source of revenue for players in the North American candy industry. It was into this setting that, to be more competitive by being more efficient, Hershey sought to develop and implement an ERP system. Here, according to one source (Nash, 2000), is what happened:

> “To meet last years Halloween and Christmas candy rush, Hershey compressed the rollout of a new $112 million ERP system by several months. But inaccurate inventory data and other problems caused shipment delays and incomplete orders. Hershey sales fell 12% in the quarter the system went live--down $150.5 million compared with the year before.”

Due to the late implementation of the ERP system Hershey could not deliver their product to retail outlets and their major competitor, Mars Candy, benefited.

We must assume that, when deciding to develop and implement an ERP system, the managers at Hershey did not have increasing the profits of Mars Candy as their goal. Yet, this is what was achieved. So, here again, we have another example of an enterprise trying to do something to their competitive advantage yet doing it so poorly that it ends up with precisely the opposite result. Though not as dramatic as the example of an IT application contributing in a major way to bankrupting the firm, the Hershey result is not uncommon. The interested reader can consult (Nash, 2000) for several other examples of good intentions gone horribly wrong. Less common are examples of ending up with a similar unintended consequence represented by the upper left-hand quadrant of Figure 1.

3.2 Way 2: Doing bad (dumb) things well

To illustrate the dumb way of achieving an unintended negative consequence of IT application we will begin with an example that is actually supposed to have happened. For any number of reasons, including protection of the guilty, the following can be neither confirmed nor refuted. But, since we are only giving an example, just suppose it did really happen.

As mentioned in our earlier discussion of IT for competitive advantage, in the late 1960s the airline industry in the United States took advantage of new technical advances in computing (notably data communications and direct access storage devices) to build the first online reservation systems. The Sabre system by American Airlines and the Apollo system from United Airlines were early implementations of the systems that, by today’s standards, were primitive in their capabilities. Being limited, especially by the amount of secondary storage capacity available on the early disk drives, the systems could only tell that a passenger had a seat on a flight, not the specific seat. Later in the 1970s, as technical capability grew, the systems were expanded to be able to reserve specific seats and to ticket an entire itinerary involving several flights.

It was in the late 1970s and early 1980s that the capabilities and features of an airline's reservation system became one basis of competition in the airline industry. Airlines began to compete based on what their reservation systems could offer passengers. However, it was not until the middle of the 1980s that airlines really started to exploit features of their information technology for competitive advantage that went beyond such clerical features as seat assignment, ticketing, and the like. Sometime during this period someone at an airline that had invested heavily in developing a leading edge reservation system had a really great idea. Asking questions such as this may have triggered this idea-

> "Hey look, we have all this data in our online files about who is flying where and when. Why not make use of this data to find out who our best flyers are, where they want to go and when, and try to use our technology to lock the best customers into our airline? If we do this before our competition, we can move a whole bunch of the most attractive flyers over to flying with us and, at the same time, make it less desirable to fly with other carriers."

What followed was the introduction of the "frequent flyer" programs that would not have been possible without the databases that had been collected by the leading players in the reservations business (notably American and United Airlines). The notion was simple. It is well known that about 20% of all those flying account for approximately 80% of the ticket revenue (thus the "frequent flyer," most often the business traveler). The idea is to get as many of these very desirable customers to become dedicated to flying your airline. How is this done? Use IT to identify these customers and use IT to make is as undesirable as possible for these customers, once gained, to switch back to another carrier. But, it is imperative to get to these customers first, before any other competitor, because of the programs will be structured such that it will be disadvantageous for any customer to belong to more than one program. Thus being first to offer the potential opportunity for customers to join enroll is critical.

With the data stored on their disk drives, those airlines most advanced in the reservations business (note they serviced the reservations made through travel agencies as well as their own ticket agents) were able to follow the above plan. It was easy to search the files to locate the passengers who flew a lot, even on other airlines. These flyers, out of the blue and perhaps from an airline they had never flown, received notification that they had been selected to become a member of the "So and So Club of XX Airline," and were provided their plastic membership card and number. As everyone now knows, the "hook" for the frequent flyer was to be able to accumulate miles toward free tickets, upgrades, and other benefits on the airline based on miles flown (links to credit card partners offering miles for dollars spent came later).

The frequent flyer programs were immediately a big success. One factor supporting the success of the programs was that most businesses let their employees accumulate the free miles on a personal basis rather than being allocated to the enterprise paying for the tickets. Another factor adding to the appeal of the programs for airlines in the United States is the fact that the US government has never been successful in taxing the monetary equivalent of the free tickets awarded by the frequent flyer programs.

It is the observation of the authors that once something new in business practice is especially successful in one or a few instances business practitioners try to carry a good idea too far or expand its application into inappropriate areas. The former is highlighted by the hypothetical example we are offering here.

Consider that our "imaginary" airline, having had a successful initial experience with their use of IT to gain competitive advantage, a frequent flyer program, is confronted with the problem of the competition catching up. Others in the industry now have frequent flyer programs as well so the early developers of these programs begin to look for even more imaginative ways to utilize their IT capability to ward off their customers switching to other airlines.

At the airline a few managers, consultants, and some technical people began looking for new and creative ideas to exploit their customer data in new and effective ways. Perhaps it was a marketing manager who may have said something like:

> "I've got a great idea. Why don't we offer our best customers, as a reward, a free ticket when they purchase a full fare ticket so they can take their spouse along on a business trip when they go to a nice place? Their business will pay the full fare ticket and, since we have excess capacity on most of our flights right now, we can fly the companion for very little additional cost."

No other airline had done this. Analysis showed that the program would have little actual cost, and it looked like a great way to please good customers that were loyal to the airline. The program was given the go-ahead.

Six months passed. What we currently refer to as the "companion ticket" program was a great success. Customer feedback was very positive. If the airline had stopped here, all would have been well. But, in their exuberance to push IT for competitive advantage to the limit, they went even further. Maybe one of the managers at the previous meeting, say from marketing, was the one that took the next step. We have to assume that it was an individual that took this step, surely had a group of persons been involved, someone would have recognized the potential for disaster. (Or would they?)

To push the IT capabilities further in order to impress the frequent flyers, the manager decided to identify each person that had taken advantage of the companion ticket (they had both names and local addresses in the files). Instead of sending each frequent flyer using a companion ticket a simple thank you, the manager thought it would be more impressive to contact the companion with a message indicating that the airline hoped they enjoyed the trip. Since a high percentage of the frequent flyers were businessmen, most of these messages went addressed as follows and, along with some promotional material, contained a brief message something like the one below:

Dear Mrs. Nurminen:

_________________ Airlines sincerely hopes you enjoyed your trip this January to San Francisco with your husband. _______________ Airlines is pleased to be able to offer companion tickets to our best customers, our frequent flyers. We hope to see you again soon on our flights.

Sincerely,

Manager of Special Promotions
_______________ Airlines

We assume that readers see the seeds of disaster that were sown here, but in case some are very innocent, we can provide some hints by proposing that upon receiving the letter from the airline Mrs. Nurminen says to her husband, “But dear, there must be some mistake, I didn’t go with you on your trip to San Francisco.” Of course upon checking, Mrs. Nurminen (and many like her) discovered that there was some “Mrs. Nurminen along with Mr. Nurminen on the trip to San Francisco.

One can project the outcome at the airline had something like this really happened. The airline is embarrassed, the manager who had the bright idea for the follow-up letter certainly loses a job, and other not so naïve airlines benefit at the expense of our example. This is an example of doing something in an attempt to gain competitive advantage that is, at best naïve, and at worst simply stupid. And unfortunately, unlike the examples in the previous section, the development and implementation of the application is done really well. But, again the outcome produces a negative unintended consequence.

As a second example of this sort of situation, we will again use a contrived example. But even though something may not have happened exactly as we describe it, rest assured that our description mirrors many real applications. Suppose the president of a bank reads the popular press and, after reading about IT for competitive advantage, decides to make the bank more efficient. The president requests that IT develop an application to look at all their credit card customers to locate their most unprofitable customers, those who pay their bills in full each month and, therefore, do not pay the very high interest rates on an outstanding balance. These persons, although they pay their bills, are not the good source of revenue as are the customers who pay the interest. So, the president argues, why not use the bank’s IT to locate these low profit customers and ask them to get a credit card from some other bank?

The IT organization does precisely as the president requests and, does this well. They even go so far as to produce and send polite letters to the "offending" customers that are identified asking them to take their business elsewhere. A good application of IT to focus on the most profitable customers and make the bank more efficient, correct? Wrong!

Guess which customers are asked to leave the bank? It is the ones that are most wealthy and use their credit cards simply as a convenience. They have the resources necessary to pay off these bills each month. If they need what amounts to a loan, they will obtain them through other ways that require much less interest. In fact, the customers asked to leave have the bank's largest account balances, profitable loans for cars and houses, and have other good financial relationships with the bank (maybe even a multimillion-dollar trust account). They may not be profitable credit card customers for the bank but they are the banks most profitable customers overall. It is this group that is alienated and moves their business to competing banks. In short, here again we have a dumb use of IT carried out well with a negative consequence.

There is one more way to be competitively disadvantaged through the application of IT. Whereas Ways 1 and 2 represent active approaches gone badly, Way 3 is essentially based on doing nothing at all.

3.3 Way 3: Burying one's head in the sand regarding IT

The only truly national bank in the United States (having operations in all 50 states) is The Bank of America. This is a bank that originally was a relatively small one located in North Carolina. But, through many years of aggressive acquisition the bank, although changing names several times in the process, eventually achieved its current national position. A well-known banker named Hugh McColl led this expansion. A few years ago, McColl was quoted about his feelings regarding IT as a competitive force in the banking industry:

> "Mr. McColl believes that technological change threatens to remake the banking industry. But how swiftly, and in what form, these changes will come is still anyone's guess. And that's what is bugging Mr. McColl. He is convinced that if he makes the wrong bet, or the right bet at the wrong time, the company he nursed form a regional bank to a player on the national stage will fade into obscurity" (Deogun, 1996).

Essentially McColl was worried about two things. One is that, with information technology, he does not know anymore who his competition is. It may not be a bank, it may be Microsoft, Wal-Mart, or any number of other surprising competitors. The other is that he is not sure how IT will be related to how bank's compete in the future. Home banking, online banking, smart cards, and the like are all wild cards to him. At least Mr. McColl is astute enough to think about the role of IT as a competitive factor in an industry and realize that in the final analysis his competition may not be another bank as it has always been in the past. Consider the example of an enterprise who ignored IT and its effect on their business.

The Encyclopedia Britannica is a very old and respected enterprise. They are widely known (at least in the United States) for their volume of encyclopedias. Many children grew up using this set of very expensive encyclopedias that had been bought for them by their parents (why the parents bought them when they were available in virtually all public and school libraries is another matter). However, the Encyclopedia Britannica enterprise was seriously undone by narrow thinking that ignored the role of IT in their industry. The enterprise's managers, until much too late, considered that their competition was from other producers of hard bound sets of books called encyclopedias. Generally, these competitors were considered to have far lower quality and, consequently, were much less prestigious (and pricey). But, along came IT. Manufacturers of PCs (and their operating systems) started including an encyclopedia on a CD-ROM for free with the purchase of their product. True, the encyclopedia may have been more limited that the Encyclopedia Britannica, but when it was provided free (and updated quickly for free or low cost) why buy an expensive set of books that are static and take up lots of space?

The Encyclopedia Britannica was totally taken by surprise by a substitute product made possible because of IT. The enterprise's managers, from a firm producing books, never thought their competition would be IT. As a result of this shortsightedness, the company's profits were severely reduced. The case of Encyclopedia Britannica is a classic instance of managers putting their heads in the sand and ignoring IT as a competitive factor.

Now competition to banks may not come from other banks, customers have other alternatives for buying an automobile than from a dealer, and travel no longer is booked only though a travel agency or a carrier. The point is that IT not only opens up factors for competing, IT also opens up new avenues for competition. Many industries, particularly those formerly based on personal selling, will undergo tremendous changes in how they compete as a result of IT. The message to managers is, ignore IT as it affects your competitive environment at your own peril. The authors observe that, in their experience, far too many managers are too narrow regarding what business they are in, who their competitors are, and what is the future basis of competition in their industries. Ignoring the role of IT in competing is almost a sure way to achieve an unintended consequence such as the case of Encyclopedia Britannica.

4 Conclusion

The failure of technology is an issue that has been around for a long time. Two information systems professors have tried to demonstrate this fact by writing cases for use in their courses based upon the sinking of the ship, Vasa, in the harbor in Stockholm in the year 1628 (Dickson, 1999a, 1999b and Mason, 1994). Both professors, visiting the Vasa Museum at different times were struck by the similarity of the circumstances leading up to the sinking of the Vasa and circumstances frequently associated with the modern failure of information systems.

Failure when building and implementing information systems has been a subject that has been dealt with almost from the time computers began to be applied in organizations. One of the authors of this paper, for instance, wrote a paper dealing with the behavioral aspects of information systems 35 years ago (Dickson, 1970). Others, over the years, have also explored the failure of information systems in an attempt to learn what causes failure (e.g. Sauer, 1993; Lyytinen and Herscheim, 1987). Understanding the causes of failure should allow them to be avoided. Yet, we still seem plagued by the failure of information systems, particularly large projects. As late as 1994, 31% of all large information systems projects fail completely (all the effort and money spent on them are lost) and 51% are completed vastly over time and cost budgets and often have to be scaled back in terms of their functionality (Bulkeley, 1996).

Our focus in this chapter, however, deals with even more dramatic failure than simply having an information systems project to cost too much, take too long to complete, to fail to live up to its expectations, or to be cancelled. Here we have gone one step further to focus on how information systems can, indeed, end up disadvantaging their host organizations and benefiting the competition. We would hope that the ways we have identified to use information systems for competitive disadvantage, and the examples we give of how this has been done will come to the attention of managers. We would respectfully suggest to these managers that, when considering applying IT for competitive advantage they think through what they are doing and how they are doing it and act so as to minimize the risk of the unintended negative consequences. But, being realists, we predict that we have not seen our last example of IT applications that end up in achieving competitive disadvantage.

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Humans and Artefacts: Post-infurgic Reflections

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Abstract. The article departs from Markku Nurminen's work on work, in the *Infurgy Manifesto* and in his book about *People or Computers: Three Ways of Looking at Information Systems*. I discuss use as work that can be understood as relations between work knowledge and work conditions. Systems development deals with design of computer-based artefacts, and the relations between use and design are important to understand and to handle. I emphasise four such relations: learning, expectations, domestication, and categorization.

1 Infurgy and systems development

Markku Nurminen has been a colleague and friend for many years, and I am very happy to participate in celebrating Markku on his 60th birthday. Markku is the robust continuity in the development of the IRIS[1] community, and his large Scandinavian network includes many different people. He is a generous and supportive colleague; he has a very catchy laughter that is present in all his doings. As an IS researcher Markku has a distinct position; his interest is grounded in the human side of information systems; in people's doings and knowings, in their collaboration and interaction with others, and in their use of artefacts. An obvious source of inspiration is his long-standing love to his clarinet, and to the joy of making music together with other musicians; an exemplar of a close relationship between a human and his instrument in activity.

Markku introduced the term "infurgy" at the 17th IRIS seminar in 1996 in order to discuss information systems as a discipline. The *Infurgy Manifesto* emphasizes:

- information and work [inf(ormation) + ergon (work in Greek)] and their interrelations
- information technology is means for work and should depart from that

[1] Information systems Research seminar In Scandinavia

- computers are not acting subjects
- information cannot be separated from work
- work is individual and collective
- work and information systems are context-sensitive
- work knowledge includes both work and use of information systems
- effects of computers in work are difficult to identify

The *Infurgy Manifesto* represents a continuation from Markku's book: *People or Computers: Three Ways of Looking at Information Systems* from 1987, where he argues for taking the human being as the basis for understanding and designing information systems. In his view people use information systems as an inseparable part of their work – and the information system may not be the most important part of their work. As with the humanistic perspective, infurgy is an alternative to systems thinking. The emphasis on the human as knowledgeable worker fits with other Scandinavian perspectives[2].

The aim of Infurgy is to design information systems as means for work. Design should depart from the work situation. It is work – as carried out by the workers – that constitutes the basis for an information system; for designing and evaluating the system. Even if the system may perform work on behalf of the user, skilled, situated, professional action can only be carried out by people. There should be no confusion about the agency in work: work is always contextual and computing machines can only perform pre-defined operations – which therefore constitute stable (and sometimes rigid) parts of the working conditions that make situated action an important skill.

Work is carried out as work activities and work tasks. The workers have different work roles characterized by a responsibility area and its corresponding work tasks / processes. Each worker carries out a number of work tasks and may embody a variety of work roles. The information system is embedded in the work roles. But the work of the user is not mainly to use the information system, and the way that the system is used therefore depends on the work context: the tasks, the work roles, the organization of work, specialization as well as social and cultural aspects (e.g., power). A computer system is therefore used in a variety of ways.

The infurgic perspective emphasises work and thus makes information systems similar to work studies or organization studies, says Mathiassen (1997). He criticises infurgy for being an ethical rather than a professional perspective, and claims that it is the technical aspects that gives systems development its identity. I think both perspectives are needed in a sound theoretical and practical basis for professional systems development[3].

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[2] like the Scandinavian ”participatory design”, cf. Bjerknes & Bratteteig (1984; 1995) – but not so explicitly political

[3] in line with Bratteteig (2003). I use nursing to discuss characteristics of work.

2 Use is work

Use of information systems is work – as use of all artefacts in work. Use is always part of a context that provides the meaning to the use activity – and thus to the artefact. Users incorporate the artefact into their practice, on the basis of the practice rather than the artefact. The incorporated artefact becomes a part of the concrete conditions for the activity: as an instrument for doing things, or as an object of the activity. The basis for including the artefact into the activity is knowledge about the activity (in the activity). The relations between knowledge and conditions explain how an artefact is used, and changes in the relation (or its sides) contribute to the development of the use activity.

2.1 Use is work at different levels of abstraction

Use is not just operating a computer: it is embedded in work and in the way we think and act in work. Use is usually not the primary interest of the user: while writing this text typing is not my focus: the computer and its text processing program is a way to write. I write with pen and I write with the computer: pen and paper is the easiest way to create a structure for a text, the computer (and the printer) is the easiest way to produce the text product. The computer (or pen) is not my focus in the moment of writing – as long as it is a part of my writing work. But I write differently when I sit at the table with pen and paper and when I sit by the computer; I think writing differently when writing means operating the pen or the computer; I think and do writing differently because the result is different rather than the instrument – although the instrument is integrated in the production.

Use of a computer system requires knowledge about how use is integrated in work at different levels; the operations of the system – where to push; the actions in which these operations are part: writing text or making a calculation – and at a more abstract level the activity as a whole: why we do it. The levels are related and it is impossible to understand one without the others, but the analytical distinction between levels of activity in work enables an understanding of use as a kind of work. Use is what we do, but "what we do" include the concrete operations we carry out as well as the goal-oriented and motivational analytical level of our doings. Use of computer-based systems is motivated by the work in which it is a part – which in turn is motivated by the long-term result of the work.

2.2 Bad use can express work knowledge

Gasser (1986) defines computer use as articulation work[4] and discusses use of computers that do not fit the work very well as a special kind of (articulation) work. He introduces three strategies for handling such systems in order to get the work

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[4] see Strauss (1986) and Star (1999)

done: fitting, augmenting and work-around. Fitting work "is the activity of changing computing or changing the structure of work to accommodate for computing misfit" (Gasser 1986: 214). Fitting work includes changes and adjustments so that the computing misfit gets smaller or even disappears. Augmenting work "is undertaking additional work to make up for misfit" (Gasser 1986: 215). Augmenting means adding tasks to the task chain and by this making the production lattice more complex, hence increases the need for articulation work. Much augmenting work has to do with checking things (the data, the reports, the bills). "Working around means intentionally using computing in ways for which it was not designed or avoiding its use and relying on an alternative means of accomplishing work." (Gasser 1986: 216). In this category come exotic examples of entering really wrong data because they will give the right output or fancy short-cuts of computer-implemented procedures, and the less exotic examples – and quite common – of double archives and backup systems created because the system is not trusted.

Gasser's three strategies demonstrate in different ways that people who know their work well are able to do the work even if the conditions for doing work are not the best, and that they may utilize their knowledge about work activities and organization of the work systems that enable them to overcome the hindrance posed by the system. The ability to do so also requires a certain level of knowledge about the system, and in particular knowledge about how the levels of work: operations, actions, and activities interplay. Much of the work-arounds described utilise knowledge on the action level on the operation level.

2.3 Articulation work crosses levels of work

The interdependence of work tasks necessitates work that deals with the relations between the tasks; the interdependencies, the coordination, the facilitation of work. Strauss calls this kind of work articulation work.

> Articulation work amounts to the following: First, the meshing of the often numerous tasks, clusters of tasks, and segments of the total arc. Second, the meshing of efforts of various unit-workers (individuals, departments, etc.). Third, the meshing of actors with their various types of work and implicated tasks. (Strauss 1985: 8)

Strauss distinguishes between primary work and articulation work. Primary work includes tasks that contribute to the organisational goals. Because the contingencies of primary work change all the time, articulation work is needed to sort out possible conflicts between parts of the production lattice. Articulation work is the work to establish, maintain, or break the coordinated intersection of task chains, i.e., work tasks that are needed in order to get the primary work done. The notion of articulation refers both to the act of expression, but also to the interrelating of different parts (e.g., joints between bones in the skeleton).

Articulation work is normally not visible in formal accounts of work. Studying work by observing what is done often reveal that the work day is filled with activities that are not conceived as work, but still requires skills and knowledge to perform. Studying nurses at work make visible that they almost never sit by the bed-side even if they claim that "real nursing" happens at the bed-side. Nurses have the responsibility to care for each of the patients in a way that takes care of all the patients. The nurses distribute the resources present at the ward (the time in particular) among all the patients so that they can care for each of them. They distribute the responsibility for the patient group between the nurses on duty, but they all know enough about each patient to take care. This requires an evaluation of the needs of each of the patients compared with the available resources – a real professional skill. Real nursing also includes maintaining overview as a basis for providing care, combining knowledge at different work levels in the professional articulation of care resources. The concept of articulation work is related to seeing the whole and the parts of the work together.

3 Work conditions and work knowledge

Use can be seen as a relation between work knowledge and work conditions, where work conditions include both the object of work and work instruments. Work knowledge is concerned with the professional activities concerned with the work object. Computer-based artefacts are instruments for performing work and express – are – work knowledge.

3.1 Work conditions

Work conditions are made up of the object of work: what we are working for, and the instruments: what we are working with. We are working for an object, a result, and the result plays a role in how we chose to work. The object of work defines the motivation and the more concrete goals in work. In nursing, the motivation is (in general) to provide care and treatment that enable sick people to get well and participate in normal activities in society. The motivation for my writing is to contribute as a member of a research community to a discussion about information systems development. The object of work influences how we understand what we are doing, and how we go about to organize and plan what to do.

Work is situated and concrete, and the concrete conditions for work influence the way work is carried out, at the operational, action, and activity level. Work conditions are the concrete circumstances that make the work situation unique. The conditions for doing work vary and the intricate interdependencies of work tasks with other work tasks create uncertainty: we cannot predict exactly what will happen due to contingencies in the work situation. The physical location where work occurs, the arrangements of work apparatus, the proximity of colleagues, the working environment (light, noise etc.) influence the particular character of a work task. The practice of work includes details and trivial operations, situated knowledges and creativity, personal preferences, accidental moves and unforeseen actions.

The work conditions are always unique, even if they are similar to what we have experienced before – work is always different and similar. Reflecting on work processes and situations over time makes us extract some characteristics which are repeated while other change. The repeated characteristics make the basis for patterns and routines for work: this is how it usually happens. And this is how we expect it to happen.

Dealing with work conditions is basically to handle the concrete relations between work objects and representations (of objects and representations). The work of dealing with representations are carried out at different levels of work; as operations like registering a dot on the temperature curve sheet based on the reading of the thermometer in the morning nursing routine, as parts of the goal-oriented action of getting to know the temperature development, as one element in evaluating (the effect of) the medication – as part of the activity of professional making hypothesis of how to help the patient get well fast – that gives the registration of the temperature its meaning.

3.2 Work knowledge

Work knowledge is developed as we perform work in a work setting, adding experiences of concrete examples of work objects and work conditions to knowledge gained through professional education and professional activity. Work knowledge is to handle work conditions – based on work knowledge. Work knowledge connects operations with the larger actions and activities, in the social setting. Different knowledge is needed at the different levels, and work knowledge is the unity of the levels in which the different knowledges interplay.

On one hand knowledge and skills are personal, as they result from the individual experiences and accumulations of knowledge. However, the person is always a member of a social community in which the knowledge, the skills, the experience makes sense and contributes to the accumulation of shared knowledge. Learning and experiencing is hence better seen as processes of transactions between the individual and her/his environment (the community) in which the results of the transactions contributes to changing the community.

Work knowledge is knowledge in action – the act of knowing. Knowing is based on a combination of action and reflection, not necessarily carried out at the same time. In order to act one has to practice: practice is established action-connections where the repeated elements – rules, norms, patterns or the like – are necessary but not sufficient. Concepts and verbal / formalized expressions of knowing require some degree of regularity (in patterns) as well as explanations of the regularity. To the individual becoming a member of a community of practice, it takes time to build up a professional knowing. The regularity of a practice makes reflection and verbalization possible, and thus makes possible a conceptual basis for understanding action that contributes to the knowing action. Work knowledge includes patterns and varieties, similarities and differences.

The professional systems developer is a reflective practitioner[5]. But the immediate, instantaneous action, the action without reflection is often considered to be the most important expression of expertise[6]. The ability to act professionally in exceptional situations is based on routine – the ability to immediate action only comes after long time practice. But mastery of instruments may cross the relation between action and reflection. In an interview the Norwegian fiddle player Annbjørg Lien talked about her relationship to her fiddle; about the feeling of cooperation she had with the fiddle when she managed to transcend – "stretch" – the capacity of the fiddle (up to that moment), the extreme focus on the fiddle that made her utilize its capacities just a little better. The fiddle is very present when she plays. But her focus is not the focus of mastering the fiddle; it is not a question of how to act in order to be able to play the music. Mastery of the fiddle is routine for her; her focus is how she can make the fiddle sing different. This knowledge about the relationship between her and the fiddle is not between the human and the instrument, it is between the knowledge and the concrete conditions for utilizing this knowledge – it cuts across both the human and the artefact.

Emphasizing relations helps us see the interplay between different types of knowing exercised at different levels of work. Watching nurses in action with an asthmatic child demonstrates the situated nature of work knowledge as well as its back cloth of general professional knowledge. Teaching a child how to breathe in order to get the full effect of an asthma medicine illustrates that knowledge at all levels come to play: knowledge types like factual and evaluative, medical and emotional, detailed and as a totality, situated presence and professional overview were obviously combined in the instant action. Dealing with computerised representations also requires a complex interplay of knowledges both if the representation relates to a physical object (like a patient) and if the representation relates to other representations (like the measured lung capacity of a patient). When the representation is a process (like in a computer) the knowing concerns the process and its location in the action / activity.

4 Relations between use and design

Use influences design in several ways, more or less directly. Ideas about future use are the start of design – and the design result as a integrated part of somebody's everyday activities (at home or at work) – are the ultimate design goal and success criteria.

Both work knowledge and work conditions influences design: work knowledge is the basis for suggesting and choosing instruments as it includes the purpose and criteria to use and evaluate the instrument. The work conditions are very concrete, and give material limitations and possibilities to instrument (e.g., its integration and

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5 see Andersen et al. (1986)

6 Molander (1996) gives a solid argument for this

interaction with other instruments) as well as to the content of the computerized representation (representations of the object of work or work processes concerned with the object).

4.1 Learning

Learning is development, and expresses relation between utilization and improvements. Human activity makes use of tools, as a constant interest in improving the world by making it better, easier, quicker etc. Utilization of tools is the basis for use, as improvement is the basis for design (and engineering). Improvements often include making new artefacts; utilization includes appropriation of artefacts in current activities. Learning is the interplay between the utilization of artefacts and the improvement of the activity: the interplay between experience and interpretation, of doing and reflecting, of combining different levels of the activity, different logics, to see and do differently.

Human beings try to improve the way we do things – life is development and change. Human development and learning is a part of everyday life and work: through experience we develop expectations about what will happen that act as a basis for interpreting the world – which in turn may change the way we see – and do – work. Learning happens, to a large extent, through use and refinement/invention of material and conceptual instruments[7]. We improve instruments used in activities and by this change the activity (at some level) and hence the way we understand the activity – which may in turn give rise to new improvements. And “we” are the individual members of many communities-of-practice: what I learn from one community I bring with me to the next where other people learn from me, and so on. We all act in different arenas and our actions in one arena are influenced by our experiences in other arenas – an individual is a complex interplay of roles and experiences in life. Andreassen & Wadel (1989) lists five arenas that all come to influence the individual action: home, education, work, friends, media all influence the individual football player’s achievement in a football match. Ludvigsen et al (2001) makes a similar point observing that the behaviour of sales engineers can only be fully understood when seen in a larger context and take into consideration their former engineer background.

4.2 Expectations

Traditionally use is said to influence design through the existence of needs that designers can fulfil. This is a rather simplified view. Needs rarely occur when there is not already a solution available; there is a complex interplay between what can be offered and what can be sought that defines “needs” in terms of expectations of improvements of some sort. Needs do exist, however, as expectations of

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[7] see Säljö (2000) for an elaboration of this view

improvements, in most of our life areas – the computer industry benefit from expectations of being free of routine tasks through automation and through this introducing a number of other expectations basically concerned with speed and independence of our physical limitations.

Use influences design through images of what people do with computers, and what they do that would be done in better ways with computers; making both the way we live and the current technology sources for imagination. Sometimes the technology as an imaginary source seems to totally override use, resulting in technical possibilities that nobody needs or even wants – or in technical opportunities that create needs (like mobile telephones creating the need to be constantly available).

The relation between needs and support is best characterized by the concept of expectations. Needs are developed through social and cultural practices acting as the basis for an activity and for interpretations of the context of the activity. Knowledge about technology and its role in society (or some part of society) act as a basis for expectations of changes in current work operations, actions and activities, i.e., as expectations about improvements. The notion of support express expectations that human capacity can be extended through instruments, and that work can be delegated to instruments (automation to liberate human beings from work). The expectations fit with observations of human beings: we do make efforts to extend our capacities through instruments (e.g., memory through pen and paper) and we do delegate work to them (e.g., calculations through calculators). What may be lost in these relations is the movement; the expectations to improve human activities through utilizing instruments is not static, but a constant interplay between opportunities for support and the identification of a need – or wish – both based on expectations that comes from the interplay rather than any of the sides.

4.3 Domestication

Domestication denotes the interplay between appropriation of an instrument and the instrument's integrative design[8]. The instrument is appropriated into a practice, but in order to be appropriated the instrument must have been designed for integration: the instrument has to be designed to fit the practice both conceptually and concrete. The instrument has to fit to the standard of the context, but still be different, and it has to be flexible for new use, but still recognizable to the contemporary user. Domestication relates to the relation between standardization and flexibility, but emphasizes the context in which the artefact is to be used as the basis for evaluating what is standard and flexible. Flexibility should be an opportunity for use rather than a property of the artefact[9].

The work of dealing with representations does not focus on the verbalized vs. the non-verbalized knowledge: instead the work is concerned with making,

8 see Silverstone & Haddon (1996)

9 a discussion about flexibility in function and form is found in Findal (2002) and Bratteteig (2002)

communicating, interpreting, combining and translating stories about the work objects – knowing that no one story covers the whole truth. It seems that the distinction between verbal and non-verbal knowledge confirms the old dichotomy of body-mind, and can make us miss other important distinctions (and relations) relevant to computer use.

4.4 Categorization

Categorization denotes the relation between creating a product identity and contemporary culture (or fashion). The design process is aimed at consumers in a market or at workers in an organization – the goal is to design an artefact that can be recognized by the consumers or workers. In order to do that, the contemporary culture, its trends and fashions, are used to suggest form, function, and structure to the artefact (not yet a part of the culture). The newness as well as the well-knownness has to be carefully designed so that the artefact is new enough to represent an improvement, but well-known enough to be recognized and fit with the existing activities and conditions of the use context. The balancing act of categorization – and domestication – needs careful consideration and interplay between design and use contexts.

5 Concluding remarks

Use as work is the continuity that exists before and after design. Work is carried out and made sense of as normal practice – a new artefact introduced to the work context changes the work conditions and therefore the work knowledge, and this happens within and as part of work. Work has its own logic and the analytical levels of work: operations, actions, and activities may also be conceived as processes with their own logic, interacting and influencing each other.

But design is the core of systems development, and the understanding of work in systems development will always be biased towards what is needed in order to create new computer-based information systems. In line with Markku’s humanistic and infurgic perspective, however, I believe that seeing use as work makes a better basis for design because it guides our focus to the underlying reasoning for work organization and work knowledge – independent of current technologies and routines. This can result in more robust and durable design suggestions.

A basic skill in systems development is therefore to facilitate and deal with relations between design and use. I suggest emphasizing four such relations:

1. *Learning*: the relation between utilization and improvements. Learning is development, and deals with individuals as well as their interaction in larger contexts (groups, organizations, societies). Learning is change, where the direction is only partly controlled and predictable, and where individual differences and preferences are not seen as deviations and problems. Learning is work, and the conditions for doing the work are both physical and

mental, both individual and collective, both new and well known. Learning as human development is clearly a most important part of systems development.

2. *Expectations*: the relation between needs and support. Expectations are also important as they tend to guide us to the future, they motivate us to improve, to experiment, to want to learn and develop. Expectations are made by each person, thus they are a source for inspiration and common understandings as well as conflicts and resistance.
3. *Domestication*: the relation between appropriation of a tool and the tool's integrative design leans towards the use side. Domestication addresses important aspects of the interplay between use and design contexts as they try to influence each other. Domestication addresses the balance between standardization and flexibility, but is basically concerned with the work that users and designers do in the balancing act.
4. *Categorization*: the relation between creating a product identity and contemporary culture (or fashion) leans towards the design side. Categorization (like domestication) addresses the mutual influence between use and design, but the focus is the designers' activities to reach the users.

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Open Source System Development and the Functioning of the Academic Community

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Abstract. The open source movement way of developing information systems is currently a hot topic. When reading descriptions of the functioning of the open source way of developing information systems, one cannot escape the feeling that the community is inventing the academic environment anew. Issues such as contributions without a separate compensation, non-commercial products, peer reviewing, modular and cumulative product development and quest for collegial appreciation are shared by the both disciplines. Both industries too share common problems, such as low quality, late projects and yet long working hours. One of conclusions is that while in the software industry open source development is trendy, in the research field academic institutions still carry the emblem of an old-fashioned way of working. Further one could conclude that the world of open source is just that of the strong individuals, leaving the weaker ashore.

1 The open source movement

Costs of information processing resources for organizations increase all the time (van Hillegersberg & Altes, 1998). At the same time, the productivity of these resources is questioned (Lee & Barua, 1999); (Willcocks, 1999); (Jorgenson & Stiroh, 1999). Knowledge worker productivity is a constant source of problems and critical discussion (Brynjolfsson & Hitt, 1998). At the same time, information technology should contribute to the organizational success (Powell & DentMicallef, 1997). Within this framework of pressures, organizations and IT managers search for possible solutions. Among the most usual ones are:

- outsourcing (Kern & Wilcocks, 2000; Willcocks & Kern, 1998)
- business process redesign (Davenport, 1993; Hammer & Champy, 1993)
- centralization or decentralization of IT-activities (Belanger & Collins, 1998; Tonn, 1990)
- emphasis of human resource management in the IT-area (Finnegan, 1999) (Suomi, Holm, & Viljanen, 2001)

- standardization of software and hardware (Buxmann, 1996; West & Dedrick, 2000)

One part of the organizations is turning into open source software (OSS) in order to gain cost savings and maybe even increased productivity. From open source software, companies search benefits such as

- lower investment costs
- lower total cost of ownership
- less dependence on specific vendors
- a vista on innovation in software technologies and development methods.

However, there are also doubts about open source software. Many potential users fear that the open source alternatives do not have the full functionality as seen in the commercial programs. This is a big issue for example in the office software market. For more critical applications, fault and error tolerance may turn critical. Again, in office applications, the adherence to different standards, often stipulated and too manipulated by Microsoft, might turn problematic. In transaction processing setting, there is more room for interface work, but in office applications the interfaces should work as they are, users have no tools, time or skills to work on them.

Yet it would be wrong to discuss the open source concept just in the light of the organizational issues such as cost and productivity. For the individuals participating in the open source movement promises a totally new concept of living and working. In the open source development, work is not predominantly done for a salary, but satisfaction and experience is sought in community building (Weston, 1997), sharing of ideas and software, and most likely, future gains through good personal connections, profound professional knowledge, and concepts and products which can also be turned into a commercial success. Through a later commercial success, the financial incentive is too there for the open source community.

A third important discussion area is that of seeing the open source movement as a challengers in the software market. Many want to simplify the issue as a war between Microsoft and free / open source software. However, the issue is far more complex and contains difficult issues such as licensing terms, the digital divide dimension, vulnerability to security and privacy threats, ownership of intellectual property, total cost of ownership (TCO), software market functioning in general, just to name a few points of view.

2 Comparing the open source movement and the academic community

2.1 Common problems: low quality output, late projects and long working hours

Both software industry and the research community are information intensive industries, where knowledge worker productivity is a key success factor (Davenport, Thomas, & Cantrell, 2002). Both industries too seem to suffer from the common shortcomings in knowledge work, such as low quality output, projects being late and still long working hours.

Many researchers have too criticized the work practices in the software industry. For example, (Pfeffer, 2001) lists the following shortcomings in the way of working of the software industry:

- The free-agency model of employment, featuring relatively little commitment on the part of companies to their people or vice versa.
- The extensive use of outside contractors, even for hardware and software development
- The use of stock options as an important form of compensation
- Long working hours.

As we look at this list from the point of view of the research community, we have things in common. The research community is divided into a core permanent workforce (professors, lecturers, etc), and to a big group of actors working on less permanent positions or even on a free-agency model of employment. The long working hours too sound familiar for the academic community.

The question of using outside contractors for research is a more complicated one. Basic research is often done in a simple setting without external contracts. Applied research, however, usually involves a relationship between the research organization, the organization to be studied, and a customer paying for the results. Both types of research – basic and applied – of course form different kinds of co-operative arrangements. In the academic field, this kind of contract development is not usually seen as a bad thing. In the IT-management field, too, of course there are many that see outsourcing and external contractors actually as the key to lower costs and better quality (Kern & Willcocks, 2002; Quinn, 2000; Suomi, Tähkäpää, & Holm, 2001).

What we do not have in the academic research topic list are stock options. Maybe we however should, as for example the state employer in Finland is looking for encouraging pay structures, where you get extra paid for productivity.

2.2 Contributions without a separate compensation

The ideal picture of open source system developers is that of established professionals contributing to different projects with the best of their skills. All this happens in a virtual organization, very often taking actions in the cyperspace offered by the Internet. The organizational reality might be different, but at least the clean picture given of these professionals is that they work without any compensation from the particular project, just because of the joy and excitement they find in the projects. An important aspect is, that the software developers are very proud of their output.

In the academic world too we are living in the middle of a period of different virtual organizations and projects. National organizations, EU research projects, and the individual organizations we serve, all demand contributions involving different kinds of skills. Such projects cannot be performed as individual work. Here too in practice extra financing is usually available, but many times contributions are expected to emerge just as a byproduct of other responsibilities. The academic culture does not support one to be proud of his/her undertakings. It is better to be modest, and rather for example discuss the restrictions of the study and results, than the opportunities they offer.

This ideal model of uncompensated work deserves some comments and critic. It is well known that the productivity of the IT-field is often found to be too low in productivity. Maybe this is partly because the best IT-professionals really concentrate on other issues than the ones their original employer is really paying them for. In the academic world too, we too often hear that researchers do not have enough time to do their core activities defined in their task description.

Another point is that you can really take part in unpaid project work, when you first have your financial background secured. In the academic world, this is happening through the salary the state is paying us. In the open source community, we often find that the best open source programmers are actually senior investors that have already made themselves to millionaires through earlier activities. A fresh face in both fields without an established financial positions might find it hard to work in the open source –way.

Unpaid work and unpaid contributions to some society are possible from the organizational point of view just if there is enough organizational slack available: the organization can do something else than just the basic core activities (Lawson, 2001; Nohria & Ranjay, 1997). Organizational slack is too a key factor in fostering innovativeness. It seems that both the software industry as well as the academic community have enough organizational slack to allow for unpaid contributions, and innovativeness too.

2.3 Non-commercial products

Knowledge and software production are very similar processes. Products of both processes are available both on a commercial as well as on a free basis. In software you speak of shareware, freeware, open source software, …you name it. In academic knowledge production we do not have those fancy names, but the idea is the same: the knowledge produced should be available for anyone, but the copyright and labor of the original producer should be respected.

You can easily see that the demarcation line is not so strong: each discipline has its free and commercial products. Software is often somewhere in the middle: you will have to pay for some characteristics and services, while some are free. On the academic side, the case is the same: the pure academic results are usually freely available, but the interesting value-adding elements of the knowledge are usually hidden to commercial or other reports, which contents is not freely available for everyone.

Here we too have one of the shortcomings of the open source software. System maintenance is not the strongest characteristics here. If you give something away for free, and if you do not know who the users of your software are, how can you maintain it and develop it further. In a similar way, academic knowledge is usually served in a quite raw way: no maintenance or usage guidance is offered.

2.4 Peer reviewing

Low software quality is a burning problem for the IT industry (Slaughter, Harter, & Krishnan, 1998). Established software companies have detailed internal instructions for keeping up software quality (Cusumoto & Selby, 1997), and many too turn to external quality certificates (Baker & Rouse, 1995). The open source way of producing software is trying to solve the quality problem through extensive usage of peer reviewing. Everyone should be proud of his/her work, and is willing to get comments of it from the others.

Peer reviewing is too a strong system of peer learning. It is well known that in the open source movement, not all are equal. Older and more experienced professionals take the role of system integrators, and see to that the modular contributions of younger programmers fit nicely together. Through this co-operation knowledge is exchanged between the generations.

By now I expect the reader already having seen the similarities with the academic community. Here too older professionals perform reviewing duties. Knowledge is passed between the generations, and output quality is put on open assessment and review. In the academic world, the tradition of peer reviewing is still maybe a little more established and strong, as blind review is often used. In the open source system development the concept of blind review is as far as I know absent.

2.5 Modular and cumulative product development

The layered way of looking at software has a long tradition (Auger, 1992; Müller, 1996). The same is true for example for telecommunications, as materialized in the famous OSI-model. New functionality is built on the software on a layered way.

New contributions can rest on a basis set earlier. This too allows for a modular way of working.

In the open source software, modularity is of especial importance. The governance structures of the action are very weak, and each programmer will have to work independently. Neither is the control on what the end-user is going to use and in which configuration available.

In the academic field, strong emphasis is given to the cumulative tradition (Adam, Murphy, & Fahy, 1995; Keen, 1980). You should build new knowledge just on established research results that are validated to be true. In addition to building on true knowledge, through giving of references you give credit to the original author of the text and ideas.

Unfortunately, in neither field does the system work without problems. In software production, immediate mistakes can maybe be seen, but the software may still have mistakes after even years of application. Mistakes are neither any on-off –phenomenon, software can be performing less than optimally in many ways. In the academic world and work, unfortunately even crucial errors often remain undetected, and the cumulative errors may make the situation a serious one. No wonder the notion that especially social sciences are not based on any absolute measurable truth, but rather on a broad consensus, something that is socially constructed, is so dominant and well accepted (Astley, 1985).

2.6 Quest for collegial appreciation

If money is not a motivation for best software developers, what then is? In the open source system development, the best performers are rewarded with the respect of the community. (Denning, 2002) nicely describes how in any profession people proceed in their general knowledge and respect:

- Blind person
- Jerk
- Novice
- Advanced Beginner
- Professional
- Proficient professional
- Expert
- Master
- Legend.

Who, then, would not like to be a legend in the academic community? In this community, the formal academic ranks actually are even better described than in open source environment.

As financial rewards are subjective, so is of course fame and respect too. Both in academia and in the open source world, there are competing clans and subcultures, and the competition can be a harsh one. Fame and respect are easy to harm, and surely there are sabotage actions towards the respect and fame of many professionals in both disciplines.

To be a little jealous, it seems that the open source movement is able to produce real legends. In the academic world, we have no such outstanding legends such as Linus Torvalds or Steve Jobs. At the very end, the academic community seems to be less generous in the distribution of fame and respect.

3 Conclusions

Both information system development and research are knowledge intensive areas, where both the processes and products are knowledge-intensive. No wonder the industries share a lot. Both problems and working habits are very similar in both industries, even though differences too exist.

In research, the thousand year old university system and commercial research institutions work side by side. In the latest time, commercial research has gained in size, share and respect, while the basic academic research, relying just on public means financed by taxes, has enjoyed just modest growth. To simplify a little, the ancient university system is still alive, but sharply challenged by commercial research institutions.

In the software industry, it is harder to say who actually started the industry. In total, the industry is just some 50-60 years old. Most obviously here, too, first programming was done very much like research and on a non-commercial basis, just as open source software nowadays. Even there, however, big software houses, first IBM, to be followed by companies like Microsoft or Oracle, took the lead. The original roots were fast forgotten.

Here we come to the interesting difference. In the software industry, going back to the roots, producing software in an open source way, is again trendy. We have seen some kind of protest to the too strong power of big software houses. In the academic field, we have not seen this. The gravity point of research still seems to turn away from academic institutions to commercial actors.

Information society researchers have hoped and defined, that the new information society should be different from the industrial society too as it comes to the way people think ethically (Ermann, Williams, & Gutiérrez Carranza, 1990). Self-centered way of thinking, either as individuals or as organizations should not be the leading star. Individuals should participate in knowledge and experience sharing, in cooperative work and in voluntarily work for the benefit of the weaker. Organizations should participate in different virtual organizations, strategic alliances and co-operative arrangements, where profit making is not the only goal. The open source movement has succeeded in becoming a symbol for these kinds of thoughts, whereas the academic community has missed this train: working in an academic research institution is not considered as a sign of new “better” ethics.

One important discussion should take place in the field of digital divide (Compaine, 2001; Norris, 2001). Here the idea is to get lower differences between individuals and nations as it comes to access to and mastering of new information and communication technology. Unfortunately it seems to me that the open source movement is not driving developments into this direction. If big software companies are mainly American, I would say that the open source myth and work is even more concentrated just to the Silicon Valley. At the individual level, the myth just gives room to the strongest individuals: poor performers are not allowed to take part in the development of open source software. Is this maybe too the future of the academic community, I think I see signs of that already.

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IT Artifacts in Design Work: How Technology Reveals Practice

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Abstract. This paper is about what happens when information technology artifacts are used in creative design practices. The paper is based on a small study of a design related situation where new IT artifacts are being used. The study is on composers and *musical composition*. The analysis and interpretation is based on the concepts of the *information-reality* relation and the *technology-preconception-use* relation. The idea of *externalization of knowledge* is also used as a way to understand some of the dynamic aspects found in the study. Based on the study it is possible to conclude that technology use lead to new demands concerning skills and knowledge needed to take part in a design practice and it may also change the appreciation of what constitutes a good design. The overall conclusion is that through close examination of technology it is possible to see how the notion of practice itself is changed. Technology *reveals practice* and challenges our understanding of the role of technology.

1 Introduction

> "An improvement of the tools for description of a certain domain will, in general, also be the starting point for new design and prescription which will change the domain originally to be described." (Sinding-Larsen, 1991)

In many design processes, such as architecture and urban planning, design of communication systems, of social systems, of educational systems and in infra-structural design, information technology is becoming more and more used. Designers are increasingly embracing opportunities brought by new technologies. But how will this increased use influence these processes and will it change the outcome of the design work? If we accept that this technology use will have impact on the outcome then in the long run it will influence vital aspects of the development of our society. Is it possible to say that technology actively plays a role in this process and if so, is it possible to study?

The purpose of this paper is not to answer these almost overwhelming questions concerning overall societal changes but to begin a "naming and framing" (Schön,

1987) of the influence information technology might have on design work in general. To do this it is necessary to formulate a conceptual framework for the understanding of the use of IT artifacts in design. This paper is such an attempt.

The paper begins with a short discussion on the possibilities of performing studies of the relation technology and practice. A small framework is presented. Them follows a discussion of the nature of information technology and what these IT artifacts in means and will mean when used in design work. The paper is based on a small study of a design-related situation where IT artifacts are used: *musical composition*. The study is interpreted based on: *the information-reality* relation and the *technology-conception-use* relation. The idea of *externalization of knowledge* is also used as a way to understand some of the dynamic aspects found. The paper ends by discussing how technology can be used as a way to reach a deeper understanding of practice. And how a close study of practice can help us understand technology.

2 The Technology – Use – Conception Relation

The way people use a specific technology is to large extent determined by their ideas, beliefs, understanding of the "nature" of that technology. Many studies have been made on how the users' expectations or conceptions of an information systems has shaped the way they approach and use the system (Orlikowski & Gash, 1994; Stolterman, 1991). These ideas are often based on some "constructivistic" or phenomenological approach. The basic idea is that peoples conceptions about reality strongly influences the way they can use technology. To be able to create a use situation of a specific technology it has to be part of the conceptual understanding of both the technology and the specific setting. Orlikowki and Gash (1994) presents the basic philosophy behind these ideas in labels the phenomena as "technological frames".

Technological frames can be understood as the "subset of members' organizational frames that concern the assumptions, expectations, and knowledge they use to understand technology in organizations. This includes not only the nature and role of the technology itself, but the specific conditions, applications, and consequences of that technology in particular contexts" (Orlikowski & Gash, 1994).

Orlikowski and Gash has the organizational context as their focus but the idea of technological frames can be transferred to a professional context, where we can find professional technological frames instead of organizational. What Orlikowski and Gash found in their study was that different groups, "technologists" and "users", had different technological frames, which lead to different assessments of the value and functionality of a specific information system. Even the actions taken by the two groups were in line with their particular technological frames. Similar results were seen in the Utopia project where a specific group of professionals were given to opportunity to design their own "tool" (Ehn, 1988).

Technological frames or preconceptions must be analyzed when a specific technology is studied, but it is as important to realize that use of a specific technology also influences and changes the preconceptions held by different users. There is a dialectical relation between the conceptions held by someone and how these conceptions shape the way the technology might be used *and* the way that technology slowly (or rapidly) influences the conceptions both about the nature of the technology and about the task or process in which the technology is used. This dialectical relation becomes quite visible in the example of musical composition described below. And it is a truly dialectical relation since the "clash" between the conceptions and the technology actually result in an emergent reality difficult to predict, at least in its particular instance.

We might form a simple triangle with the concepts *technology*, *conceptions* and *use*. The triangle shows how these three are mutually dependent and dynamically interrelated. If there are any changes in one of them the other two also changes. If we have a small change in the technology that might lead to changes in how it is used which has to lead to changes in the conceptions on both the technology itself and about how it is possible to use. If someone by accident or intent starts to use a technology in a new way, that will challenge our conceptions and it might actually inspire development in the technology. We have a fully dynamic and reciprocal relationship between these three "components".

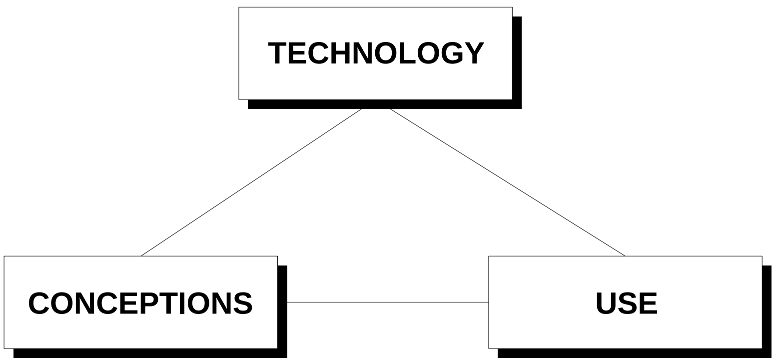

Figure 1. The technology-conception-use relation.

Looking at an "old" and established technology we usually find that the "triangle" has been stabilised over time. We usually think we understand the technology, both what it is, how it can be used and how we actually do use it. For instance, a technology such as bicycles has over time reach a quite stable "triangle". We still see changes in all three components but they have a more slow incremental character. We are seldom challenged to the degree that the triangle is threatened. But when we have radical changes in technology, conceptions or use the triangle is gets unstable. People feel as if they do not really understand technology and its use. We have to rethink technology, we have to test our way of using it. And at the same time if we have new ideas changing our understanding of technology we might have to change the technology. When a new technology appears there is no triangle available. We cannot explain the technology by pointing at some representative use of it, and we do not have any good conceptions by which we can understand what the technology is all about.

So, change can be induced in any of three corners of the triangle. This fully complex and dynamic dialectical relation puts us in a difficult position if we wish to analyze a specific technology and its relation to practice.

The relation between technology-use-conception demands, of course, very careful studies. The example below is not meant to be a good example of this. Instead it is an attempt to show that it is possible to make some of these complex and dynamic relationships visible and that this kind of study can lead to knowledge that can inform design of IT artifacts.

3 The studied technology

Information technology has a number of extraordinary properties, such as an unprecedented ability to store information, process and calculate data, manipulate symbols, etc. One of the most important properties of information technology today is its capacity to advance visualization. This is also the aspect focused in this paper. To see information technology as a visualization technology is in line with the new growing understanding of information technology as primarily a sensory and experience based technology (Waterworth, 1995; Smoliar & Waterworth & Kellock, 1995; Ivanov, 1995).

To visualize can be understood as a way to show the structure, order, form, dynamics, flow, relations of a phenomena in a visual way, i.e. in a way that to a lesser degree rely on the users imagination but more on his/hers senses. Visualization techniques may in a broader context be understood as the use of all senses in the attempt to convey understanding and meaning to data or information.

Visualization techniques are all around us in everyday life. We use signs, drawings, models, symbols in traffic, signs in work places, at home, to convey meaning and information to ourselves, to friends, and colleagues. Some techniques are very simple, e.g. traffic signs that with a small and simple symbol visualizes a danger or a rule that would be difficult to show at sufficient speed and precision with the use of text. Of course, also text and language is a way to visualize sounds and words.

Visualization techniques made possible by information technology can be everything from a word processor to a highly advanced flight simulator. In between there are visualization techniques such as multimedia and virtual reality techniques, but also techniques not primarily focused on the visual but more on the dynamics, such as systems for simulation of dynamic processes or interactive educational software and games.

It is possible to distinguish between, at least, two kinds of use of visualization techniques. The technique can be used to: (1) visualize something *existing* and/or (2) visualize some-thing *not-yet-existing*. The first one can be understood as a *description* (of the “real” reality) and the second one as an *imagination* (concerned with a future or fictive reality).

When technology is used to depict or describe reality new questions arise such as the relation between reality and the representation. With virtual reality techniques, this relation becomes even more delicate. Even if we in the case of the not-yet-existing have the same problem to some extent, it has a different meaning. According to Coyne (1995) there are two ways to deal with the relation between the real and the representation. We can adopt a *correspondence* or a *constructivist* view. In the first case (correspondence) representations can be measured in relation to how well they actually “copy” reality. In a constructivist view appreciation of “realism” is something that has to be learned, since it “is a cultural phenomena” (Coyne, 1995).

This means that visualization, according to a constructivist view, is not necessary about photo-realism but a question of choosing a visualization that the expected “readers” under-stand in a planned way. Coyne uses the expression the “appreciative community” to show that “reading” skills are culturally determined and something that changes over time. A simple example is music. A sheet of music with its notes does not represent the music performed based on that sheet. Any musician can and probably will interpret the notes in her own way. There is no true correspondence between the notes and the sounding music; still the notes do represent the music.

This means that whenever we changes the technology used to visualize we also need to change the “appreciative community” if we want to be sure about how the visualization is read and understood - for instance, if we want the music to sound in a particular way. Throughout this paper visualization is understood based on a constructivist view. One reason is that when the focus is on the not-yet-existing there exists no reality possible to be used as a measure on how well the visualization is made. A new design has no corresponding “reality” – it is “only” an idea, a thought. Description in this case can not be measured as true or not. Instead, it has to be valued according to the reactions and actions it evokes in the “reader”. It becomes a more pragmatic tool in design instead of a tool for analyzing the truthfulness of something already existing.

One idea to get away from the question of “realism” is to understand technology as having the ability to disclose a world, not by depicting or describing it, but by showing us differences between our perception of the world and the portrait of the world shown in the visualization. We can, based on this view, leave the question of truthful representations behind and instead focus on how different visualization reveal and discloses a new reality to us. This is a pragmatic view in line with the philosophy of Richard Rorty (1999).

Based on the two studies (presented later), sometimes the use will slowly change from being visualization *about the existing* to be *about the not-yet-existing*, or the other way around. In almost any creative design work, both of these uses may be found. However, in this paper the focus is on people trying to visualize something not-yet-existing.

Visualization technology changes the way we are used to face information on future designs. Instead of being forced to *imagine* the qualities of the new design, it is now possible to *experience* them. Even if this new technology cannot, today, fully justify all aspects of new design proposals there is already experiments and attempts done to use the technology in real situations, for instance in the design and planning of new sports arenas or new shop-ping malls. And experiments where politicians and planners are given the opportunity to experience how it is to be in a wheel chair in a city center.

Advanced visualization techniques can be described as d*ynamic* and *concrete*, while traditional techniques (such as maps, tables, models and text) are *static* and *abstract*. They are static in the sense that they can not visualize dynamic processes and time related changes in the visualized design. They are abstract since they only capture a few of the aspects needed to get a full understanding of a design, and because they demand an intellectual transformation before they can be experienced. The concrete instead is directly available to our senses. “VR is thus the culmination of our recent, technologically-motivated, cultural progression towards the concrete and away from the abstract” (Waterworth, 1996).

A good example of how really advanced visualization technique could be like is the computer game SimCity. In this game, it is possible to design a city. The design is dynamic in the sense that many time related activities are built in the system, e.g. the economic system is dynamic, buildings and streets age and has to be repaired, everything demands energy that has to be supplied, etc. There are even social reactions built in, so if you design a city with high crime, or bad streets, the citizens will complain. Of course, SimCity is only a game and the dynamic structures and relations built in are very limited (but still complex enough for the player). Still, the game presents a good picture of what might be the future of visualization techniques used in design work.

When new technology is being used things happen. There are two basic skills involved in the use of visualization techniques: the *“writing” skill* and the *“reading” skill* (Borgmann, 1995). Writing and reading are here used as generic concepts to denote all activities involved in the creation of a visualization of a specific design or plan and similarly all activities involved in the “use” of that design or plan.

With the use of visualization techniques, new skills are demanded from those who have the responsibility to “write” or construct the visualization. Depending on the techniques used it might include graphic design, musical composition and editing, the construction of animated or 3D dynamic and interactive “worlds”. Apart from technical competence, one general consequence seems to be that *aesthetic form* and *dynamic presentation* will become increasingly important.

Since visualization is more aesthetic and dynamic “reading” design proposals will become more *experienced based*. To see, experience, and maybe even participate in dynamic processes (physical or social) “performed” in a virtual reality will radically change the preconditions for the handling of complex situations for designers, planners and decision makers of societal systems. Such a move towards concreteness will drastically reduce the need for specific reading skills – “now the abstract to concrete mapping involves no conscious effort on our part” (Waterworth, 1996). With the help of this technology it will, for instance, be possible to experience a new planned city district, or a new sports arena, or a new information infrastructure without any architectural or engineering skills.

This is a big change, since it will decrease the need for specialized professional “reading” skills (Borgmann, 1995). Today all information “reading” demands an intellectual effort that often requires training and education. The skills of reading and understanding abstract descriptions and models are essential to be able to take part in the design processes. The new technology changes these demands. This transformation is a focal point of this paper.

4 Some concepts for interpreting the study

It is obvious that the use of highly advanced technologies can be analyzed in many different ways. My purpose has not been to create a coherent theoretical framework; instead I have tried to find concepts that can be used to interpret some of the findings in the studies. I believe that more work is needed. There is a need for both a deepening of the theoretical foundation in a way that makes analysis of more complete studies possible, but also a development of a broader theoretical frame that could link these findings to other theories concerned with the use of technology at large.

The purpose of this section is to give a short background and presentation of some of the concepts used in the interpretation of the study. Even if these concepts provide some basis for an analysis, there might be other ways to analyze the findings, especially since the study is small. Still, however small, the study can function as a way to open new questions and new fields of inquiry.

As a way to understand the underlying dynamics found in the study I use the concept of *externalization of knowledge*. And as a way to understand how this technology have a social and professional impact I use two theoretical constructs: the *information-reality* relation and the already discussed *technology-conception-use* relation.

4.1 The externalization of knowledge

Through history mankind has continuously transferred knowledge to a storage outside human mind (Sinding-Larsen, 1991). This externalization has mainly been a question of using technology to become “bearer” of knowledge. Written language was, of course, one of the most important steps in this development (Ong, 1982). And today information technology has the leading role in this continuing externalization. Every form of externalization of knowledge presupposes a common understanding of the form in which the knowledge is to be externalized. It also demands the two skills of “writing” and “reading”. The writing and reading should be understood in a broad, generic and almost metaphorical way. When it comes to the written language, writing and reading is the actual skills. In composing music it is the skill to write and read a specific notation.

The skills of “writing” and “reading” are with the use of visualization techniques in the form of IT artifacts becoming more diverse and perhaps also more complex. These techniques are not based on a single well-defined notation system as written language or the traditional musical notation. In the process of externalization we see today a move from abstract externalization’s, such as written language, statistics, musical notation, architectural drawings, to more concrete and dynamic ways of externalize. When this happens there is a change in the reading skills.

The reading is slowly becoming more experience based and similar how we face our everyday reality. This might lead to a situation where the externalized knowledge must be perceived and understood in the same way as we encounter our everyday reality.

Since the externalization of knowledge is an important way for humans to cope with an increasingly complex reality we might also assume that the way this externalization is done influences our overall perception and understanding of that reality. At a basic philosophical level, when our external knowledge changes in form and contents, our reality is also changed.

In his study of the history of musical notation Sinding-Larsen shows how the externalization of music not only has changed the process of writing music but also how it has changed the perceptions of music and also the appreciation of good music (Sinding-Larsen, 1991). The same changes, though in a much smaller scale, in externalization and how the writing and reading skills are changed can be found in the study below. The concept of “externalization of knowledge” will be used as one way to understand some of these changes.

4.2 The information-reality relation

Borgmann (1995) makes a distinction between three ways to understand the relation between information and reality: (1) information *about* reality, (2) information *for* reality and (3) information *as* reality. These distinctions are all quite intuitive and simple but still they can be used as a way to interpret changes in our way to use information.

When information is used as a representation of what is existing, we have information about reality. This is information, as we often understand it in education and research but also in our every-day dealings with information and news in media of different kind.

When information is used *for* reality, it is information showing or presenting a reality not yet existing. This is when we want to inform about something “remote in conception and imagination” (Borgmann, 1995). Typically, this is design proposals, plans, and all kinds of descriptions of the future. It is when we use information as a way to envision a future reality. Architectural drawings and musical scores are examples of information *for* reality. “While information about reality renders our world perspicuous in its order of nearness and fairness, information for reality is the source of a distinctively prosperous culture” (Borgmann, 1995). To be able to use these two kinds of information we need “competence and discipline”.

With information technology, we are faced with a new situation where we actually can see information *as* reality. With information *as* reality, we enter a new and different world. Information becomes at the same time both for and about reality. Information is no longer separated from the thing it is about, whether it is existing or not. The “thing” the information constructs is what it is about. When we enter cyberspace, “virtual worlds”, “virtual reality”-systems, we enter an information world that is not necessarily about another world.

To Borgmann, this change drastically influences our perception of both the idea of information and the idea about the “real” reality. Borgmann believes that this change might, in the end, separate us from the “actuality of people and the nearness of things”. To him we need to regain that nearness - a theme he has developed in his latest book “Holding on to reality” (Borgmann, 1999).

5 The Study

The purpose of the study has mainly been explorative. I have used it as a source in the attempt to create a first crude understanding of what happens when IT artifacts are being used in a design or planning process. The study should not be seen as representative of the entire field of design. Instead the assumption has been that basic conceptual work can benefit from specific cases since it is in the details and anomalies that technology reveals practice[1].

The study is about *musical composition*. The education of composers has radically changed over the last ten years. Composition has moved from being paper and pencil based to a high-tech setting with computers and software, synthesizers, keyboards, and studio equipment. The composition process can today be a process highly supported by advanced IT artifacts.

This changed situation and the changed preconditions for the composition process have had real impact on composers’ way of understanding the process of composition and on how they perform their design work. This is of course not a new thing, changes in the understanding of composition has occurred throughout the history with the advent of every new technology (Sinding-Larsen, 1991).

5.1 The study

In this small study four composers at the Department of Musical Composition at the Institute of Music in Piteå, Sweden, were interviewed. Two of them where teachers in advanced composition. One of the teachers is also professor and chair of the

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1 This is a very bold assumption and not well argued in this paper. At the end of the paper I will get back to this specific methodological assumption and comment on it.

department. The professor is an internationally known composer. The other two persons were advanced students in the late stage of their education. I also followed some of the composition sessions where the professor instructed some of the more advanced students.

The description of how composition is changing and influenced by new technology presented below is mostly based on the picture presented to me by the professor, the teacher and by the two students. The interviews were informal. The purpose was to establish an overall picture of how these professionals perceive changes in their relations to their tools and skills as a result of the use of advanced visualization techniques, i.e. IT artifacts. This group of composers might not be representative for the profession, but still their case provide a picture of one possible transition in professional skill caused by new technology.

5.2 Changes in composition

Composition has a long history of “externalization of knowledge” (Sinding-Larsen, 1991). In the beginning the notation of music was only meant as a tool to remember and to educate. It took a long time before the notation was perceived as a way to design new music. In the beginning they were largely unaware of the fact that the tool of description they developed with the aim of preserving a tradition would become a major change agent, transforming the very music they wanted to preserve. (Sinding-Larsen, 1991)

History shows that the notation system gradually became a tool for com-posers to explore new possibilities in the design and organization of music. The tool was intentionally developed to inform *about* a reality, but it soon became a tool *for* reality. “..its [the notation system] power to create and pre-scribe new kinds of knowledge changed its original domain of description” (Sinding-Larsen, 1991).

Composers have traditionally worked with a notation system characterized by semi-formal properties based on strict rules concerning what is and is not permitted. The notation system has many of the properties we are used to find in other formal systems, e.g. rules concerning consistency and completeness.

The study showed that composers today are a lot more visually oriented. They use technology that diminishes the demand of a formal notation system. The IT artifacts used allows the composer to shift between many different kinds of notations to create a representation of the music. Composers’ use various ways of visual images, pictures, or structures as a way to represent the sound they want to create. Composition has change from demanding an *intellectual imaginative competence* to a demand of a *visually experience based competence*.

Historically composition has required a composer to have the ability to *imagine* how the finished composition will sound. Now, composition can be a continuous experimental process where the composer all the time, repeatedly, can experience (listen to) the music and adjust and change the composition after the repeated experiences.

One conclusion might be that the new visualization technique can best be exploited by composers with a change attitude and understanding of the "nature" of composition, i.e. with a different set of conceptions of what "use" is all about. This new technique also demands a new set of talents and abilities from a person wanting to become a composer[2].

5.3 The session

At one session I followed the professor instructing an advanced student (who also was a teacher in composition). During this session new ways of approaching composition became visible.

The student had made a composition based on an old hymn. The music piece was arranged as a brass ensemble. The student and the professor listened as the computer played the composition. The professor said that he was not quite pleased with the result. He described it as "too heavy, and somewhat boring". He sat down by the computer. He took the score that was in a traditional notation and transformed it with the help of a composition program into a visual abstract layout, not resembling traditional notation. This new layout only consisted of black blocks indicating very approximately the height and length of a sound, not of individual tones or chords.

The professor said "we have to move things around, make it less dense". He used a kind of "cut and paste" tool to do what he had suggested. He also changed the instrumentation while discussing the overall sound of the musical piece with the student. He asked the student a couple of questions about his basic idea for the piece and what his expectations had been. The student answered and the professor made changes according to the answers he got.

The way he used the tools on the computer revealed quite clearly that the "cutting and pasting" and the rearranging was not based on a clear idea about the final result. His actions and comments during the process showed that even if he did not know what the outcome would be like, he had some vague ideas that led him in the experimentation with the piece of music. This "re-design" of the music piece took only about three minutes.

When the professor was done, he played the new "edited" piece. The sound was completely new and different. The whole idea of the piece was changed but still it was possible to recognize the original music and the original "mood" expressed in the piece. After this first try the professor and the student together made a number of new changes and they experimented with new instrumentation, different rearrangements, etc. After an hour, they agreed that they had reached a new and much improved version of the original composition.

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[2] Based on this study it is possible to develop some interesting knowledge on the future of composition and maybe also on what could/should be required from future students in the field. This is though outside the scope of this paper.

5.4 Conceptions and use of technology

This way of working with a composition presupposes the use of advanced new technology. With the help of the composition software the composer can work both with different representations and different visualizations of the music at the same time. The composer can also experiment with sounds and arrangements in ways not possible without the technology. The technology also permits the composer to go back and retrieve earlier versions and compare them with the new.

It is not necessary the case that it is the *need* of tools for composition that have lead to this new situation. Composers have probably not requested this kind of IT artifacts, and they have maybe not even been able to imagine such tools. But the capability of the technology has imposed new possibilities and restrictions to the composition practice and thereby caused radical changes. And this capability is difficult not to use – “if one can manipulate things to produce a solution in a reasonable time period, one is less likely to put as much effort into solving the problem mentally” (Waterworth, 1996).

In order to appreciate and even understand the new technology there is a need of a changed conceptualization of what composition is all about. If composition is seen and understood in the traditional way the capabilities offered by the technology will not be a contribution to practice. If composition is based on the traditional understanding of the need for an intellectual imaginative competence, than you do not have any use of a tool that enhances an experimental and visual approach to composition.

In the interviews the composers described how they had changed their perception of the new tools, but also that this change had taken quite a long time. A change of “technological frames” or preconceptions can sometimes only be a result of many hours or days spent with the new technology. Other studies have showed how people approach a new technology based on their understanding of the old way they did their tasks. For instance, from the beginning the word processor was seen as a typewriter that is a conception of the tool that in many ways prohibits the user to take full advantage of the new possibilities. The change of preconceptions is how-ever very important and when it has occurred it can have strong impact on the way people approach new technology, how they evaluate it and even (as in the case with the com-posers) how they appreciate and understand their own profession and skills.

In the traditional composition process the material used can be described as static and abstract (the notation) while the new technology creates a situation where the material used is dynamic and concrete. In the new approach to composition, there are no longer any sharp distinctions between the process and the product. The dynamic and experimental character of the composition process makes it difficult to define a state when a composition is finished or when the composer is no longer composing. Since the representation does not have the qualities of a closed system, there are no inherent properties in the notation system that puts such demands on the composer. It is possible (and not uncommon) to make compositions that are in a cybernetic relation to the situation in which they are performed. The composition changes in relation to changes in the environment, the audience, etc.

This affects the way composers see themselves. In the interviews, this became visible as they expressed a view where they did not see the composition process completely distinct from the actual performance. In some cases they actually perform their own music “live”, which means that they use the computer as an instrument and they mix pre-composed material together with “real-time” input. This shift of understanding of the role of composer versus musician is an example on how technology actually changes their conceptions, and how that leads to changes in their use of the technology.

5.5 Technology and skills

In the study it was possible to see that the shift of technology in the composition process also changed the dominating conception of the role of technology in composition. The composers were aware of the role of technology and how it had changed their profession, but they were not all convinced that the change was for something better.

I found the composers involved in a lively debate among themselves about how technology had changed the preconditions for being a composer. They talked a lot about the “new situation” and how traditional abilities were not suitable or necessary any more. And how technology demanded new kinds of abilities and competencies. They all agreed that to be a composer today does not necessary demand the ability to read traditional notation and “hear” the music inside your head. This specific talent or skill that always has impressed people and almost been seen as “magical” is maybe no longer necessary. They all agreed that today a composer need to be interested in technology and interested in experimentation, both with technology and music itself.

5.6 Technology and the idea of music

One of the most interesting findings was the change in the rhetoric regarding “good music”. It seems as if the use of technology not only changes the composing process but also the idea of what constitutes good music. In their discussions about good and bad qualities of different compositions it was possible to trace concepts and expressions back to the new competencies expressed in the use of the new technology.

What has happened is maybe that “a new tool of description (notation) makes it possible to make explicit (i.e. to give external reality to) structures that had previously been implicit” and to see them as isolated “conceptual entities and give them names” (Sinding-Larsen, 1991). The technology makes it possible to talk about new aspect of music, new qualities become visible and possible to value and judge.

This change is as a very important aspect of the use of new technology. When new techniques are used we do not only change the necessary skills but also the way to “name and frame” qualities in the produced products. It seems also probable to believe that this kind of change is not easy to predict. New technology will influence how designs are valued might depend on aspects of the technology use not visible until the technology has been used for a long time. It was obvious that even if the composers knew or at least felt that technology did influence their values they could not easily describe in what way or why or when it began. Technology might influence our conceptions of what the technology itself but also on how it is used and what that use means in ways not anticipated or even possible to guess.

5.7 Conclusion

A study of the way composers work with the use of new visualization techniques have given us a lot of clues and ideas on how to form a more general interpretation of what will happen when we adapt IT artifacts in design and planning processes.

One value of the case is the fact that today composers are among the professionals with the most sophisticated use of IT artifacts in their design work. Furthermore, musical composition is a field commonly characterized and believed to be dominated by a very artistic approach – the study raises concerns about that belief. We might assume that this is a too narrow understanding.

The composers in the study were very well aware of the fact that their use of advanced technology is changing their practice and competence. They were also aware of the slow and almost invisible process where their ideas of music and its values are slowly changing. Still, they are not rejecting new technology. Instead the studied group seemed to be professionals actively experimenting with all kinds of new techniques to learn about the possibilities and restrictions caused by their use, with the hope to find new ways to express their musical visions and dreams.

6 Some interpretations of the study

Even if the study presented above can not be used to draw any general conclusions about the consequences in the use of IT artifacts in design, at least it has revealed some important questions that need to be further studied. Some hypothesis can be created based on the study.

6.1 The externalization of knowledge

In the study, we could see that the use of a new technique changes our way to externalize knowledge. In the composition case the “inscribed behavior” (Akrich, 1992) in the used technology changes the skills needed to perform the design process – the “writing” skill. It also changed the skills needed to “read” that design.

It is also clear that the way knowledge can be externalized has radically changed musical composition. There are at least two major shifts. First we have the possibility to construct “dynamic descriptions of processes through simulation” (Sinding-Larsen, 1995). Visualization techniques make it possible to interact with a dynamic visualization of a piece of music. We could see indications of such a shift for instance when the composers used a kind of “trial–and–error” and “cut–and–paste” approach.

Such an approach changes the more traditional deliberate and conscious step–by–step approach where the design has to be thought out in advance, since larger changes becomes very time consuming and difficult to make. Instead, we can see an increased interest in a more flexible and improvisational way of working which might lead to new designs and new music.

According to Sinding-Larsen this “conflict” has always been a battle between two regimes “one characterized by notation, explicit knowledge, fixation and standardization; the other by oral culture, tacit knowledge, openness and improvisation” (Sinding-Larsen, 1991). To Sinding-Larsen this is not a question between one side or the other but to find a balance between the two, which implies a better understanding of the contributions from both sides.

6.2 The information-reality relation

When we change the use of technology in a specific design process it will also change our perception of reality and of what constitutes the design process. In the case of composition the composers were aware of the difference of seeing the notation as something for reality and the new situation where notation also was seen as reality. The music does not have to go through the process of being read, interpreted and performed by someone else than the composer. The interpretation and performance actually becomes a part of the composition process. This is a radical change of our relation to reality and a change that could have strong implications in a society where more and more of our work is done with, by, and on information. The distinction between representation and reality slowly vanishes.

Is it important to keep this distinction? Borgmann argues that it is. To him it is important to have a nearness to the “real” thing. The problem in the case discussed here is that we are slowly moving away from a situation were there actually does not exist a “real” thing. When the composed music only exists in electronic form, and is only played by a computer and synthesizer, what then is the “real” thing? To what do we need to keep a “nearness”?

In the age of Virtual Reality and Cyberspace we are increasingly confronted with a new parts of our reality that will no longer be possible to view as a representation of the “true” or “real” reality. Cyberspace is not only *about* reality it *is* the reality. We do actually do work in cyberspace. When we write a text with our word processor, when we publish it on a web page, when someone visits the page and reads the document, it all takes place in cyberspace and the distinction between information *about* reality and information *as* reality is difficult to uphold.

7 The technology-preconception-use relation

It is in the study possible to see a change in the way users of a specific technique also changes their way of perceiving not only the technology used but also the content it is used upon. The chosen technology seems to have implication on our values and our way to make rational decisions. It is also possible that the choice of technology will change our way to appreciate good quality, as with the composers who changes their idea of what constitutes good music when they have been using their new technology for a while.

When this happens we will also change our way of understanding the technology itself. If we in the beginning are reluctant to the use of a new technology because we think the quality of the outcome is not satisfactory, maybe after a while this will change and we will start to appreciate the qualities supported by the use of this technology. And this will, of course, change our willingness to use the technology in fields where it would never have been accepted before.

This may be a way to understand how technologies slowly becomes accepted in society even though they in the beginning are not believed to be either wanted nor needed. The introduction of the cellular phone has for instance slowly changed our perception of what constitutes a telephone. It is no longer something closely related to a specific location, instead it is distinctly associated with a specific person. When the person moves around, so does the phone- (connection), and when we call a cellular phone and someone else than the owner answers we are surprised. This new way of using phones has also changed our way of under-standing what it means to be reach-able, or what a phone is good for. Some may not like this change but it is difficult to keep the old understanding of the technology when the new is already around. Even if we took away cellular phones our ideas about the technology would still be changed.

As with the case of the study, the cellular phone is not only a new way of using a technology, it actually brings about social changes in the structure of society. Similar social changes will take place when IT artifacts become more frequent in design and planning processes. There is a need today to study these changes to prepare ourselves to some of the changes we might not like or want. Even if we cannot decide how, where and when a certain technology should or could not be used, a better understanding of how they might influence our societal life increases our space of possible actions as a society. This is also a way to increase our design ability. If we, as in the study, can see and understand some changes caused or influenced by the IT artifacts used, this knowledge can inform our future designs.

8 Conclusions

Based on the study it is possible to conclude that technology use will lead to new demands concerning skills and knowledge needed to take part in a design practice and it may also change the appreciation of what constitutes both good practice and good results. The findings show that in order to develop knowledge of what constitutes good design of IT artifacts we need a more developed understanding of the complex relationship between technology, use and conceptions. The study also shows that it is possible to come up with general conclusions on this relationship even in small studies of situations with a very specific use of technology. It might even be the case that such studies offer a better possibility to make changes visible since they are not hidden by a stable and conform common understanding of what the studied technology is all about.

The study also shows the importance of having conceptual and theoretical "tools" that helps identifying and finding dialectic influences between technology and practice since the complexity of the relation otherwise almost makes the relationship impenetrable.

The overall conclusion is that through close examination of technology it is possible to observe how the practice itself is changed. In this case it is not that technology necessary changes practice but *technology reveals practice*. Through our examination of technology practice becomes visible and possible to analyze. At the same time this new understanding of practice challenges our understanding of the role of technology. All of this is vital knowledge, both as a background for design of new IT artifacts but also for our general understanding of how this kind of technology have influence on our society and its development.

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Re-Inventing Information Systems: Continuous Adaptation Capability

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Abstract. We have a good understanding of the factors facilitating Information Systems (IS) assimilation and effective use, but there is a lack of studies to identify the state of IS utilization in an organizational context. However, it has been identified that individuals do have a major role in supplementing deficient IS and making IS and work inseparable. Here, we investigate the role of continuous adaptation capability as a source for competitive edge. The aim of the paper is to elaborate the nature of long-term cumulative learning process and organizational capabilities to overcome potential learning barriers.

1 Introduction

Nurminen and his research team have notified that most IT systems do support work deficiently (Laboris, 1998). Their research underlines the importance of human integrators where the end-users are responsible for tailoring IT systems suitable for work processes. Nurminen argues that IS and work are inseparable. Nurminen concludes that users are the ones who have the capability to combine IS and work. Could we use the research finding when we elaborate IS a source for competive edge? Nurminen has developed a layered approach to evaluate the same problem from different perspectives. The framework is known as the Onion model (Kortteinen et al., 1996). This paper combines the author's previous research about organizational capabilities to use IT systems (see Auer, 1995) and industrial knowledge gained as a practitioner.

The changes in IS use and management have been extremely rapid. About twenty years ago IS use and management belonged to specialists. The IS management issues were mainly technical and IS tasks in user organizations were mostly operational in nature. At the same time the competitive environment, business organizations, usage of information systems as well as technology have met radical and numerous changes. However, a major part of core information systems do originate from the 1980's.

Lets take telecommunications industry as an example. About 20 years ago telecommunications industry was regarded as a utility rather than a service business. For example, here in Finland major banks had to apply new data communications lines from an operator. Yes, the operator had the power to decide whether the customer really needed the access. We can easily agree that the business needs and challenges have totally changed. Our (TeliaSonera Finland) core service delivery and billing system for mobile services has been developed in the early 80's. The system is called as NAK (NMT, ARP and Kaukohaku). The old IT legacy has provided a real sustainable competitive edge – or rather the usage of these systems. Fully automated provision of mobile services has been the reality for years. Automated processes have been developed based on the foundations of a 20 years old legacy system. Our competitors have not been able to match this performance. Further, as our track record clearly shows, new service innovations have been introduced to the marketplace – if there has been a will - much before our competitors.

What's the basis for such a competitive edge? Do we regard the system as a source for competitiveness No definitely not. It's a real bottleneck. The developers are not happy with the system, management sees that the system slows down our capability to launch new services, and from a user perspective the system is complex and difficult to use. But foremost the customers do get suberp service.

We investigate the phenomena as a continuous learning process. IS utilization is not only a matter of users, management and the IS, but also their mutual interaction within environmental constraints and possibilities. Organizational context is the environment in which the organizational actors are performing their work tasks. Organizational routines and norms direct individuals' actions, resulting in cumulative IS utilization to support organizational goals, but by doing that they may also form barriers against learning. IS form organizational realities by freezing organizational processes and structures. On the other hand, organizational structures are changing extremely rapidly, whereas IS are relatively slow to change. Every new organization tend to start a project to simplify its IS architecture and IS map, but much before the project ends another major organizational change is going on.

2 Cumulative learning process

We argue that a significant source for competitive edge is dependant on organizations capabilities to re-invent IT continually. Here, the phenomena is called as continuous adaptation capability. Continuous adaptation capability is defined here as "*an organizations capability to adapt into emerging ways to use information systems where the usage situation cannot be predefined*".

Ability is defined as a skill required to accomplish an objective (Nelson & Cheney, 1987). Form an IS viewpoint it includes both the artifact dimension (skills to use IS) and work dimension (skills to combine work and IS), but also the realized action (Eriksson et al., 1988). Here, we underline the need for understanding the existing organizational abilities before directing learning efforts, since in a learning process giant strides cannot be taken. It is the achieved competence which makes it possible to acquire new abilities (see Cohen & Levinthal, 1990; Huff et. al, 1988). The learning process itself is long and requires a lot of support until organizational level ultimate value effects can be realized (see for example Hamblin's change analysis, 1974). At the individual level, the changes may be realized relatively rapidly, but the transition of an organizational unit is much more complex and requires both resources and time. In contrast, IT can be improved through heavy investments, but this then raises the question of how the more advanced state of IT can be put into practice. In some cases the same and even better results might be achieved by investing in the use of existing systems. The potential of current systems might only be partially used, and changing existing systems might result in an unnecessary learning process.

To understand the continuous nature of IS adoption, we have to consider the complex interplay of organizational actors, information technology, and organizational processes in their environment before we are able to draw a realistic picture of the quality of IS usage as a function of time. Studies evaluating IS generally assume that the system under study (Kaplan, 1991; Rogers, 1983) or environment has become stable. The ever changing nature of organizations and information systems results from the interaction of organizational actors and their environment.

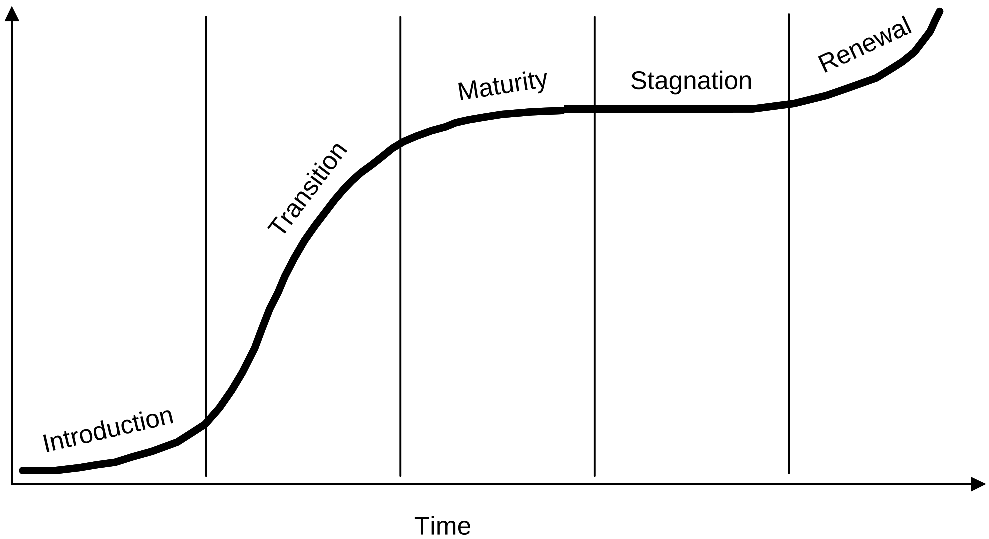

Figure 1. Cumulative learning process.

To understand the continuous nature of IS adoption we use models to describe learning curves (see Auer, 1995). Researchers have used these models widely, when assessing advancement of IT in organizations (see for example Li & Rogers, 1991;

Magal, 1989; Mason & Willcocks, 1991). At organizational level, the evolution process of IS-related cumulative learning entails five phases (Figure 1): Introduction, Transition, Maturity, Stagnation and Renewal. The descriptions of the phases are as follows:

- Introduction: IT is implemented in an organization at the first time.
- Transition: A phase to integrate the usage, management and IT components in their organizational environment, in order to reach a balance between the components and organizational goals.
- Maturity: A balance exists between the usage, management and IT and organizational goals, and IS are utilized effectively in a user organization.
- Stagnation: Where IS utilization is unsuccessful, since IS-related organizational maturity as a whole - or one or more of its components - is not changing or developing in the way organizational goals require.
- Renewal: A change in usage, management, IT or organizational environment offers new opportunities for IT utilization and another maturing process begins.

Figure 1 presents the phases as sequential stages, but we do not suggest that they would be realized as such. Earl's idea (1989) that S-curves of learning are repeated for new technology, and different parts of an organization might be at a different stage, gives us our starting point. It is not only the technology that can offer new opportunities, but an organization itself and an organizational environment may also trigger the renewal process. We adapt the idea that phases are not connected to each other in any deterministic sequence (see Miller & Friesen, 1984). This means that an organization may proceed, for example, from transition to renewal. Further, whereas maturity is seen as 'good', stagnation is a cause of 'over-maturity'. If an organization remains at the stagnation phase, this is seen here as an interference in the learning process.

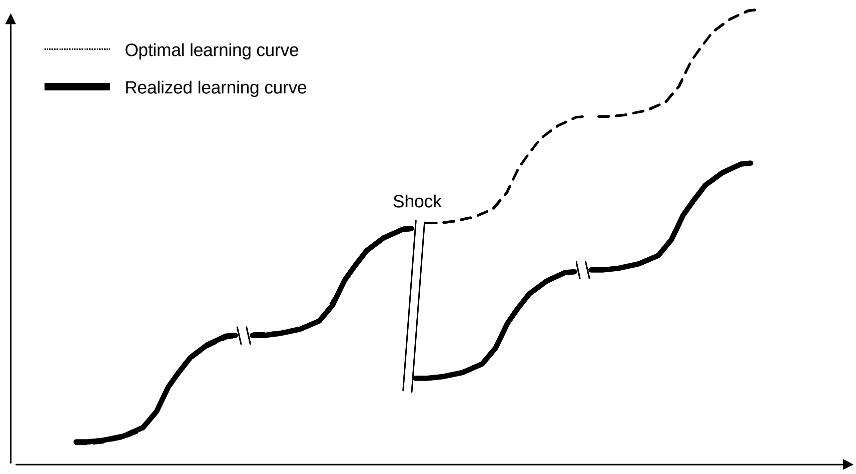

Figure 2: Discontinuance in the learning curve.

In a normal situation, a renewal phase can be built on existing competencies, but in some circumstances we may have to dispense with (or may lose) existing organizational abilities. We call this discontinuance in the process (Figure 2). A shock (Senge & Fulmer, 1991) may occur due to gradual or radical changes, and previously valid abilities (or sound and usable IT) might become useless.

3 Barriers to learning

Every organizational change (as well as introduction of new IT systems) triggers another learning curve. The effectiveness of each learning curve is dependant on an organization's capabilities to overcome learning barriers. If an organization fails, discontinuance in the learning process will be realized.

Factors exist in organizations that hinder assimilation and the effective use of Information Systems (Argyris, 1990; Attewell, 1992; Beatty & Gordon, 1988; Boynton et. al, 1994; Cohen & Levinthal, 1990; Dodgson, 1993; Kim, 1993; Senge, 1990). Beatty and Gordon (1988) classified these barriers into three categories. First, they identified built-in mechanisms that deterred the adoption and successful use of technology, which they termed structural barriers. Secondly, human barriers refer to hindrances caused by employees' perceptions, skills and biases. Thirdly, they identified the technical barriers hindering IS adoption and successful use thereof.

We adapt the classification presented by Beatty and Gordon, and suggest some changes. First, human barriers should be split into user and managerial categories. An organization's innovative capability is dependent on its prior related knowledge, termed absorptive capacity (Cohen & Levinthal, 1990). The level of absorptive capacity depends both on a potential adopter's ability to recognize [management] the value of new information, and to exploit that information for the organization [users]. Similarly, according to diffusion theory (Rogers, 1983), innovations are initially adopted by organizations rather than individuals, and in most cases an individual cannot adopt a new idea until an organization has previously done so. Problems related to the IT can be blamed on management's failure to direct IS activities in user organizations; the usage problems also may reflect on management's shortcomings (Auer, 1995) to combine organizational change and existing IT.

Altogether, the barriers may originate from 1) structural, 2) managerial, 3) user or 4) technical factors, or 5) from a combination thereof. In this study, an organizations capability to overcome these learning barriers is seen crucial for quality IT use.

4 Analysis and summary

We argue that continuous IT related learning capabilities both at individual and organizational levels do play an important role in gaining competitive advantage. As an example we have used a 20 years old legacy system. Originally the system was developed for a totally different organizational context and competitive environment. The example illustrates that it is possible to gain competitive advantage by substituting deficiencies of IS with quality organizational adaptation capabilities.

In the illustrative example the main source for competitive advantage seems to arise from the cumulative learning capacity of end user organizations to supplement IT systems, management to concentrate on the bottleneck and IT personnel to integrate old and new.

The example does not suggest that IT systems should not be changed radically or replaced with modern and more suitable ones. However, we do argue that human related continuous adaptation capability might be the most important factor to gain competitive advantage.

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When Grasp Exceeds Reach: Will Fortifying our Theoretical Core Save the Information Systems (IS) Field?

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Abstract. The information systems field has witnessed multiple calls for a disciplinary identity founded on a strong theoretical core. This is seen as a critical condition for disciplinary survival. In this paper we critically evaluate assumptions that underlie these discussions. Our analysis suggest that such evaluations are based on a false logic, and do not recognize ample evidence from the emergence and growth of different disciplines. In brief, there is no empirical support that the existence of a core explains disciplinary success, or its lack explains disciplinary failure. Instead, the existence of core is better explained by a disciplinary success, which follows from novel and bold boundary spanning activity. The need for strong intellectual cores is rather caused by institutional politics in the academia, a dominating ideology of the role of science in society, and defensive political strategies followed by many IS scholars. To become successful the IS field needs intellectual discipline in its boundary spanning activities, but it does not need to be a *discipline* defined by rules of inclusion and exclusion. The essential discipline in our scholarship occurs in the minds of creative investigators, not in the social conventions of our field. Therefore the IS field has a greater need for a *bold intellectual reach* than for a *tight disciplinary grasp* in order to flourish.

KEYWORDS: Information Systems, disciplinary identity, core theory, paradigms, institutional politics, evolution of science

“Ah, but a man’s reach should exceed his grasp, Or what’s a heaven for?”
The Faultless Painter, Robert Browning (1812-1889)

1 Introduction

We'll start with a little history. When we entered the field in late 70's[1] there was no information systems (IS) field. There were some emergent IS programs at places like Minnesota, Arizona, NYU and similarly in Europe in LSE, Netherlands and some places in Scandinavia, but there was as yet no established identity. Our first faculty job offers were not in IS, but in public administration and computer science, respectively. ICIS started around 1980 and many other similar IS conferences like IRIS a few years earlier or later. IFIP TC8 was established in 1975, and IFIP 8.2. around 1977. MISQ started around 1980. Yet, IS as a "field" didn't really begin to form until the late 1980's, after a few more journals had been launched, and the movement to create AIS began. In disciplinary terms the IS field is maybe 20 years old. We cannot think of any identifiable disciplinary field that has attained strong independent status in less than about 35 years. The IS field is about as far along as we might reasonably expect at this time, if our goal really is establishment of disciplinary identity.

Yet, while IS has grown since its humble origins in the early 70's into maturity in size, institutional status, and the general quality of the disciplinary discourse the students of information systems (IS) are constantly haunted by the "something is rotten in the state of Denmark" syndrome: they perceive deadly threats that will eventually lead to the demise of the IS field unless something is done to its theoretical status. Such voices are most common in North America (Straub 1999, Markus 1999, Benbasat and Zmud 2002), but are also widely shared in Europe (Ciborra 1998, Stowell and Mingers 1997). Such apocalypses have been around for a while, and are currently increasing in number and severity[2]. It looks as if the IS

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[1] While we both think of our academic homes as IS, we both have been also academic outsiders to the area. John's undergraduate work was in philosophy and biology, and he got a high school teaching credential in biology, but never taught in high school. He went into an MS program in Administration, and got his Ph.D. there, doing research on computerization in city governments. After being a post doc for three years, John took a faculty position split 75% in Information and Computer Science and 25% in Management – two separate schools at UCI. He also did a lot of academic administration at UCI. In the past fifteen years he has been encouraged to apply for academic positions in management school IS groups, in library schools, in industrial engineering departments, and in public administration programs. He is now the Dean of the School of Information at Michigan, which used to be a library school. Kalle's undergraduate and graduate degrees were both in computer science (a more normal route to many current IS scholars), but he also took minors in statistics, political science, and philosophy. He later also studied a major in accounting. He did his PhD in Computer Science, but the topic was clearly an IS topic (systems development) which would not had been possible in most CS departments in the US). He has held positions in CS departments in engineering schools, IS departments in business schools, in Political Science departments (administration) and has been also been encouraged to apply to industrial engineering departments, information schools, and both IS and CS departments. He was also the Dean of the first faculty of Information Technology in Finland which has c.a. 60 faculty, and covered all areas from IS strategy to telecommunications and scientific computing. He is currently a professor at Case Western Reserve University.

[2] It is important to note, however, that these types of claims are not typical only for IS. Many a discipline is currently in danger to be questioned, because of the fast technological change (e.g.

field has come blind to its success: it is larger than ever, smarter than ever, and stronger than ever. At the same time many IS researchers— like the blind prophet Job— sit in the dust, babble about their poor theoretical status, and wait for God's wrath that will wipe their disciplinary body from the earth.

In this paper we take a fresh look at the question of how the disciplinary core (or its lack) affects the future of IS and what we can do about it. Instead of asking whether the IS field is truly a discipline because it lacks a theoretical core, and whether we can make it one, we shall look at the disciplinary politics and ask a (meta) question: why do we so eagerly question the disciplinary identity of IS, and how come we tend to predict apocalyptic futures for the IS field? What internal and external logics, ideologies and political agendas underlie the continued preoccupation with disciplinary identity? The organization of our treatise is as follows. We shall first unravel some typical claims from the constant flow of apocalyptic voices of the fate of IS. These are used to classify and exemplify typical warrants (Toulmin 1958) that IS scholars have used to justify their continued whining about why IS will not stand the test of times. Thereafter we analyze the dilemma faced by vanguard discipline builders: they must go against the powers that be, and yet play the intellectual game dictated by these same powers. We position several different political agendas that IS scholars can follow in situations like this. The analysis suggests that in order to flourish the IS field needs a *bold intellectual reach* rather than a *tight disciplinary grasp*. This suggests a different strategy about how we should go into disciplinary battles: instead of fortifying our disciplinary core we must increase our intellectual boundary spanning capability and quality of our discipline.

2 Ongoing discourses of the problematic nature of disciplinary identity of IS

Any student of IS cannot avoid observing the fact that the problematic nature IS as a discipline and its future has been an object of constant doubt within our community. Here are some typical examples over the last few years:

> "IS is a polyglot discipline that lacks focus, centrality, and theory. It will eventually be absorbed by other academic disciplines with more intellectual clarity and substance. In spite of the creation and support of AIS for the discipline and the formation of many new

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marketing, accounting, education, information science) and associated institutional change. In situations like this there is a tendency to seek conformance in the disciplinary field and one of the most powerful means— as known by all politicians at all times is the identification of an external threat (just read your Shakespeare). In our wanderings we have seen hand wringing about disciplinary identity from lots of angles and in many different disciplines. The years we both spent in computer science were consumed with this subject. In UCI where one of the authors worked as a department head the department had an annual distinguished lecture on the subject, "What Is Computer Science?" This was given up after a while because no one could answer the question (they still can't) over the period of 10 years. We have gone through IS definition wars as well. If you have difficulty explaining what the IS field is, imagine trying to explain entities like a School of Information.

> and excellent IS journals, we are losing ground in business and management schools. We continue to play second fiddle to computer science as the real training ground for IS professionals, for example.” (Straub 1999),

> “Is Information Systems a Distinctive Discipline? (Stowell and Mingers 1997)?”

> “We have a) difficulty distinguishing ourselves from others who are bigger and more powerful, and b) our intellectual contributions, at best, are deemed problematical by our colleagues in other disciplines. We run the risk, therefore, that diversity will be the miasma that spells the demise of the discipline” (I. Benbasat, R. Weber, ISR, vol 7, no 4)

Yet, these statements do not bring fresh news. If we ask how long has this been going on, we readily observe: as long as there has been an idea of IS as a separate intellectual regime. The history of anxiety covers such landmarks as Ackoff’s (1967) and Dearden’s (1967) questioning of the MIS concept. Nearly twenty years later a panel in ICIS (1986) was titled “Back to the Future: Will there be an ICIS in 1996?” (Maggi, Zmud and Wetherbe 1986). The rationale for the panel was formulated as follows:

> “Further within the community of IS academics some individuals have argued strongly that IS as a distinct academic specialty is, like the dinosaurs, heading blindly toward extinction. One of the reasons frequently cited is that the “distinctive competence” of IS academics (computer literacy, basic system design) are being absorbed and taught by faculty in other functional areas such as finance….”

Around the same time the consortium which lead to the publication of a classical book “Research Methods in Information Systems “ (Mumford et al 1985) was titled “Information Systems- a Doubtful Science?, which questioned the poor intellectual and methodical rooting of the IS discipline. With the benefit of hindsight it looks that little has changed over the last thirty years in Information Systems with regard to its disciplinary status. To paraphrase with a well-known idiom: it’s “déjà vu” all over again.

The main point in these scripts is a continued concern of possible “demise”, “absorption by others”, “going away” or the lack of “distinctiveness” of IS. Though some of these verbal fireworks can be explained by the IS scholars’ need to use strong rhetorical devices as a means to communicate their view of the state of the discipline. Yet, the scope, volume and seriousness of such statements over the last two decades show that the reason behind these intellectual defences runs deeper. They reflect a specific view of our discipline and build upon a specific “theory-in-use” that seeks to explain disciplinary successes or failures.

Though the political tides and economic possibilities surrounding the field have changed over time this constant moody tone of our perceptions should raise some intellectual curiosity among us. Why are there are not similar positive accounts of the IS discipline and its impact given rapid expansion of the field[3]? Computer science, in contrast, has been known of its capability to develop positive and bright

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[3] We have tried to find such analyses, but the closest we can get to such attempts are defensive statements of the value of IS in the disciplinary community (see e.g. Robey 1998, Keen 1991)

accounts of its future by demonstrating its capability to address important societal and technological challenges to obtain continued funding and support (Hartmanis and Lin 1992). This preoccupation with the poor performance of the IS discipline reflects an inward looking disciplinary strategy where the IS scholars' concern over MY destiny comes often close to scientific narcissism. The relentless pursuit of the theoretical core reflects a misplaced homage to dominant political coalitions in the academia, and their ways of organizing the world. It shows a form of scientific (or canonical) obedience where scholars assume that they can only join the club if they follow the rules and the disciplinary organization given by their ancestors.

3 The need for an unique IS core and the disciplinary success of IS

A common justification for the demise of the IS field is that the field lacks a clear theoretical focus and hence identity. The IS field is too broad and encompasses heterogeneous themes as it draws upon many reference disciplines (Keen 1991, Benbasat and Weber 1996). There is weak or no agreement about what counts as the core of the discipline and what type of theory or theories form part of it. Moreover, because there is no such core, other disciplines with such a core can take over, and use the lack of such core to divert resources (Weber 1987). Benbasat and Weber (1996) formulate this crisply:

> “"disciplines attain relatively stable place and identity among other disciplines only when a) they have developed at least one powerful, general theory, and b) the theory is widely accepted as their own, and not the property of some other discipline (Benbasat and Weber 1996, pp. 393)

People do not predict grim futures without good reasons. Most of our colleagues holding this opinion are thoughtful and many of them belong to the crème de la crème of our community. We have great respect for these scholars, and admire their devotion to seriously thinking about the future of IS. We also expect that they are completely rational in their formulation of “good causes” as ultimate “warrants” or “because of reasons” (Toulmin 1958) about why the IS field is going to suffer unless its disciplinary identity is established. On rational grounds, however, we strongly disagree with these explanations. In the following we shall examine a host of arguments that defend the need for an “IS core”. We shall discuss their validity in light of historical evidence garnered from other disciplines with or without a core.

3.1 There is no disciplinary core for IS

Because of its broad scope many argue that the IS field will miss a unified way of representing its “essential” phenomena and therefore it can not build a strong theory basis. It can only borrow from other disciplines, which have developed one. Those disciplines with a strong core will absorb the IS discipline and its topics will be redistributed to other scientific communities (like organizational behavior, economics, computer science etc). This line of reasoning also implies that there is no true core for the IS field now and in the future. All that needs to be said about IS can be said within other disciplines. Therefore, IS as we know it now will wither away. We think that this analysis suggests a correct image of IS as a *boundary spanning* discipline, but that its implication that this will lead to the demise of the discipline is invalid and dangerous. We shall justify our conclusion below after we have investigated why the existence of the core for the IS field is neither necessary nor sufficient to be successful.

3.2 There is no disciplinary core in IS now but such can be developed

A more refined line of reasoning is that the IS field is currently a federated “umbrella” for IS related topics among many disciplines, and between the IS “discipline” as we see it now. The IS field lives as a residual which is left over from the others. Consequently we have multiple separate communities like IS related cognitive psychology, IS related marketing, or IS related computer science, but there is no true IS “theory” and core as the residual is not fully developed. In this scenario the IS field will remain an intellectual agora (periphery/residual) until its own theoretical core is fully developed. The IS field may help organize interesting and useful interdisciplinary educational programs across many disciplines and serves thus important educational mission. Yet, continued failure to develop intellectual identity around the residual will lead to diversified and marginal knowledge gains (Benbasat and Weber 1996), and the demise of the discipline (Weber 1987). The lack of the IS core will distract IS research from the main game: to establish a basis for the IS field to fully develop. As a result the IS field will remain a fragmented adhocracy (Banville and Landry 1989, Whitley 1984) and entering the field will remain easy. This, in turn, will yield mediocre research. The IS field will be home for bad psychology or poor computer science and the weak theoretical status will drain research funding, and lead to a vicious cycle that makes the IS field a servant to its master core disciplines (Benbasat and Weber 1996).

In this reasoning the establishment of the core results in a strong disciplinary identity that creates strong theory basis, increased funding and a cumulative tradition. Therefore this scenario is normally supplemented with an urgent need to search for the theoretical “holy grail” i.e. to develop and establish the core of the IS field by fostering and unifying theoretical work and manipulating institutional and political factors which may prevent this happening (Benbasat and Weber 1996). What is at stake is our perseverance and smartness in building the core. In line with this quest there have recently been multiple requests for IS researchers to improve their *unique* theorizing around the IT artifact (Iacono and Orlikowski 2001, Benbasat and Zmud 2002, Massey et al 2001). The paper by Benbasat and Zmud (2002), in particular, asserts that the IS field is in a precarious position, and that becoming more of *a discipline* around theorizing the IT artifact is the cure as it will help establish a more favorable condition for the IS field to flourish. In order to become more respected IS researchers have to narrow their focus by applying rules of exclusion and inclusion that define the division of labor with researchers in other fields.

We sympathize with the utility of connecting IS research to the IT artifact, and see great value in doing so. In fact, we have argued multiple times for more careful analysis of IT artifacts (Lyytinen 1999, Bergman et al 2001). At the same time we think however, that it would be a grave intellectual mistake to *predicate* the future of the IS field on theorizing about the IT artifact[4]. For one thing, it would be difficult for the IS field distinguish itself from computer science- especially when it is moving to systems and applications. Moreover, computer scientists focus only on *the computer* and on *theory of computation* from the start thus defining clearly their division of labor, but that very focus strangled the field in the past 15 years. Why would we expect that the IS field is different? Moreover what value-added has an IT artifact *per se* ever produced? IT is virtually always a complementary asset in production and operation, and its value cannot be understood without the context of its application. If anything, the great strength of the IS field has been its ability to move *beyond* the IT artifact to the real story, which is the context of IT application while at the same time having the capability to open the IT black box unlike organizational theorists or economists. This was the contribution of BPR, and say what you will about that crazy fad, it did a lot of good for our understanding of interactions between specific IT artifacts and the organizational structure and processes, in spite of the other nonsense that accompanied it. We expect similar opportunities to emerge mobile applications, B2B electronic mediation, or in applying P2P technologies for new forms of organization.

4 The Disciplinary identity of IS and its success: an analysis

Though the need for establishing an intellectual core is formulated many times in speculative terms, we can see therein an attempt to build a causal theory of "success factors” for an academic discipline. Though the underlying theory is intellectually appealing we argue that it is not founded in empirical evidence and moreover following it can be politically dangerous for the future of the IS discipline. We will therefore show that this theory is not logically consistent and empirically valid, it misses several important insights obtained from the study of the evolution of

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4 Surely many of the older Is researchers remember the hilarious antics of the ACM as it tried to find a new name for itself that didn’t concentrate on “Computing Machinery.” The interests of the association had moved far beyond that quaint signifier. They failed to find a name enough of the members could agree on and that still spelled their real name (ACM), so they decided to hell with it and stayed with the old name. But they did not stay with the focus on computing machinery. AACSB was more successful in this regard, shedding the “American” and going international without giving up the acronym.

disciplines, ignores the inherent a-theoretical nature of many reference disciplines, and misses recent observations that the concept of a core is breaking down in many established disciplines.

4.1 Refuting a simple theory of scientific success based on intellectual core

In a simple form we can state the theory underlying the need for an intellectual core with the following syllogisms:

1)	All x :CT (x) HS (x)	or	1b) All x: ¬CT (x) ¬HS (x)
2)	CT (physics)		2b) ¬CT (IS)
3)	HS (physics)		3b) ¬HS (IS)

Where CT = erection of a core theory for a discipline,
HS = high success of a discipline

Let us study different elements of these syllogisms more closely to find out whether such simple theory makes any sense.

The argument (1b), (2b), (3b) is logically inconsistent

First, the syllogism (1b) on which most of the current arguments draw is analytically false. The logical implication: “The lack of intellectual core implies the lack of success for a discipline” cannot be logically derived from implication (1):“If you have a core you are a successful discipline”. Therefore steps (2b) and conclusion (3b) are not a consistent conclusion from the lack of a disciplinary core. Hence, we cannot imply a lack of success for a discipline without a core. This follows from a well-known false syllogism (*modus tollens*): from the *lack* of something (i.e. negation) we can derive everything, which amounts to the same as not being able to say anything.

The proposition that every strong core leads to success is not empirically founded and refutes (1)

Let us now examine implication (1) more carefully. This implication suggests that if IS has a core, it will have success. In essence, it conveys a synthetic statement— an “empirical” hypothesis— which is amenable to validation. After validating it we can thereby argue with confidence that all those disciplines, which have a core are successful. *Ditto*, the IS field should establish one in order to become successful (though other routes cannot be excluded). It is therefore worth while to examine this statement in more detail in light of empirical evidence —in particular, because none of those papers, which have predicted the demise of the IS field due to the lack of intellectual core have investigated this statement thoroughly. Instead, it is only *assumed*.

Unfortunately, we do not find strong support from the history of sciences that such a strong causality holds between a strong theoretical core and disciplinary success. In fact, the more likely explanation is that the establishment of the core follows success. There are examples of disciplines, which have flourished at certain points of time because of the existence and continued defense of such a core (e.g. physics, or economics). But, there is no clear evidence that this holds for all disciplines at all time. In contrast, several efforts to force a disciplinary identity onto a momentary equilibrium within a discipline have proven to be disastrous.

Take, for example, our close ally and reference discipline computer science, where the problem of scarce processing and storage resources over two decades (the 50's through early 70's) gave rise to extensive research to increase the efficiency and correctness of algorithms and data structures. Based on this analysis much of the CS in the 70's and 80's developed mathematic models of computation (e.g. complexity theory, program correctness). These problems were incrementally relaxed when semiconductor and magnetic storage technologies improved exponentially in the 80's and 90's but the political power of the so-called "theoretical" computer sciences did not change. For a long time (and it still is the case in some CS departments), the powerful theory people strangled growth in the "systems" area (i.e., large software systems) because it was not "core" theoretical computer science and did not have "strong theory", even as it became clear that the most serious problems facing the field were in systems. Take just a look at the list of Turing Award winners in computer science – the overwhelming majority comes from the theory area[5]. It is no surprise, therefore, that many visionary people coming out of the computer science field have complained that the computer science "discipline" has been its own worst enemy due to its sticking to the core. This started in earnest in 1992 when the Computer Science and Telecommunication Board of the National Research Council issued a report titled *Computing the Future: A Broader Agenda for Computer Science and Engineering*, which argued strongly that computer science had to start looking beyond computation and computers, and engage strongly with applications of the technology[6]. Many orthodox computer scientists were outraged at this report, and some even demanded that it be retracted. But the strength of the report's view has been reinforced since that time in a myriad ways. One example of it is the rise of the so-called new "IT Schools" that cover computer science, IS, HCI and/or Library sciences, among others. Nearly all the deans of these schools quote *Computing the Future* like it was the Bible, and the report has become the key organizing document of the National Science Foundation's CISE Directorate (Computer and Information Science and Engineering) that funds a lot of CS and IS research[7]. Hence, we cannot conclude that implication (1) is empirically validated.

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5 A similar story can be told about the collapse of Operations Research into a sustained fixation on optimization even after the low-hanging fruit of optimization was exhausted and the problems of efficient satisficing had become the key challenge. It doesn't take much imagination to find other examples.

6 You can get the whole report at http://www.nap.edu/books/0309047404/html/

7 One of the authors is a member of the CISE Advisory Committee although he is not a computer

There are successful disciplines without a strong core, which refute (1b)

There is no evidence either that the lack of disciplinary core hinders success (i.e. negation of the core leads to success). There are examples of several disciplines, which have never had any single core, but several cores— like sociology (Giddens 1996) – and still have made “progress”.

4.2 The need and capability to build a core for a discipline is contingent upon external factors like the stability of observations or multiple theoretical principles

A still more refined form of the implication (1) is that some disciplines (like physics) in addition need to share some additional properties X, Y, or Z (like stability of the studied domain) that in conjunction with a disciplinary core make success possible (and necessary). Likewise, the IS field could belong to such disciplines. What these additional properties for the IS field could be has not been said in any of the analyses.

This observation resonates well with an interesting corollary operating in disciplinary politics around core identity: if you relax your focus on *disciplinarity*, you need to increase your focus on *discipline*. Disciplinarity isn’t a bad thing, *per se*. It can be useful when a field of work cannot anchor itself sufficiently to make intellectual progress, and must constrain its intellectual ambitions to a narrow set of concerns to permit specializations to emerge. When that happens, a canon of belief and practice can emerge that provides a template of intellectual discipline that is thereafter subsumed automatically by those who become socialized into the area (c.f. Kuhn’s 1996 concept of paradigms and puzzle solving). Disciplinarity, in this sense, is a shortcut to achieving intellectual discipline to sustain a disciplinary matrix. Follow the rules (and the paradigm), the discipline comes, and results will follow. Unfortunately, this only works as long as the subjects to be studied are inherently stable enough for the community over a sufficiently long period of time to establish and benefit from a well defined strategy of knowledge discovery and exploitation. The natural sciences have often provided such affordance: a scholar could spend his or her whole career elucidating one highly specialized topic – the life cycles of a subset of the flowering plants, for example. It is therefore no surprise that Kuhn’s (1996) examples came from this area, and Kuhn himself was a chemist (c.f. Bernstein 1978). Because nature really is “out there” over a long period of time, it can be systematically studied in this way that makes the emergence of well-established paradigms possible. But even in the natural sciences, the stovepipe strategy has always broken down when it becomes necessary to make

scientist; this is one interesting example of the changes underway. He has seen at meetings that a few members of the CISE-AC still beat the drum about supporting “the core.” But the definition of the core has been enlarged dramatically in the past few years, and the NSF leadership repeatedly stresses that Congress will only increase funding for the CS area if there is increased attention to applications and economic/social aspects of computing.

sense out of bigger problems that cross disciplinary boundaries, or when the issues at hand do not match with the current disciplinary matrix i.e. when the paradigm shift, or revolution takes place (Kuhn 1996).

In fields that are continuously emerging there is not sufficiently time to develop the discipline through disciplinarity. Simply, the game changes too fast. The IS field is currently an example of such a field due to rapid technological change and the complementary growth in knowledge about how things might be done given the new capabilities (the structuration thing). There is no sight in the near future that this situation would change. It is likely that nothing stays put long enough for the next decade at least to serve as the anchor for more disciplinary paradigmatic development. In situations like this it is in fact dangerous (as we will elaborate below) to seek for disciplinarity, as it will move us away from where the action is, and where the hot topics emerge.

4.3 The concept of theoretical core is nebulous and currently breaking down

The whole concept of clearly defined academic disciplines is currently breaking down especially in the most vibrant fields of inquiry and hence the very idea of having the core for any discipline is evaporating. Yet, this isn't a new process and should not come as a surprise for any well-read history of science scholar, but its visibility at the current times is stronger than ever. The history of disciplinary action is in fact one of continuous expansion and contraction cycles around disciplinary identity, core and focus. The classical universities of the late medieval period were organized into seven faculties, where only theology and philosophy were regarded as true disciplines, while e.g. law or medical sciences were not. Often the two first ones had a blurred line between them. Later, the Renaissance university branched the two further into "natural philosophy," which became the natural sciences and thereafter the multiplication has just continued at an ever increasing pace.

Within the natural sciences, the life sciences branched early into botany and zoology, and then into bacteriology, before abandoning that whole scheme and reorganizing around systematic biology based on relative complexity of organismic processes (biochemistry, molecular biology, physiology, developmental biology, ecology, evolutionary biology, and so on). Now, we are seeing yet another retreat back to the broad, but vague concept of Life Sciences. Faculty recruiting ads in the life sciences no longer contain the old disciplinary terms, but rather delineate contemporary (and temporary) lines of work such as enzyme metabolism, or molecular proteomics. The life sciences keep changing their sub-identities because their problem sets keep changing thanks to computing and genomics advances. In the mean time, the other natural sciences such as physics, chemistry and geology have morphed dramatically because they are intersecting with each other, and/or the life sciences. In the past ten years geology has moved aggressively to join with atmospheric chemistry and oceanography into what is increasingly being called Earth Systems Science, focusing on problems such as understanding the carbon cycle and climate change. Similarly, new techniques in crystallography, biological macromolecules, molecular biology, and biophysics are coming together under the moniker Structural Biology.

Overall, it is questionable whether there are any specific sciences, which over time stick to their “hard core” will retain intellectual leadership. This is not suggesting that there are no disciplinary politics involved in these evolutions – of course, there are. But the disciplinary cores—though temporarily established— are over time marginalized, because the top people want to focus on the challenging problems outside the core. If these problems make mincemeat of old disciplinary definitions so be it. The challenge in the best places and frontiers of science is hence no longer about protecting disciplinary boundaries, but about getting to the hot topics first. In fact, the old disciplinary structures are seen in many cases as deadweight burdens on intellectual progress, because they are wired in administrative departments that jealously protect their prerogatives, irrespective of the costs to the soul of the academy, and its long-term salience in society[8]. In the long run, however, the salience to society normally wins, and the old disciplinary structures will lose. That process is already underway in many natural sciences. We do not doubt that the case would be different for the IS field if we can find hot topics, and cool things to do.

4.4 Our successful “peer” disciplines do not have a distinct core

Ironically, in the management schools the idea of the need for a core for the IS field should be an easy task to argue against, because it is virtually impossible to create any intellectually coherent argument about disciplinarity within them. Virtually every group in management education must legitimate itself with reference to some outside disciplinary agency creating an ever increasing cascade of intellectual references. Finance people are financial economists (though they make a lot more money), OB people are organizational psychologists or sociologists, marketing people typically align themselves with a branch of psychology, or other behavioral science. OR folks have it a bit harder, because they are torn between applied mathematics and engineering, both of which are not considered real disciplines by opinion leaders in fields like mathematics, or the physical sciences. Much the same story applies to IS, but IS doesn’t have mathematics to claim. About the only group that doesn’t align itself with outside intellectual legitimation is accounting, but accounting does not need to be a “discipline” to prosper. Accounting figured out

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8 In a rather startling example of this, the previous president of the University of Michigan set up the new Life Sciences Institute completely separated from both the biology department and the medical school because he felt that they could not stop warring with each other long enough to make the new initiative a success. This strategy has been modified since he left, but the lessons were not lost on the people in biology and medicine, who have now decided that what unites them is a lot stronger than what separates them. Besides, they want to get their hands on part of the $1 billion the initiative entails.

long ago that it is a lot easier to maintain legitimacy by promulgating laws that require organizations to use their services.

4.5 Does the IS field truly lack a "core"

Another view-point is whether the IS field even *truly lacks its own theoretical principles*[9], and thus lacks the capability for distinctive theory building. It may be more of a question of differences of opinion of which criteria to use to judge what a theoretical "core" denotes. Clearly, the IS field must have something distinct because otherwise we would not have this discussion in the first place. The issue then comes down more to a choice of preferred criteria one should use to decide when a discipline has a core. In case like this some would argue that IS has its own disciplinary identity, but it is not just recognized by others as they use different criteria.

All analyses of disciplinary identity seem to assume that there is only one form of theory building or theorizing- or at least, there is only one form of theory building, which counts in current disciplinary politics- that of respected peer disciplines in business schools. We are not told exactly why this should be so- why should some theorizing and knowledge claims be privileged in the IS field so that it must liken that of finance or marketing (Benbasat and Zmud 2002)? In their argument Benbasat's and Zmud's main justification in developing distinct IS theory is that the *form of the theory should* be the same as that of their peer (or reference) disciplines. It is only a question of differences in content or choice of variables in that the IS field focuses solely on the IT artifact[10]. In contrast we might as well assume that theoretical principles of IS are just different, and its theory building spans multiple domains in a manner, which is alien to identified peer reference disciplines. In consequence, the IS field, in fact, has its greatest intellectual value at the intersections between established fields, rather than in the middle of any of them, *and it is this cross-sectional nature of scientific knowledge that forms the foundation for the theoretical advances of the IS field*. There is ample material in recent discussions of the nature of IS research to back our claim. For example, this is a substantive conclusion associated with the call for diversified "intellectual structures" of IS development by Hirschheim et al. (1996). A similar point is made by Robey, when he observes that "diversity in IS expands the foundation upon which knowledge claims in the field are based" (Robey 1996, p. 403). Yet, another formulation of this idea is the recognition that IS field spans over empirical, mathematical and constructive modes of generating knowledge claims, which

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[9] We use the term theoretical principles to differentiate the idea of conducting theory based inquiry from the necessity to have a unified view of theory building as suggested by the proponents of the core idea.

[10] Note that we are not denying the value of such theorizing or its importance for IS discipline- we only question the claim that this should be the only type of knowledge built in IS discipline, or that such rules of inclusion and exclusion would really make IS discipline more respected.

follow very different forms of validation, and standards to evaluate the correctness or acceptability of the results (March and Smith 1995, Nunamaker et al. 1991).

The life at the intersection – at the margin or the fringe, you might say – is however, never a normal intellectual picnic, because of the proximity of the frontier. Therefore the principles are looser and more varied as the uncertainty is higher. Accordingly, to become an intellectual leader in the IS field is not often possible without moving into the frontier *and inventing the theoretical principles as one goes*. Every person who we know and who helped start the IS field was a pioneer, fighting an uphill battle against entrenched interests and established theoretical core. For this reason the IS field has never been able to settle down into the cushy lifestyle of the landed gentry of established disciplines: the IS field exists only at the frontier as long as technological change and its rapidly increasing capacity to improve human enterprise continues. Hence, we do not necessarily lack *theoretical principles* - they are just different, because we are pushing and tacking at the frontier. Hence, when the IS field is not the same and will not become the same as economics or cognitive psychology, why should it bother to establish the same standards to evaluate its knowledge claims or need similar types theories to interpret, construct and understand the phenomena it deals with? Note, that this difference may not be observed by the peers in other disciplines just because the IS field is *different*. They do not have any incentives to recognize and honor differences in theoretical foundations, because in this game they have only to loose.

5 The politics of strong disciplinary core

It is time to ask a question: what are the reasons for clinging to the core discipline idea, and why do many academics find it so appealing despite its poor empirical credibility? Why are they following the same “objective” criteria when assessing their disciplinary situation, and why do they ignore the objective empirical evidence available about the evolution of sciences that refutes the established logic for the need of a single disciplinary core. Overall, we find that the long-discussed concern about the theoretical foundations of IS is overblown on its merits, but we acknowledge that some outsiders (most of whom have no more convincing theoretical credentials than IS folks) sometimes use that as a club to beat up IS people. Therefore it is more important to understand the politics of this discourse as this revelation makes the whole phenomenon a natural and predictable part of the institutional politics within academia. Yet, the remedy for this is not to run out and get some theory quick (and dirty): it’s to be strong on other dimensions that repudiate the intent behind such attacks and, to understand the ideological and political reasons for these attacks.

5.1 The importance of institutional forces in maintaining the core

We both have learned from many years of doing academic administration that if you want to work at the frontier within the conservative institutional realm of the academic institutions, you must recognize at every instant where the genuine sources of power reside. Despite all of the rhetoric to the contrary, academic organizations are not very interested in the future. They are preoccupied with their glorious past and regulating their future as it was their past. Mostly this happens through disciplinary identities that have been legitimized over time as being successful in scientific problem solving. Therefore disciplinary tradition and strong theoretical foundations that can offer a uniform approach to some problem domains form a formidable asset in disciplinary politics. It establishes a strong position in the institutional regulation of the future of the academic institutions (within schools and universities) that guarantee continuity and slack for specific knowledge domains. Therefore, the boundary spanning fields more easily become internally vulnerable to predatory academic policies due to their weaker "theoretical positions" that result from multiple institutional locations.

There are, however, multiple contextual factors that ought to be borne in mind in interpreting and responding to such claims from the view-point of our intellectual mission. For one thing, this is an old story, and will be repeated for any discipline that is a boundary spanner and does not fit with the existing status quo. For example, social sciences have a notorious history of ignoring the importance of technology as it does not fit with their core as "social sciences". The only social science fields that have taken technology more seriously are economic history, the small branch of anthropology that considers technology as the foundation of human culture, a handful of psychologists who do engineering psychology/human factors work (including human-computer interaction), and the interdisciplinary movement that calls itself STS (Science and Technology Studies). The mainstream social sciences have ignored technology almost completely. Management study is at least somewhat derivative of the social sciences, and the same pathology is apparent in business schools. Hence, the failure of most academic institutional bodies to engage studies that cover both technology and social phenomena is more likely to be the result of backsliding to an unjustified equilibrium established by the academic identities around disciplinary cores than to a deliberate move to delete or avoid technology or social issues. It's predictable, albeit ridiculous.

5.2 A misconceived understanding of the nature of scientific progress to justify a strong core

The need to support the holy grail of an intellectual core relates to an inherent misunderstanding of the nature of scientific development and what factors explain it (see Figure1). The traditional dominating model (model 1) of relationships between science, technology and social welfare suggests that scientific discovery precedes technological innovation. The latter one when applied will later on result in social welfare in the form of better production, cleaner environment etc.. In this stovepipe recipe of scientific progress the main originator of the knowledge food chain is a smart (heroic) scientist who through his or her genuine theoretical work discovers core principles of the studied matter. The source of many advances in a society lies with those intellectual elites who “control” and “own” the evolution of core principles. Therefore, the need for a strong disciplinary core is not only matter of scientific excellence it is also a matter of access and will to power, and associated capability to garner adequate resources that guarantee the evolution and further growth of the scientific discipline. Society must fund basic research in order to advance welfare, and scientists with their theories are the main source of it.

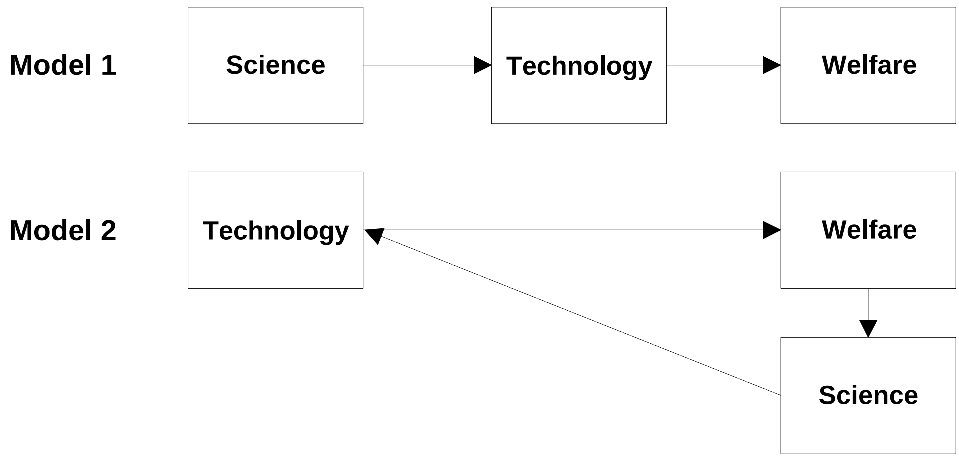

Figure 1: Two models of Scientific Evolution.

Many scientists believe in this model, as it provides them a secure feeling of importance and intellectual superiority, and justifies their claims for *big theory and big spending*. It is also maintained in the popular applauds of science as witnessed in rituals that go e.g. with Nobel price winners. Some disciplines, that fit cognitively well with this model— especially analytic philosophy and mathematics— have moreover strengthened the “credibility” of this model by providing the canons that explain how discoveries emerge and why they are “scientific”. Consequently, there is a constant movement to jockey for “strong theory” positions in the race among all disciplines, and those who do not qualify for the finals are frowned upon. The idea behind a strong IS core fits perfectly with this model as the proponents of strong IS core believe that only a strong core provides access to resources and solicit higher respect.

Unfortunately, the model 1- though appealing to any scientist (including us ☺) - is not valid and does match well with what actually happens during scientific “progress”. A more faithful alternative that matches with the evidence obtained from the evolution of sciences is depicted in model 2 (Figure 1). In this model scientific discovery emerges at the interfaces between technology, society, and science.

Many times, scientific progress is preceded by innovations in practices and artifacts, which offer insights to new phenomena that wait to be explained. There are ample examples of such processes starting from advances in sea-travel in the 15^{th} century that required the development of better astronomical theories, Pasteur's groundbreaking work in biology, Carnot's and others work on thermodynamics which was preceded by innovations in steam-engines, or Codd's work on relational theory, which was preceded by the development of data base management software and associated practices. In this model the scientific discovery does not precede but *coincides* or *follows* the social or technological innovations, and/or creation of social needs to address an important social or economic challenge or societal bottleneck. In this model science emerges as a means to codify, expand or explain emerging practices, or to utilize new technologies that help explore the nature deeper (e.g. use of MRI to investigate brain behaviors).

The political implications of this model especially for understanding the role of scientific theories in the evolution of society are significant. First, it suggests that the idea of the IS field as a boundary spanning activity and theory builder makes a lot more sense if we want to establish any strong first principles- the core is always an outcome of preceding boundary spanning activity. Second, it suggests that there are two ways in which we can theorize in the IS domain: by looking at the interactions between types of ICT artifacts and social processes (welfare), or between the theoretical principles and how they are reflected in / emerge from technological experimentation with new ICT artifacts. We see value in both types of research as they would enable broader and more complex boundary spanning processes- for example invention of new types of ICT artifacts, and theorizing around them. Third, the model suggests that the value of the core is not so much due to its external impact on the society, but is due to its capability in knowledge transfer, knowledge maintenance and disciplining activities which are critical in the education of next generation scientists and refining the core further. Overtime this core may provide a large amount of symbolic and political capital within the institutional politics, but if made too rigid and closed it will also become a powerful barrier to renewal of scientific knowledge. As noted, however, most disciplines are willing adjust their core in light of the needs of novel boundary spanning and problem identification if and when their core maintenance fails to provide justification for interesting future problems.

5.3 Political Strategies for IS Discipline Building

We can clarify further the impact of different models of science and technology on IS research agenda by comparing how these models influence the choice of political strategies for successful IS discipline building. Those who believe in the value of core as the major **means** to compete internally with other disciplines (and define a sensible division of labor between them on an equal ground) and thereby able to obtain external legitimacy i.e. resources and respect will normally take a *personal* attitude towards the need for a core. Basically, without the core my discipline (=me) will become vulnerable, and at the end my personal security is at stake. Because the building of the core implies compilation of a *disciplinary matrix* and focuses on drawing boundaries (what to include and what to exclude) the approach becomes inherently conservative, and seeks to operate within the *existing status quo*. The idea is the following: with good communication and the development of shared vocabularies among disciplines reasonable demarcation lines will emerge that offer a general understanding of different cores, and their relationships (aka rules of inclusion and exclusion) and helps coordinate research activity. The core model reduces thereby the welfare of individual scientists to the access of some accepted core building activity: and the discussion of a core is finally a discussion about *me*.

At the same time the core model divides the community to those *empowered* (cell Empowered in Table 1) who have intellectual and symbolic capital through the access to their core, and to those *who are not empowered* (Not empowered in cell I), because of the lack of such core (as seen by others). In the case of the IS field this boils down to two policy observations: 1) due to its lack of core the IS field is not an empowered discipline, and 2) because of this I as an IS researcher will suffer as a not empowered scholar. This position equals with the second part of the Cell I in table 1, while the position of disciplines with strong cores (e.g. economics) would relate to empowered zone of the same Cell.

Table 1 Different positions for IS research activity.

	My stake with the future of the discipline	
Relationship to status quo	**Personal**	**Depersonalized**
Adherent or attentive to political equilibrium	**Cell I** Empowered (Economics) | Not Empowered (e.g. IS)	**Cell II** Commentaries and studies of science and technology (e.g. STS, Philosophy of Science)
Indifferent to political equilibrium	**Cell III** Entrepreneurial innovation (not viable in the university)	**Cell IV** University based studies of emergent phenomena that do not fit with the prevailing political equilibrium

Table 1 offers also other possibilities for IS research activity that align with the model 2 of scientific evolution. A certain part of the IS scholars, if they do not take a personal commitment to the fate of IS, but examine it as an interesting guinea pig in the experimentation related to the evolution of sciences, would move from the Cell I where the talk about the discipline is a talk about me to a cell II where a talk about discipline becomes a (sad) story about them. This situation offers safety from personal anxiety, but it also comes at the cost that my research is not about doing interesting stuff, but understanding how and why others are doing this interesting stuff[11]. If an IS researcher chooses to opt for Cell II it implies that he must move outside the field.

Another option is that IS researcher can ignore the idea of empowerment within the current status quo, and rather decide to do cool things, which he or she likes. In a situation like this the researcher becomes indifferent to the current political status quo and moves to cell III or cell IV. If he opts to move to cell III this implies working at the interfaces between technology and science (i.e. new artifact construction), or moving technological artifacts into organizations (consulting, action research). As is quite well known in most cases such a position (especially in business schools) does not allow one to stay in the academia given its merit system and associated power structure — at least to the extent that the person can become empowered. In most cases these people would leave the university and become independent entrepreneurs (which in some cases can be happy for the field if one is lucky and makes a lot of money), and work closely with academics if they see a need for it.

The most interesting case for an IS scholar is to move Cell IV as a political strategy. This aligns with our idea of IS researchers as disciplinary boundary spanners working on new emerging topics that do not fit with the current academic power structure. This is also a position in which most of the pioneers of the IS field have started. The position is not about the need to organize and interpret garnered experience and knowledge through the existing canons of scientific knowledge- a cell IV scholar is out there to understand and explain something, which does not fit within the current disciplinary (institutional) structure. Cell IV researchers are therefore more interested in the new “stuff” that opens in front of them, and they seek to make sense of “it” by expanding and crisscrossing different intellectual frontiers. These researchers would thereby go (deliberately or accidentally) against the dominating political nomenclature.

We feel that the IS field (or some parts of it), if it wishes to maintain its intellectual vigor - given the fast moving nature of “it” – must position itself as a cell IV discipline and remain as a boundary spanning discipline. This position frees IS researchers — at least for a part of them— from a constant concern for disciplinary core and associated accretionary capability building. At the same time the choice carries personal and intellectual risks: you are chartering unexplored intellectual territories which can be lonely and sometimes frightening. A typical Cell IV IS academic is more concerned with IT as “it” than (s)he is concerned with the “IS” core and with “me”. (S)he would also admit that there is no point in arguing about what counts as a strong discipline with those who hold the current institutional power by relying on their “core” definitions of acceptable science. They define the rules of the current game anyway, so why bother? One can never

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[11] In principle there is no escape from the personal commitment as a researcher as all STS researchers etc. must justify to themselves and others that this is a worthwhile exercise and this leads to some useful knowledge claims. Hence, most of them, in their own lives would be in fact located to Cell IV in most social science or engineering schools as noted above.

win in this game and therefore one can only refuse to play in that game. An IS scholar in cell IV would instead honor the following principles:

- Establishment of any new “field” like IS takes time; (though we have been fast);
- When the evolution of “it” as IT is more rapid than the establishment of “field,” it is likely that concern about “field” is irrelevant to “it” (i.e. industry);
- If “it” i.e. IS is intellectually important for “it”, the political equilibrium will eventually accommodate, not the other way around;
- The accommodation does not come from conformance but from revelation that comes through boundary spanning; and
- Any discussion of our disciplinary identity should start not with how bad things are, but how good they might be by examining the cool things and hot topics that lay in front of us.

To clarify a potential misunderstanding, we are not against the idea of having scholars who want to work in Cell I, and focus on edifying and polishing our intellectual core for the discipline. We need them for recording our intellectual heritage, clarifying its intellectual mission and, formulating a research agenda based on what we know already. Such activity is vital for any scientific field if it wants to remain “healthy”, and provide a corpus of systematic knowledge and problem solving capabilities. We, however, disagree that the viability of the IS field which deviates significantly from the existing institutional and disciplinary order comes from an inward looking strategy of trying to define *exactly* what IS research is all about, and which types of theories and inquiry it should draw. Such a strategy tolls a narcissistic kiss of death for the survival of our intellectual heritage and in this strategy we are only to loose. Our gateway to heaven is not so much about how to increase our intellectual grasp of what we are and what we can do but to reach towards the unbounded intellectual territory of finding what the IT as “it” is all about in at the intersection of social and technical. This demands internal tolerance towards our intellectual pioneers and boldness in our intellectual mission.

6 Conclusions

Our examination of the multiple calls for a clearer disciplinary identity in IS reveals that these calls almost always dwell on the negatives, and boil down to this: *we get no respect and no resources as we are not empowered* (cell I politics). In a way we understand why people in the IS field whine: it *is* hard to get respect and resources, and in most universities it always has been the case. Yet, we are concerned about the tendency to conflate the problems IS people face in getting resources and respect with the putative lack of disciplinary identity. For the sake of argument, and because we actually believe what we have said above, we reassert that is a grave mistake for IS to even *want* to be a recognizable discipline in some specific field. The quest for disciplinary identity is dysfunctional and betrays the IS field’s initial intellectual mission. The suggested strategy is not founded in strong empirical evidence of the evolution of sciences. The idea is also *passé* as the conception strong "disciplines" is losing ground as an organizing principle in the realm of scientific knowledge for the simple reason that we are gradually outgrowing from it most fields.

The question of a disciplinary identity is almost always more about academic politics than about intellectual substance. This is problematic especially in cases where the intellectual substance is more elusive like in the IS field. The fact is that those who already hold more power than IS—especially in management schools – are seeking disciplinary identity in their own ways. They don't *want* IS to establish itself as a real discipline because the establishment of a strong disciplinary identity for IS would require that IS receives more resources, more respect, more power. And, ironically, since the salience of disciplinary identity is only found in the receptivity of the *observer* of the discipline, and not in the protestations of those who are trying to establish the new discipline, all these other groups have to do to stop the IS-as-discipline movement is ignore it and refuse to honor it. There is virtually nothing the IS folks can do to force their way in. And, in fairness to those shutting IS out, what's so attractive about the IS field, anyway? If IS arguments for disciplinary identity can be traced back to not getting enough respect and resources, what's to like about them? Any discussion of disciplinary identity should therefore start not with how bad things are, but how good they might be.

Most of the efforts we have witnessed to create new disciplinary identity have been motivated by political reactions against perceived persecution and threat. Escaping and setting up a new colony does not always make life better for the colonists, especially, if they follow the practices of the old regimes. Therefore, an inside focus on what's repelling about the current situation is hardly going to win the hearts and minds of those outside who might change the issues of respect and resources. Everyone loves winners, but dislikes whiners. The challenge of finding the positive spin on the identity of IS lies clearly in figuring out who our true audiences are, and what type of intellectual reach we need to make things better, instead of tightening our grasp of our internal affairs to meet the external pressures from powers that be. We therefore suggest that it would be more helpful to the field to concentrate our intellectual energies on the questions of the world we are trying to improve rather than the discipline we are trying to create. Why should we care for example that a bunch of know-nothings conclude from the dot.com meltdown that IS does not matter? We all know that time will prove them wrong. Why argue with them? Let's set our sights on the prize that lies ahead.

We'll conclude with an observation drawn from some historic work on the role of epistemic infrastructure in the creation of knowledge communities. One of the authors recently found a great quote from Daniel Webster, taken from a speech he gave on June 17, 1825, at the dedication of the Bunker Hill monument in Boston. He said:

> A chief distinction of the present day is a community of opinions, and knowledge, amongst men, in different nations, existing in a degree heretofore unknown. Knowledge

> has, in our time, triumphed and is triumphing over distance, over differences of language, over diversity of habits, over prejudice and over bigotry. The whole world is becoming a common field of intellect to act in. Energy of mind, genius, power, wherever it exists, may speak out in any tongue, and the world will hear it. There is a vast commerce of ideas. There are marts and exchanges for intellectual discoveries, and a wonderful fellowship of these individual intelligences, which make up the mind and opinion of the age. Mind is the great lever of all things; human thought is the process by which human ends are ultimately answered; and the diffusion of knowledge, so astounding in the last half century, has rendered innumerable minds, variously gifted by nature, competent to be competitors, or fellow-workers, on the theatre of intellectual operation. From these causes important improvements have taken place in the personal condition of individuals. Generally speaking, mankind are not only better fed and better clothed, but they are able also to enjoy more leisure; they possess more refinement and self-respect.

The IS field is all about the “vast commerce of ideas.” It’s not our fault that many of the outsiders do not recognize that fact. Hopefully, in time, they will. Maybe we can help them. To do so, the IS field needs intellectual discipline, but it does not need to be a *discipline*. The essential discipline in our scholarship must occur in the minds of investigators, not in the social conventions of our field that define what is to be excluded and what is included. It will be found, when it is found, in the strength of the intellectual arguments that researchers make about *whatever* topics they are pursuing that makes sense. Sometimes IS researchers will pursue topics that run so far a field that no other IS researchers will follow. We will call those topics “outside of IS” for a while. But this is just a matter of fact, and probably a momentary fact, at that; it is not a necessary condition of any intellectual work. We should not design borders to keep people “inside” IS – the failure of the community to relate to some work is a self-regulating mechanism to define the field. Moreover, we should treasure those cases where someone of exceptional insight persuades the community to follow along into territory no one thought of as IS, but that proves to be of real importance. Diversity is a good thing both in methods *and* topics. The only thing we should discriminate on is intellectual quality, and in that, we must be ruthless.

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Revision of Privacy Policy: Five Perspectives and ONION-model

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Abstract. Issues concerning the privacy protection on the Internet have been studied and especially discussed largely for some time. However, there is no agreement on how we should do the revision and evaluation of privacy policy and which kind of factors ought to be taken into account. In this paper I discuss about approach which includes five perspectives and layered ONION-model. Recognition of unpredictability entails new principles and practices to the revision and evaluation process of privacy policy. The combination of different perspectives and layered model serves a constructive approach and it offers an important device for dealing with unstable and unpredictable environments.

1 Introduction

This paper provides an overview of aspects and changes of privacy related issues in rapidly evolving information and communication technology (ICT) context. ICT enables new means to provide services for societies. For knowledge intensive industries such as insurance, banking and health care the new technologies appear to challenge the traditional ways of how services are delivered and consumed. Changes of business maneuvers can be very fast and radical. The Internet and mobile devices provide opportunities for developing new ways to operate, but they may also increase vulnerability and unpredictability. The focus of this paper is mainly on the Internet issues but it should be seen in wider context as well. Privacy is a broad concept, whose values underlie the way that economies and societies function, and, thus, privacy has recently become prominent topic in the context of ICT.

Previous system research provides the basis for investigating how systems should to be planned, designed, implemented and evaluated, but nowadays the development of ICT cannot be easily distinguished from the broader perspectives related developing services as a whole including ethical aspects. It is very important to know the ethical level of ICT-related business and what influences ICT would have positively and negatively at the stage of the Internet. There are many potential benefits and opportunities, but also many threats and weaknesses within ICT related services. There is hardly anything that happens anywhere in the world-wide context of ICT that might not have an effect on the privacy policy we ought to make. We need not know all of these events as such, nor of all their effects because it is impossible to manage but we should be ready to make some proper decisions in advance. And therefore information system research privacy issues of new technology are becoming an increasingly important area.

I have written the first part of this paper in the position of oracle, who emphasis the unpredictability of events. In particular, it is not obvious that, if one allows the future to be unknowable before its time and undetermined by past events, one has necessarily to jump to the polar opposite from perfect foresight and proclaim that we can say nothing about anything (Earl and Kay, 1985). The oracular perspective certainly does involve a rejection of a notion that privacy policy managers should seek to make single-line predictions of what will happen. However, it does not deny that we might be able to contribute to the process of policy formation by providing insights on the range of things that could happen. In the latter part of the paper I describe an alternative model for revisiting privacy policy, classifying encountered problems and producing alternatives for redesign.

This paper considers privacy protection by asking whether unpredictability and novelty are destructive issues in the Internet world in general, or whether we can make sensible remedies for privacy protection of customers in the setting in which changes of technologies and development of services are pervasive, even paramount.

Section 2 provides background of this study. In section 3 I discuss privacy as a time and situation dependant issue. There is a brief overview of privacy, confidentiality and security issues on the Internet and in health care context in section 4 and section 5. In section 6, I present observations about my study results. Section 7 presents strategies and scenarios. Five perspectives of uncertainty and modularity are discussed in section 8. In section 9 I introduce organizational perspective and the modification of ONION-model. It offers within perspectives new useful technique for revision process of privacy policy. Summary is finally presented in the section 10.

2 Background

The interest on these sensitive issues is not a new topic. In early times, the law gave a protection only for physical interference with life and property and later the scope of these legal rights broadened. For hundred years there has been a feeling that the change of society and the technology must afford some remedy for the unauthorized use of tangible and intangible property. Since the era of newspaper and photography privacy have been considered as an important issue.

> “That the individual shall have full protection in person and in property is a principle as old as the common law; but it has been found necessary from time to time to define anew

> the exact nature and extent of such protection. Political, social, and economic changes entail the recognition of new rights, and the common law, in its eternal youth, grows to meet the demands of society. … and now the right to life has come to mean the right to enjoy life—the right to be let alone, the right to liberty secures the exercise of extensive civil privileges; and the term property has grown to comprise every form of possession—intangible, as well as tangible."
>
> Warren and Brandeis (1890)

The development of the law and the change of attitude were natural because the life of a person includes much more than physical things. Intangible property and the right of privacy demanded legal recognition also. The right of privacy is usually discussed as a branch of tort law, but functionally it is a brand of property law (Posner, 1981). The earliest judicial recognition of an explicit right of privacy came in a case where the defendant had used the plaintiff's name and picture in an advertisement without the plaintiff's consent (Posner, 1992, p.43).

The intensity of use of modern ICT-services and at the same time the complexity of infrastructure of ICT is a combination which entails solitude and privacy more essential to the individual. Recent Internet and mobile inventions and business methods call attention to an evolutionary approach for privacy policy development and the right to be let alone should be one of the basic privileges also in the modern world. Many technical apparatuses and networks have invaded the sacred precincts of private and domestic life. There are many types of technologies that could be used to monitor citizens. For example there are products which could help pinpoint terrorists in a crowd, but it could also be misused. Reasons of terrorism there is an argument to use these types of devices but it is not an option but necessity to make sure these auto-identification devices get used for limited purposes. There should always be limits to what the organizations can do. The threat, which existed over 100 hundred years ago, is now more topical than ever. Warren and Brandeis (1890) felt that numerous mechanical devices make good the prediction that "what is whispered in the closet shall be proclaimed from the house-tops." Nowadays in the scale of globalization the scenario is more visible and tangible than ever before.

3 Privacy as a time and situation dependant issue

3.1 Time dependence

Williamson (2000, p. 596) has used the social analysis, in the setting of economics of institutions, within four levels: embeddedness, institutional environment, governance and resource allocation. The top level is the social embeddedness level. This is where the norms, customs, mores, traditions, etc. are located. Ethical issues play a large role at this level. Williamson states that institutions at this level change very slowly – on the order of centuries or millennia – whereupon he also points out that many of these informal institutions have mainly spontaneous origins – "which is to say that deliberative choice of calculative kind is minimally implicated".

Institutions are adopted and thereafter display a great deal of inertia. "…the resulting institutions have a lasting grip on the way a society conducts itself." Insular societies often take measures to protect themselves against "alien values" (Williamson 2000 p.598).

Privacy is time-dependant issue, but I argue that radical change of attitude of privacy is the possible result of unexpected happening. As a proof of I use the terrorist attack of the September 11 as a milestone. There was very much concern in the U.S. about privacy issues before suicide hijackings that destroyed the World Trade Center and damaged the Pentagon. For example representatives of the Electronic Privacy Information Center (EPIC[1]) were granted unprecedented access in April 2001 to Attorney General John Ashcroft, lobbying him to put a leash on the new surveillance system. EPIC and other privacy groups charged the Carnivore system invades the privacy of law-abiding citizens by indiscriminately scanning their e-mails in its search for criminal evidence (INF 2001).

After the terrorist attack the whole atmosphere was changed radically and fast. There wasn't any sign of Eisenhower's "delay principle": defer decisions altogether until all essential information is available or fog has cleared (Ansoff, 1979). One would expect organizations confronting treacherous but foggy landscapes either to make some explorations in a variety directions (Waddington, 1977) and avoid crucial, large-scale experiments until they can see how the land lies (Earl and Kay, 1985), but there was short after the attack much talk of making it possible for authorities to obtain e-message headers, which contain the "To" and "From" information from messages and sometimes a preview of the text, without requiring a wiretap order. DNA databases, too, were being considered for any person convicted of a felony crime. And more, there was renewed attention on efforts by the Federal Communication Commission to force wireless carriers to pinpoint a cell phone user's location within 45 to 135 meters. At the same time there were several different legislative proposals. Some of them were very reactionary and very invasive. The main point, of course, was on how to deal with events of terrorism. In general, Americans were very anxious not to have that happen again.

The whole change was so radical and fast that some professionals started to halt the whole process and were worried about the final result. The professor of the UNC-Chapel Hill Deb Aikat who is specialized in the Internet and society, stated that

> "The first thing that comes to my mind is, now it is getting so easy to track everything. Now, you could even get logs of what people are doing on their Web pages"
> (N&O, 24.9.2001)

State Senator Eric Reeves who is chairman of the senate Information Technology Committee, said he has worried in the past few days about how escalating calls for increased surveillance will affect people's sense of privacy.

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[1] www.epic.org

> “ The rhetoric I’m hearing indicated to me that there may be some very constitutional-law issues at stake here. We must be very careful at all times, that we have to respect people’s reasonable expectations of privacy. The public’s opinion will be on the side of increased surveillance right now, because nobody thinks of themselves as being a terrorist. So there may be some very well-intentioned laws coming in the next several months. … But an overly broad law that over time starts to ensnare law-abiding Americans – that may be the situation we are heading toward.”
> (N&O, 24.9.2001)

The preceding statement reflects little the idea of delay principle, but it also entails a worry about the threat of overly broad law, that includes elements open to various interpretations.

According to a study published one week after the attack by Pew Research Center for the People & Press, 55 percent of Americans said they are willing to sacrifice civil liberties to curb terrorism. As opposed to the 29 percent who were in 1997. Also, 70 percent favored national identification cards. The increase of numbers of supporters indicates as fast and radical change of opinions. The conclusion of the result might be that it is a wise decision to sacrifice some level of liberty and privacy in return for some level of security. Although the radical change of numbers the study suggested that the public wanted to set some limits, for example, though 67 percent favored CIA-sponsored assassinations, only 40 percent favored monitoring of credit cards and only 26 percent favored monitoring of phone and e-mail use.

3.2 Situation dependence

Privacy as an object is difficult to evaluate because a prevailing situation matters a lot also it makes evident that the role of stakeholder is an important factor and it will largely turn on whether we are under a threat or not. Without exception people would give every bits of privacy they have if they know that the plane they are on is under terrorist threat if it would help under the circumstances. The example has a realistic and shocking link to the Sept. 11. There is a very real threat and danger in the hijacked airplane and, thus, the radical change of attitude among victims is very likely. We are ready to sacrifice all level of privacy in return for some level of security in the case. It is difficult matter to find any opposite arguments. Another parallel example could be an accident. Everybody would love to have helpers to know they were in an accident in a certain place. The more severe the accident is the more likely is the need of help and sacrifice all level of privacy. In these kinds of cases more accurate and exact data available is the best by any means. We are very eager to give away a lot of our privacy in return for some level of urgent aid when needed. An opposite situation is also rather easy to imagine. Would people like it if their employer were checking what and where they are doing after work day?

4 Privacy, confidentiality and security

The literature contains many studies pertaining to the general notion of privacy practices for example Dick Mason's PAPA[2] - model studies people's vulnerability (Mason, 1986) and Thomas C. Rindfleish (1997) prescribes the following concept for consideration by IT professionals in knowledge rich business:

Privacy: A person's right and desire to control the disclosure of his and her personal information.

Confidentiality: The controlled release of personal information to an authorized information custodian under an agreement that limits the extent and conditions under which that information may be used or released further.

Security: Policies, procedures, and safeguards used to help control access to the contents of information systems (particularly databases) while maintaining the integrity and availability of the data.

Most major advances in technology also entail unintended consequences, via modern database and database-enabled technology, the potential for misuse of this has also increased (Baumer, Earp, Payton, 2000). Privacy, confidentiality and security revision steps should be taken before stages of the adoption life cycle of ICT services. When new technologies are adopted, an organization's security precaution measure and privacy policy should be revisited and oftentimes revised to respond to policy conflicts introduced by these new technologies (Earp, Anton, Järvinen, 2002). It is very likely that new threats of security and privacy invasion will materialize after a new ICT becomes widespread and hackers and invaders learn how to subvert it. Best practices, as they are understood at the time, should be necessary as countermeasures to build into new systems but revisions of security precaution measure and privacy policy are also needed regularly, but also impulsively to recognize and act on early hints and clues from the environment. New threats take time to catch up with the technology and exploits, but over time, best practices emerge (Prince, 2001). Early counteractions are important, and more, privacy policy and security measure should be at least one step further all the time. Therefore companies must be aware of the need for privacy, confidentiality and security, have processes in place to uphold security and privacy policies, and have the technology necessary to carry out the processes.

On the technological level much emphasis is put to data protection and confidentiality issues to prevent unauthorized use. It have used techniques such as encryption, secure transmissions, firewalls, password identifications, access control and many other technologies (Järvinen, 1999). Also reducing threats to sensitive data is the focus of several studies addressing technical methods to provide better security for data privacy (Brannigan, Beir, 1995; Memon, Wong, 1999; Schneier, 1996). Physically providing better security for customer privacy is very important issue, but I submit it is not sufficient. There is also a need for an evolutionary

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2 PAPA means Property, Accuracy, Privacy and Accessibility of Information

approach for privacy policy development in the global and rapidly evolving Internet world within many layers and perspectives.

5 The Internet

5.1 The Internet and privacy

A key detail of the Internet is that there is no such thing as “absolute privacy”. The growth of the business-to-consumer and government-to-consumer sectors, where stakeholders are many and unknown, involves emphasis on ways of reducing uncertainty in the online markets. Several online organizations are involved in collecting, sharing and using customer information, and these processes need to be as privacy protective and trustworthy as possible. Organizational privacy practices reflect an organization’s perceived trustworthiness to those with which it conducts business. Customers want their privacy protected and they do not want to be misled by hidden tactics that can undermine privacy. For example a 2002 survey[3] in the U.S., which studied about Internet users’ experience with and attitudes toward information technology and privacy, revealed that 98 percent of Internet users want a Web-site to disclose how their personally identifiable information will be used.

Because of the new and radical ICT-related global feature, different actions reflect widely on organizations’ privacy policy. There is hardly any radical decision that happens anywhere in the setting of the Internet that might not have an effect on the local level also. Owing to the nature of the Web technology, the focus should be very global. When working in global context, the differences in cultures and languages, as well as licensing and liability regulations may affect the interaction between employees and customers even thought the business target itself is basically the same in every country.

5.2 The Internet and health care

If we consider the health care business, which is very sensitive segment, it will be more evident that protection of customers’ personal information is not an option but a necessity. Health care organizations cannot be directly analyzed in terms of business organizations (Nurminen and Järvinen, 2001) but it is not weakness in the meaning of this paper. Personally identifiable information with high sensitiveness makes the assessment more interesting. How vulnerable the subject matter appears to be will vary according to the level of setting at which we operate but misuse of information may be very embarrassing to customer.

As a result of the information and communication needs of both health care workers and customers, many companies and healthcare organizations in the U.S.

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[3] theprivatplace.org

have decided to implement different kinds of information technology to support information searching, acquisition and transfer. Modern information and communications technology is being taken into usage in the healthcare context at in increasing pace. In 2000 over 17,000 different health care Web sites offered a wide range of products and services on the Internet (Goldman, Hudson and Smith 2000). Examples of activities currently available on many health care Web-sites include: purchasing, provision of clinical information, professional interaction and personal health records (Anton, et. al., 2002).

6 Case study: Revision of privacy policy

6.1 Background

Evaluation of privacy policy[4] of Internet service is a many-sided task to do, because privacy policy may cover varied aspects and effects between customers and organization. It is noteworthy for consumers who hope that they can be sure about privacy practices of the Internet service without to take a very proactive role in learning about Web-site privacy practices, which is not possible, at least nowadays.

Internet companies should secure to each customer the right of determining, ordinarily, to what extent his personal information shall be communicated to others. Generally on-line privacy policies contain provisions for sharing customer information with law enforcement agencies in the event of a criminal investigation or suspected illegal activity (Earp, Anton and Järvinen, 2002). Nevertheless, some companies that have been cooperating with authorize investigating the Sept. 11 have been reviewing their actions for possible privacy violations. A key issue, privacy advocates say, has come from companies that worry they may have gone too far in handing over complete databases to law enforcement in the immediate aftershocks of the attacks without requiring a court order or a subpoena. (Olsen, 2001).

> "I've never seen a privacy policy that says we will make all of our records available to authorities in a case of national emergency, and I think as a result of this, you're probably going to see companies adjust their privacy policies to take this into consideration," said Ray Everett-Church, senior privacy strategist at the Los Angeles-based ePrivacy Group. Olsen, 2001.

The management of privacy policy should successfully anticipate the environmental shocks. Even the most anticipated person may on occasion recognize that the organization is being asked to deal with environments that are full of surprises.

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[4] A privacy policy is a comprehensive description of a Web-site's information practices; It is located in an easily accessible place on the site (FTC98, FTC00). This concerns mainly websites in the USA. According to my preliminary study there are only a few privacy policies found on the EU websites. The comparison between EU and the US will be my interest in the near future.

6.2 Data Analysis

I present the result of Internet privacy policy analysis in table 1. The study focused on the need of privacy policy revisions. The analysis is based on the following health care privacy policies: 6 pharmaceuticals services, 7 health insurance services, 8 online drugstores, 6 medical institutes and 10 general health information services (Järvinen, 2003). The revision dates were checked in May 2002 (Group 1) and in November 2001 (Group2). I learnt that 20 out of 37 companies clearly stated the revision date of its privacy policy.

Table 1. Privacy policies last revised.

	Group1	Group2	Total
Under 2 months	4	2	6 (30%)
3-6 months	1	4	5 (25%)
7-12 months	3	4	7 (35%)
Over 1 year	1	1	2 (10%)
Total	9	11	20

Over 50% were revised within a period of less than six months. This timing, short after the Sept. of 11, may explain partly why companies have revised their privacy policies, but it also reflects the need of regular changes of privacy policy.

If detailed privacy policy of Internet service could be laid down permanently for fairly long periods and the closely adhered to, and so that no further changes of organizations would be required, the task of drawing up a comprehensive privacy plan governing all organization activity would be possible. But it is easily seen why organizations can’t operate that way. It is, perhaps, worth stressing that many problems arise in consequence of change. As long as all things continue as before or at least as they were expected and planned to, there arise no new problems requiring a radical decision or no need to form a new privacy policy statement. Within the Internet world, privacy related decisions are required at short intervals for example when new software is to be implemented or a new customer process of service is to be introduced. In addition, once customer service has been implemented, the rest is not only mechanical issue. Determined by the character of the service, and leaving much to be changed in adapting to the ever-changing circumstances of environment.

7 Strategies and scenarios

As in the case of cognitive limits to consistent behavior, the first radical change of attitude after the Sep. 11 does not mean that the rational choice approach has to be relinquished. Rather, we should look at rationality with a broader mind. Individuals are super-rational in the sense that, in general, they are able to guard themselves against certain threat and hatred by resorting to appropriate rules and institutions (Frey, 2001).

7.1 Strategy

One of the most important variables that affect the boundaries between firm and market is corporate strategy. Although there are many definitions of strategy, most agree that strategic decisions conform to several characteristics: they affect an entire firm or significant portion of it ("a strategic business unit"); they are made by top level firm or divisional managers; they are long-term in nature; and they are based on perceptions about the future rather than on hard knowledge. (Langlois, Robertson, p.17).

Business management's and, thus, privacy policy manager's approach to privacy policy and privacy protection for new technology can follow in the same nature of long-term vision. In the beginning of Internet service, they may ignore the revision of privacy policy, since new risks have not yet emerged. Sure, they will take into account existing best practices, but they can't take into account all new relevancies. And at the end of new service adoption, when the risks are well known, management will put in just enough money to offset them (Prince 2001). This is anyhow a manageable problem, when new threats are very clear and we have measures to control them. Employee awareness programs are effective means of reducing the risk in those cases and some others alike. They are good remedies after something has already happened or is in range of vision.

The situation is more complicated when we consider and try to make preparations for unexpected occurrences in advance. Cross (1982) characterized the vision of uncertainty via a "non-diagram", the position of those who emphasize the unpredictability of events. The "non-diagram" shows a point in space depicting the current configuration of variables, with arrows leading off in all directions to depict what may happen next. But anticipated attitude should be aimed at in knowledge sensitivity business segment especially, where vulnerability of customers may be very high.

7.2 Scenario

Real world strategies, like privacy policy, must try to cope with the inherent uncertainty of the future. And it would appear that the privacy policy manager who has accepted the oracular perspective can contribute to the process of privacy policy formation in a variety ways, all of which have a good deal in common with the functions served by those strategic thinkers in large corporations whom Jefferson (1983) has characterized as "scenario planners".

The privacy policy manager can actively attempt[5]:

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[5] The list is my modification for privacy policy context. The original work in the economic context were presented by Earl and Kay (1985)

1. to highlight the areas of uncertainty and delimit the bounds of unknowledge, given the existing structure of the whole Internet service, so that he can have some appreciation of what disaster organization might have to cope with and what opportunities they might be able to grasp (providing they make advance preparations) if they implement particular changes of privacy policy;
2. to propose improvements to the Internet service and privacy policy so that they are better able to cope with dangerous threats if they materialize;
3. to discover ways of modifying or eliminating the incidence of surprises in the ICT architecture, business infrastructure and environment.

The privacy policy manager seeking to undertake all these steps carefully in the rapidly evolving Internet world is likely to be in the "non-diagram" situation, where he is unable to make choice between rival possibilities. We can consider for example two different approaches to dealing the security and privacy policy. Security management wants to manage technical risk comprehensively and pre-emptively, with little regard for the expense of remedy. Business management, on the other hand, doesn't want to deal with risks at all unless there's a return to the bottom line (Prince, 2001). There were only two perspectives involved but already then there was a possibility to have deep conflicts. And, in the perspective of customer it might well be argued also that a privacy policy manager must limit the use of scenario-writing style of privacy policy as a whole if he cannot successfully anticipate the environmental shocks with which customers will have to deal. If Internet privacy policy includes all alternatives what could happen, it would look like an everlasting story. One could well imagine that a service user might end up "failing to see the wood for the trees" if he sought to arrive at conclusions about privacy issues of the Web-site.

8 Perspectives of uncertainty and modularity

Because of uncertainty and unpredictability, Internet services may function ineffectively (Belanger, Hiller, Smith, 2001; Cranor, Reagle, Ackerman,1999; Elofson, 2001; Udo, 2001). Privacy and security issues are cited as the top reasons why more people do not use services online or complete transactions they start (Luo 2002). The preceding survey revealed that 77 percent of Internet users believed developers are creating Web-based applications so quickly that little planning goes into security measures. The opposite alternatives were supported only by 8 percent. The conclusion could be organizations cope best with uncertain conditions will be in the best position to implement their business strategies on the Internet.

8.1 Five perspectives of uncertainty

An inability to specify or define stimuli in advance does not necessarily mean that the organization cannot draw up sufficient draft visions of privacy issues, and which previous features privacy policy might be useless in the current setting. First of all privacy policy manager should be able to classify situation in terms of key characteristics – for example, stability/turbulence, static technology/dynamic technology, high sensitiveness/low sensitiveness – before considering ways in which the organization might seek to cope with different patterns and policies.

In this setting, however, uncertainty has many separate meanings that need to be distinguished. The first, which I can call *jurisprudence uncertainty*, arise when radical change of relevant legislation occurs for example after the terrorist attack. Privacy policies must comply with relevant legislation. Health care Internet services must adhere to more specific legislation pertaining to, licensing and liability, malpractice laws, and other health care regulations such as HIPPA (Health Insurance Portability and Accountability Act)[6]. The second type of uncertainty, which I term *technical uncertainty*, arises when a company needs to base its privacy protection decisions on assessment about technical threats. An open network, such as the Internet, contains several access points that are potential targets for hackers to penetrate an organization. The third, which I can call *business uncertainty*, concerns enterprise objectives and activities of those engaged in purchase or sale of commodities and/or other financial transactions. Business objectives and practices often center upon how data is collected and transformed into information that ultimately becomes a valuable business asset: business knowledge. The forth type of uncertainty, which I term *contractual uncertainty*, focus on the binding agreements that form the basis for information exchange between an organization and its business partners or customer. Information and knowledge can generate new information when participants combine elements together and this causes consumer vulnerability to increase. The final type of uncertainty, which I can call *social uncertainty*, focus on organizations and their users or consumers in terms of how both kinds of stakeholders interact and cooperate to exchange goods, services and or information. The social uncertainty, thus, reflects the relationship between the consumers (Web site users) and organization.

8.2 Modularity

After attempting to analyze uncertainties at a variety of preceding perspectives in the organization as a whole, the privacy policy manager should not be unduly perturbed if he happens to recall Keynes' famous comment to his critics on what he meant by "uncertainty".

> "The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention or the position of private wealth owners in the social system in 1970. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know."
> (Keynes, 1937. p. 214)

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[6] Health Insurance Portability and Accountability Act of 1996, 42 U.S.C.A. 1320d to d-8 (West Supp.1998).

Therefore privacy policy manager may feel that is desirable to try to understand behavior at the organizational level at which certain uncertainty most likely occurs. If this level concerns that of many individual decision makers within many interests, the privacy policy manager will face the situation where one useful method could be to design privacy policy so the change of policy is possible to do in a flexible manner. If we evaluate the situation from organization perspective the organic privacy policy, which is characterized by continual adjustments, tend to be more appropriate for rapidly changing environment. By way of contrast is the evaluation from customer's perspective if changes will weaken customers' privacy protection and strengthen vulnerability.

On the other hand, if company's privacy policy is one mechanistic structure, evolving necessary changes without major restructuring operation might not be possible and therefore established new practiced may be something the existing customers would find hard to accept.

A prominent and promising strategy employed for coping with turbulent environments of the Internet is to devise methods of localizing and limiting the change posed by external demands, even if the source or form of the impulse cannot even be approximately specified in advance. If individual sub-systems can be decoupled from the overall system without threatening the latter's integrity, then this may form the basis of system design in turbulent environments (Earl and Key, 1985, p.40). Following Simon (1969), Earl and Key expected that, after a period of environmental turbulence, the surviving systems would be found to be those that had exhibited a good deal of decomposability.

In the context of privacy policy revision a privacy policy manager may exploit the adaptability features of modular design. He is able to use the uncertainty perspectives to build a suitable modular view. Those five perspectives offer a possibility to probe each perspective as an entity, but also as a part of the larger view of many entities.

Modularity gives a good basis to revise privacy issues in the perspective of several specialists. It offers, thus, possibilities to use deep and local, but also wider and more common knowledge to implement and evaluate privacy practices for the entity. It also offers chance to use prepared check-lists and special check-points. For example in the U.S. many major Internet companies have legal departments to handle unexpected situations and demands of legal issues. Jurisprudence is therefore strongly entitled to be one entity of the model. In the aftermath of the terrorist attacks some companies have ignored normal procedures for working with law enforcement, when they have disclosed too much personally identifiable information to them (Olsen, 2001). It submits also the importance of the entity. It additionally indicates the importance of the entity to be considered in the setting holistically. Privacy policy managers should maintain a holistic view of privacy within the context of their organizations in tandem with how those modules constrain and influence information practices. Privacy policy and privacy practices must thus be considered within a larger, more comprehensive framework that recognizes the role and influence of the five modules.

9 Organizational perspective and ONION-model

9.1 Organizational perspective

Modularity entails possibilities to consider privacy issues in the organization appropriately from the point of task and working role. This approaching gives many advantages. Ansoff (1979) argues that many potential strategic surprises could be avoided if organizations develop techniques to recognize and act on early hints and clues from the environment. This view seems to be parallel to privacy policy strategy. Activities at different levels in the organization typically have different tasks and goals and, thus, the importance of privacy issue may vary much at different levels accordingly. The privacy policy manager might be more confidently able to prevent privacy problem when listening to weak signals where privacy issues are important and act sufficiently and accordingly in advance. Advance of modular design concerns typically a complex multi-level organization where also description of ICT may alter a lot as we move between levels.

9.2 ONION-model

The ONION-model offers one approach, which seems to be useful. Laboris, lead by professor Markku I. Nurminen, has developed the model originally for evaluating information system performance. “The ONION model is hierarchical. The origin of the hierarchy is in the conditionality: evaluation at one level requires the acceptance of the next larger context to the object of evaluation.” (Kortteinen, et.al., 1995). They have used Saarinen’s design idea: “Always design a thing by considering it in its next larger context – a chair in a room, a room in a house, a house in an environment, an environment in a city plan” (E.Saarinen, 1956). Laboris presents basic model within four levels: individual, group, organizational unit and enterprise. The idea of ONION model is to climb through the ONION hierarchy evaluating the activity at the same time.

In the economics context Earl and Kay (1985, p. 38) have described the situation so that “even though their individual events may be unpredictable, different kinds of turbulent environments may display particular regularities of patterns, signaling the need for appropriate system design of procedure if the decision maker is to operate and survive in his own particular turbulent environment”. So although the economist may, be unable to predict the unpredictable, at a higher level of abstraction it may be possible to expect the unexpected, as Boulding (1968) has suggested.

The modification of the ONION-model and ideas by Earl, Kay and Boulding offers an effective tool for the revision and assessment of privacy policy. On each layer the privacy policy is evaluated and revisited according to the local criteria of ‘a good performance’. It is proposed that privacy policy criteria on each level must be drawn from the goals of the activities. In this way privacy policy is anchored and becomes relative to the view taken on each layer. The evaluation criterion of privacy policy can be given on another layer and it gives us consolidation. Privacy actions should be in balance with the dependence of time and situation, but privacy policy manager should not be uncomfortable to offer privacy policy revision which is characterized by Eisenhower's behavior: procrastination can have its advantages.

Using ONION-model, which takes time, but we are able to revise privacy policy which is appropriate in the each layer but also sufficient for the whole Internet service. Using five perspectives we are able to make useful check-lists and paths to follow. Those check-lists help to the scope of revision process. It is important to notice that the activities of check-list are not described in terms of information technology, but in terms of organization's activities. The revision of privacy policy should be much wider than ICT only, which is the message of different perspectives.

9.3 Revision process

The revision and evaluation of privacy policy consists of six sequential phases[7] and five loops of different aspects (jurisprudence, technical, business, contractual, and social). The steps involved in revision process, include

1. Delimit the scope of privacy revision by finding out the activities which affect or are affected by privacy issues.
2. List the corresponding stakeholders and activities on every ONION layers.
3. Describe the privacy actions in work oriented terms.
4. Evaluate the protection and vulnerability goals of every action.
5. Elicit the probable causes of eventual privacy deficiencies or deviations.
6. Create a description of corrective privacy policy.

When we have accomplished one revision loop, then we should set new measures and aspects for another perspective. The importance of revision may vary among different levels of organization. It is also possible that some loops are not necessary in every level of organization.

The emphasis of privacy issues in ICT-related business has been especially on technological level, but although it is a very important issue it doesn't give the rich picture of the prevailing environment (Checkland, 1981; Checkland and Scholes, 1990). Organizational context and many other things should be taken into account. How unpredictable and vulnerable the subject matter appears to be will vary according to the level of service transactions, service functions, and sensitiveness of customer information and many others alike. We should not look at the setting from the ICT perspective only. Rather, we should move to the setting of whole service and look at the privacy policy through different lenses of five perspectives in every layer of organization.

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[7] The modification of original work by Laboris

It is important to notice that qualifications for successful revision process depend much on the motivation of doings. Psychologist and sociologist more generally distinguish between two kinds of motivation, extrinsic and intrinsic (Kreps, 1997). Extrinsic motivation induced by manipulations of rewards or sanctions from the outside, and intrinsic motivation, where people perform an activity for its own sake because of reasons lying within their own person (Frey, 2001, p. 14). Anybody looking at successful revision process must be aware that a phenomenon such as intrinsic motivation does exit. Privacy policy revision is very sensitive business and therefore intrinsic motivation should get a special focus on to bring up also tacit knowledge and hidden practices (Nonaka, 1994).

10 Summary

We want to keep our organizations trustworthy. Our ideal aim is to manage risk of privacy issues comprehensively and pre-emptively, even though we know that absolutely privacy protection is statistically impossible because evolving threats of many changes and occurrences. Different tactics cannot eliminate risk, only mitigate it.

The management of privacy policy should successfully anticipate the environmental shocks. Even the most anticipated person may on occasion recognize that the Internet organization is being asked to deal with environments that are full of surprises – actual events which they fail to consider as possibilities. The difficulties of privacy policy revision in the turbulent environment of Internet business can be crystallized to one question: “What ought to be covered and measured?” A privacy problem arises always in a specific situation. Normally it occurs as the result of unpredictable incident. Privacy matters are deeply situation and time dependent issues and cannot be found by applying a predefined list without considering first the rich picture of the whole setting.

I claim that the attempt to find a general measure for global privacy policy is doomed to fail, because there are too many aspects to consider. The tension comes from reality of uncertainty and unpredictability. Although we can use different rational approaches to dealing with revision of privacy policy and maybe it is the way to get the risk bearable.

In this paper, I have presented approach which includes five perspectives and layered ONION-model. Recognition of unpredictability entails new principles and practices to the revision of privacy policy. The combination of different perspectives and layered model seems to serve a constructive approach. Modular revision of privacy policy may offer, therefore, an important device for dealing with unstable and unpredictable environments, but it also demands the revision process has been both intrinsic and extrinsic driven.

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Against System – Towards Content

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Abstract. The Human-scale Information System concept (HIS) was introduced in the beginning of the 80's and it is still valid. I will argue that it can be used also in the modern network economy – in fact in its ultimate form, the network economy is HIS. Nevertheless, I will also introduce a complimentary aspect on it, and that is the content. In fact, I claim that the key success factor is the users understanding the meaning of the information presented by the system. When used within a company understanding is usually no problem, since the information is used in the same context. However, used in a network, maybe even a global network, will inevitably introduce understanding problems. Therefore, I have suggested that the whole business process should be described as a story, providing the context for correct understanding of the information. Storytelling will thus be a vital part of system design and system use.

1 Against systems

When I first saw a "Festschrift", i.e. essays that was published in honour for somebody who was old enough to be honoured, I was astonished when I saw the articles. Many of them were ordinary, dull and tedious research articles, some of them not even referring to the honourable object for the "Festschrift" and with an obvious purpose of being reusable. I cannot see any reason for honouring a person by writing such an article, so this will not be a traditional research articles. Instead, it will be an essay, in true honour to Markku Nurminen, describing some of the deep influences he has had on me. I will however, in true Nurminorian spirit, speculate something over the issues and propose some new and hopefully revolutionary ideas. In that aspect, I follow the traditional model, since I might myself elaborate the ideas further in other papers. Nevertheless, Markku will have them first; I think he deserves that and I give them to him, free for use.

In the year, 1981 I met Markku Nurminen for the first time. It was in the fourth IRIS in Oulu, which at that time was called Scandinavian Research seminar on Systemeering. In fact, we shared room and I was very impressed of the fact, that always when Markku said something it was extremely sharp and witty. He had written an article called "Against system" where he, as far as I know, for the first time presented his ideas about human-scale information systems (HIS). I found the idea fascinating, but it took several years before I really understood what it meant. In my own research, I soon realised that the concept of HIS was exactly what I needed. However, Markku was a bit confused, since he claimed the concept was a purely theoretical one and not intended to be used in practice. Markku was my supervisor in my thesis work, but our supervision sessions turned out to be more opera than science. Besides, we also loved playing with our Macintoshes. Nevertheless, in my thesis about end user computing I demonstrated some practical aspects of HIS to the astonishment of Markku.

Coming back to the first article, the great and revolutionary idea was that the notion of integrated information systems was obsolete! It was reduced to a set of interrelated systems of personal scale. That meant that the information system was no more, the computer was reduced to a tool at the worker’s disposal. The single worker was responsible for the result of the work, irrespective of the information system. The emphasis was on the user and on the result of the work, not on the system. This was (and is!) indeed a far-reaching thought!

I think the first time I saw the implications of this thought was when I read the article in Bjerknes et al (1990) about transaction costs. It explained very well an experience I have had myself (Flensburg & Friis 1994), seeing how the users in a Swedish foundry insisted on having a formal delivery with acknowledgement instead of automatic updating of the information.

An interesting consequence of the HIS concept is that there is no need to distinguish between work and information. It took a long time for me to accept that viewpoint and understand its consequences and maybe I have not yet understood it fully. Back in 81, I was indeed confused when Markku very sincere claimed that there were no difference between work and information. Today, 22 years later I see a huge potential of the viewpoint. It is about internet…

2 Internet and web-based systems

In the late 90’s, we saw the explosion of internet, we saw the enormous expectations on using it for business and we saw the free fall of this idea in spring 2000. The reason was a focus on the system, not on benefits of it, depending on the humans and how they behaved, i.e. their work in a broad sense. Just one example: The mere idea of young people to buy expensive high brand cloths on internet was ridiculous, the young people don’t buy clothes on internet, for them it is a social act, they visit several boutiques with their friends, they test several versions and often they buy and deliver it back some days later[1]. Investing about 100 milj euro in a web site for this (Boo.com) was incredible and this is just one example.

Today, in the year 2003, the e-business is more between companies (B2B) than between customers and companies (C2B). However, we see a very interesting trend,

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1 I’m the father of three girls, so I know from empirical experience.

a business process covering several organisations and fragmented into very small pieces, each covering only a small subprocess of the whole process. We enter what Castells (1996) calls, the network society (Figure 1).

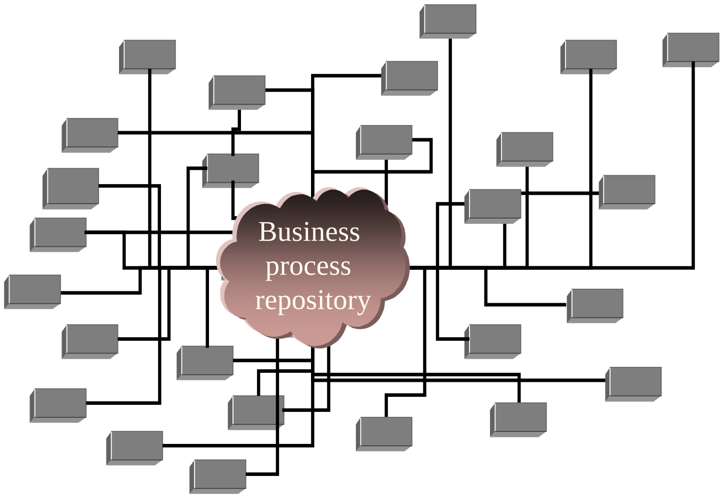

Figure 1. Business processes, fetched from a repository, will in the network society be spread over a lot of small and independent actors. In fact the business process per se can be designed different for to every transaction. The web services help to identify reliable vendors and suitable business processes. We have highly specialised units and extremely flexible processes (from Flensburg 2002).

In this network, each actor performs a small part of the total business process but she performs it extremely good. I think this a new version of human-scale information systems. Let us compare them with some of the properties Nurminen outlined 1981.

A human-scale system is a simple system. So is this network. In each node, we have a human being responsible for carrying it out. In addition, it is important to note that the business process might be redefined during its execution. According to the process, fetched from the repository the process should involve the following companies in the described order: A➔ B ➔ C ➔ D ➔E. Now A knows, that B has not time to do the required steps, so instead she passed the task to F who has free capacity. F use to work with G so after finishing her part, she passes the task on to G. However, G cannot do all the steps that C should do, so instead she passes the task to H who then passes it to D. So the business process might look something like this: A➔ F ➔ G ➔ H ➔D ➔E. The result is the same; the process is carried out with the desired result. Each actor in the chain behaves responsible and cares for achieving the desired result, just as in a Human-scale Information System!

It can be argued that in modern B2B this process should be carried out automatically, the description should be done in such a way that a computer could execute it. In my opinion, this is not possible. So far, we have not been able to construct a system automatically taking care of a business process within one company, how should we then be able to do the same thing for a much more complicated system, which even might be global? The only sustainable way to design such a system is letting the single users take their responsibility for the result of the process step, i.e. a human-scale information system!

The common notion of integrated system has disappeared, seen from the single users point of view. However, seen in a larger perspective, from the business process view, the process forms a well-coordinated whole, where synergy-effect might occur. This aspect is not emphasised by Nurminen, still it has been demonstrated that the company as a whole benefits (Nurminen 1990).

In this case, with dynamic execution of business processes we have seen that each part takes her responsibility and works for the whole process, we have a human-scale information system, despite the fact we can as well talk about a global business process. We see in fact how this small HIS transcends to being a global, all-embracing information system. We see how the total control of the whole information process is melted down to some responsible actions by human beings. Indeed, a wonderful strength of this concept! However, there is one question, which I think Markku has not penetrated in sufficient depth and that is: Why does it work?

3 The content of an information system

It has been proven many times, that user involvement is as close to a guarantee for success we can come. In the traditional collective approach the reason for user involvement is sharing of power, in the HIS approach it is mere a change of the system architecture. Nevertheless, changing the architecture requires power, so in order to first change the architecture a change in power and authority is needed. I do not think this is enough. The power issues might have been recognised by Markku, however not emphasised, but maybe he has overlooked one thing. It starts with the question asked in the last section: Why does HIS work? I cannot remember that question being explicitly addressed in Markkus' papers. He has many times argued that there is virtually no difference between work and information. In my mind, this is the first part of the answer. Because, in order to do the job, the worker needs the relevant information or rather the worker cannot do the job if he does not have the relevant information. For the single worker this means that she knows! She knows the state of affairs; she knows what is needed for the work and can thus proceed to the next step. This knowing has from the users point of view absolutely nothing to do with the architecture of the system; it has only with the *content* of the information to do! This is the point Markku might have overlooked.

In a HIS as well as in user controlled systems development process, the users are familiar with the system, they know the philosophy, they know the structure and they know what the information really means. That is why they can use the system; that is why they perceive the system as a useful one (Flensburg 2003). As traditional IT experts we claim the eventual success is due to the IT system; as collective approach oriented researchers, we attribute the success to the power structure and as HIS oriented researchers we think the success is due to a better work organisation. In fact, in all cases the success can be alternatively be explained by the users knowing what the information produced really means and being able to take appropriate actions according to that.

This can in fact also happen in traditional information systems, it has been shown (Gäre 2003) that it takes some years (up to seven according to Keen 1991), before all the intended benefits and organisational possibilities is realised. I believe this is due to the fact that it takes so long time for the users to learn the system. Gäre (2003) has demonstrated this, and he argues that organisations often neglect the implemen-tation process of an information system. Moreover, of course, the IT-experts do not realise the need for a proper education of the users.

So I argue, the reason why HIS is so good a model is simply because applying it, allows the users to understand the content of the information. By not distinguish between work and information, the user almost automatically gets to know what is needed and has a useful work tool. This is the beauty of HIS; this is the true strength of the concept.

3.1 To focus on content

What is exactly meant by saying that it is the content of the information that matters? What is the content? It can be put rather simply: The content is facts about certain objects in the working space of the user. To explain that, we can go back to Langefors' information theory. The reason is simply that an elementary message (Langefors 1966) tells the value of a certain attribute of a certain object at a certain time; that is simply put: A fact! A fact can be considered as something objective, something we cannot argue about, as long as we assume the value is correct and we are acquainted with the system. What we can argue about – and what users in fact *do* – is the meaning of a certain attribute; what the system really means.

Here the fabulous strength of the HIS shows. Markku simply says: This is not interesting! The meaning is carried out in the work process; it is allocated by the worker and shared by the co-workers. Meaning is something only human beings can have, thus we must reduce the system to just – work!

However, this informal allocation of meaning cannot always be done. Markku describes it for a company (1990) and focus on the communication and meaning creation process in certain groups. Nevertheless, in the network society as described above, this might not be possible. Every human in the business process acts responsible, but if she does not understand the meaning with the action, how can she then act responsibly? There might be a need for transferring not only the information but also the meaning with the information. How can this be possible?

The way argued by IT scientists today is use of metadata and standardisation of business processes. Meta data is required for the computers to work, but they are usually not understandable for human beings. Besides, there will soon be a claim for metametadata and so we can continue, ad infinitum. Standardisation is on the other hand a more promising approach; nevertheless, in modern e-business the most important thing is to establish relations with the customer, to personalise and share values (Keen 2001). How this can be standardised, I cannot understand!

Meaning is always dependent on the context, so the key factor seems to be a transmission of as rich context as possible. Traditional information systems are de-contextualised; many facts are presented in long lists on screens or on blue-white striped paper. It has, however, been shown (Göranzon 1983) that people develop sort of tacit knowledge and can find patterns and detect irregularities even if they do not know anything about the content in the lists. What if the users know something about the facts represented in the lists? Let me give an example: In 1982, some of my students developed a prototype to a library system. During the demonstrations, the students just entered some sample data, often with a certain student accent. When we demonstrated the system and wanted feedback about the layout, structure etc the users started to discuss the actual classification of the book we hade entered in the system. Some suggested alternative classification codes and some other argued for our coding being correct. The users saw the content; we saw the structure.

Providing a rich context means inevitably redundancy, in the meaning that not only the core facts but also circumstances around it must be recognised. In fact, I remember in 1981, that Markku said that as soon as you change something in a database, you create redundancy. We never has had time to discuss that matter in depth, but seen in the perspective of rich context it can be interpreted as several approaches:

1. The description of the fact should include multimedia presentations too. It could be a picture (or 3D-picture) of a part, a customer or whatever it can be, it could be a micro-learning session or it could be a whole encyclopaedia, dependent on who is the user.
2. The single fact could be extended to cover as many aspects as possible.

The first approach can be realised for instance by attaching a teaching module to each customer, part, operation or whatever the actual object deals with. This provides a rich description of the parts that are involved in the description of the fact, but it is not necessary a rich description of the fact per se. In that aspect, the second attempt is more fruitful and I will discuss that more in depth.

3.2 Rich description of a fact

If we say “description”, we associate to a verbal description. In fact almost[2] every other type of description could be replaced by a verbal description, however it might in some cases be very lengthy. Let us thus for the moment concentrate on verbal descriptions. The next question is: “What is a fact?” because if we do not know that, we cannot describe it. On the other hand, as my friend Paul Lindgreen

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[2] In fact I think it is every type of description, but just to be careful I say ”almost“.

says: If you cannot describe it, you do not know it! Nevertheless, in the context of information systems use, I think we can define a fact as something like:

A fact is an association of a value to a certain attribute of an object in a system.

Put in a more formal way it can be expressed as <value>; <attribute name>; <object name>, <object type>, <system>. In a verbal description, this is manifested as a simple sentence, saying for instance, “There are 42 gearshafts in the store“. In a formal way it could be described as:

<42>, <there are>, <gear shafts>, <the store>

Langefors (1966) pointed out that this is not enough. You must also know the time when this was correct. Then Ivanov (1972) pointed out that even this is not enough, since you must give an estimation of the uncertainty of the value. This estimation cannot be done by any other than the actual users, and in fact, Invanov proved a necessity for a human judgement just in the middle core of the system. Principally, it is the same as when Markku proposed HIS[3].

Nevertheless, this does not provide a description of the context. It is just a more accurate description (or estimation) of the value. In the context, we have other types of attributes. In fact, what we can say about an object is determined by our grammar. Expressed in grammatical terms a fact can be descried as

<verb phrase>, <noun phrase>, <accusative attribute>, <amount attribute>, <time attribute>

The main idea now emerges: If we assign every possible attribute to a verb phrase, we then obtain as rich description as possible of the reality described by that specific verb phrase under the specifically given circumstances. Let us now skip a 30 p excursion in dependency grammar and just present the result.

We will describe an activity, denoted by <verb> and associated with an object, denoted by <noun>. If we ask the following questions, we will obtain a description of the object <verb> that is as rich as possible.

1. What is needed for <verb> to start?
2. What <verb><subject>?
3. For whom <verb><subject>?
4. When <verb><subject>?
5. How <verb><subject>?
6. Where <verb><subject>?
7. For what purpose <verb><subject>?
8. What happens when <verb> is ended?

By asking these eight questions, I claim it is possible to obtain a rich description of a certain activity <verb>. No 1 identifies the starting conditions and no 8 identifies what is happening when <verb> is completed. In fact, the method has

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[3] Well, almost...

been tested in practice and here is a translation of how a sales representative with the name Carl describes part of the selling process:

If the customer is satisfied with the offer of the Company, Carl makes an agreement with the customer, which means that the customer shall buy a certain quantity of a certain product to a certain price.

This is a description on the meta-level of a single fact, what is needed is a description of the total collection of facts. But if we put the descriptions of all facts involved in a certain process and order them according to 1) and 8), well we then have a description of the total process in form of a story! The style is somewhat mechanical, but still: It is a story. Reading it, makes the reader create an interpretation of what it means. Seen into a context of other such descriptions, we will create a context for interpreting the story in a correct way.

However, the story is not very readable! In order to make it readable, we have to rephrase the sentences, maybe put them in another order and maybe add some stylistic flavour. Ways of doing this can be fetched from literature science and specifically literature analysis. How this can be done, I do not know – yet, but I am pretty convinced that telling a story is the best description of a business process. We will have a course in storytelling in the autumn and after that, we will know better !

Telling stories is by the anthropologists recognised as one of the main processes for keeping the society together. In our days, stories are used for the same purpose in enterprises. Telling a story, being a part of a story and acting in a story is a deep human need. I have now indicated that this need can be used in order to create better business processes and understanding the supporting systems we have around those processes. In fact, we then have true human-scale information system!

4 Summing it all up

The HIS concept was introduced in the beginning of the 80's and it is still valid. I have shown that it can be used also in the modern network economy – in fact in its ultimate form, the network economy is HIS. Nevertheless, I introduced a complimentary aspect on it, and that is the content. In fact, I claimed that the key success factor is the users understanding the meaning of the information presented by the system. When used within a company understanding is usually no problem, since the information is used in the same context. However, used in a network, maybe even a global network, will inevitably introduce understanding problems. Therefore, I have suggested that the whole business process should be described as a story, providing the context for correct understanding of the information.

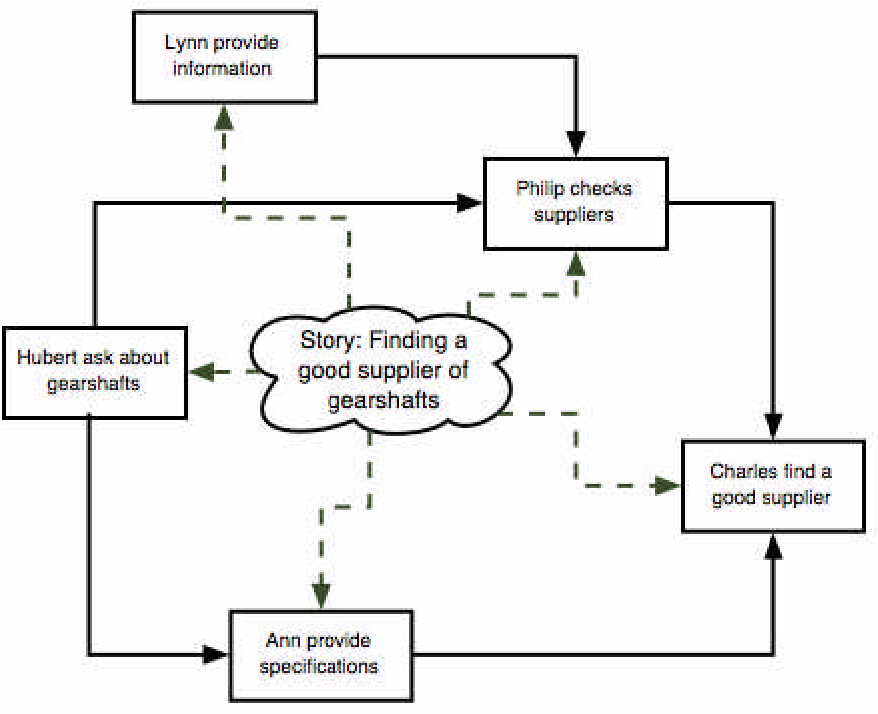

Figure 2. This is part of a process ”buying gearshafts“. The part is ”Finding a good supplier”. In doing so some people are involved in information gathering and information processing. The whole process is guided by a story called ”Finding good suppliers of gearshafts” which everybody is acquainted with.

In Figure 2, I have sketched such a system, which is hold together by a common story, well know by all involved. It demands high professional skills, since the people involved must know not only stories about finding suppliers of gearshafts but also of steering wheels, wheel centres, differential houses, cup holders etc. It also put high demands on those who write the stories, since they must be understandable in a wide cultural context and besides being easy to remember. We see finally a market for those humanists, cultural workers and artists going around and having no work. In the new economy, they have their central positions!

Here the story ends for this time. Maybe it will be continued...

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Public-key Deployment in Context

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Abstract. This paper discusses the problem of designing network security solutions. We focus on public-key infrastructure (PKI), and on the problem of creating and maintaining trust between two entities in telecommunication networks. Four different deployment models are studied in the context of product lifecycle. The lifecycle consists of phases like "manufacturing", "installation", and "repair". The study demonstrates how the product context, and "lifecycle thinking" can help the design and evaluation of security related to complex information systems. Some general recommendations on choosing public-key deployment model are given.

KEYWORDS: Security, public-key cryptography, and contextual design

1 Introduction

The utilization of advanced security technology, such as Public-key Infrastructure (PKI), is known to be expensive. For example in corporate context, the security architectures may have high costs in terms of configuration and administration. Manual work at any phase of the security deployment, physical presence of security personnel, skill requirements and the costs of tamper-proof hardware technology are examples of the costs.

In this paper, we study the costs of security in the context of telecommunication networks. The primary research subject is a "network node" and its lifecycle. We will demonstrate that the security requirements are different for each lifecycle step depending on the assumed deployment model. Research here boils down to how the deployment steps should be organized in order to minimize unnecessary factory, installation personnel and other involvement – and still maintain acceptable level of security. Organizational boundaries and roles give different motivation of optimizing the costs. For example, the network operator has various deployment goals including that it should not need to trust the installation personnel or mechanics.

The rest of this paper is organized as follows. In Section 2, we introduce the theoretical background. Section 3 describes the research methods and context. In

Section 4, we analyze some public-key deployment models in the research context. In Section 5, we conduct evaluations on the deployment models. Section 6 contains our conclusions from this research.

2 Theory

Public key cryptography has been celebrated as the solution for securing telecommunication networks. There are also many attempts of using the same technology for business applications such as mobile and electronic commerce. The technological innovation is relatively old, going back to 1970's. The basic innovation is the mathematical application of large prime numbers for creating asymmetric cryptographic key pairs in which one of the keys does not reveal its counter-pair (Ellis 1970, Cocks 1973, Diffie & Hellman 1976, and Rivest, Shamir & Adleman 1978). In this way, one of the keys could be publicly known if the other was kept secret. In symmetric cryptography, the cryptographic key must be shared between communicating entities and each communicating pair must have a shared key. Asymmetric cryptography allows the use of the same key with all entities. Asymmetric cryptography can be used for various purposes, e.g. authentication and integrity protection using digital signatures, and confidentiality using encryption (see more e.g. in Menezes et al 1997).

The basic challenge in asymmetric cryptography is the distribution of public keys. In order to communicate securely, you need to know which public key belongs to which entity and/or which public key can be trusted. If you want to send encrypted message to Bob, you need to have Bob's public encryption key. If you want to prove your own identity to Bob, one way is to digitally sign your message, and deliver your public signature key to Bob.

One solution for this problem is the Public Key Infrastructure (PKI). PKI provides a framework for trusted and efficient key and certificate management, thereby enabling the use of security services. The main technical function is related to the distribution of public keys and establishing trust on them. The entity's public keys are typically stored in a database with associated subject identity and other information, and each record is represented as a certificate.

Certificates do not by themselves create trust to the system, as a Certification Authority (CA) is still required to create the certificates. CA acts as a Trusted Third Party (TTP) between the entities that want to exchange public keys. The certificates are secured using the same technology as they are trying to provide security for. That is, the certificates are digitally signed using the key pair of the CA, and you need to have the public key of the CA in order to know whether to trust on the certificate issued by the CA. Term "root CA" is used to indicate the CA that is directly trusted by an end entity. Other CAs may also be trusted based on its relationship to the "root CA(s)". The "root CA" may certify other CAs in chains or in a mutual relationship (i.e. cross-certification), and the end entity may also trust the certificates issued by these secondary CAs. All public-key deployment models must include a process in which the trust is created between the root CA and an end entity.

There are also some other roles in a typical PKI system. For example, the Registration Authority (RA) may take some tasks of the CA to be performed locally. For example, RA may check that the identity of the entity applying for a certificate is correct. But this is mainly an implementation issue internal to the CA.

During its lifetime, the private keys may be compromised either through careless handling by its holder or through a system. Therefore, certificate revocation or other means of validity checking need to be included in PKI systems (see e.g. Hsu & Seymour 1998, Wohlmacher 2000). Revocation or other validity information is typically publicly available, as are the certificates. This information may be represented as a Certificate Revocation List (CRL), signed by the CA. In the list, each entry specifies a revoked certificate and typically includes information such as the certificate serial number, time and date of revocation, and a reason for revocation. As new revocations occur, entries are added to the list, and a new version of the list is published. Other means for validity checking include online validation and the use of short-lived certificates.

Initial registration/certification is the process whereby an entity first makes itself known to a CA or RA, prior to the CA issuing any certificates for that entity. If the process is successful, the CA issues a certificate for the public key of an entity, and delivers the certificate to the entity and/or publishes the certificate in a repository. This process may involve multiple steps, possibly including an initialization of the entity's equipment. For example, the entity's equipment should be securely initialized with the public key of a CA, to be used in the validation of certificate paths. Furthermore, an entity typically needs to generate its own key pairs. Every key pair needs to be updated and certified regularly. As certificates expire they must be updated if the network security policies require it.

3 Research setting

There are a wide variety of factors affecting the design of a PKI based system. For example, customers' immediate and future security needs have to be considered. There are also some legal requirements that may set limits to the design, e.g. a potential requirement to disclose the decryption key in the event of a criminal investigation. The security risks need to be investigated. Sometimes the goal is not in "perfect security" if the threats are acceptable. Technology and use context may set special requirements to the hardware and software used in the design. Also, the existing security infrastructure and protocols may set additional requirements. Interoperability, scalability and performance are also important issues affecting the user experience and possibilities for future deployments. There should be some secure fallback arrangements to be applied in the model if something goes wrong during the use phase.

Costs related to security are often high, and they vary at different phases of deployment. The costs naturally include technology, but also many deployment related aspects. Initialization of trust to the products, process wise complexity, required skills and competences, and maintenance are good examples of deployment related costs.

The product life cycle involves different actors, and the costs are typically distributed unevenly between them. Even though one public-key deployment model could have low total costs, it might be expensive from the perspective of one particular actor. For example, one deployment model may add complexity to the manufacturing process in the Factory, and may not be appropriate for this reason. On the other hand, if the deployment model creates competitive advantage to the Factory, the higher costs may be acceptable.

We will evaluate different public-key deployment models using the following steps:

1) Different deployment models are evaluated in each product life cycle step locally. The evaluation criteria include aspects such as manufacturing requirements, ease of delivery, need for external trust, skill requirements, costs for the Factory and costs for the Operator. It is also necessary to consider various security threats, such as physical security, key compromise models and different attacks. Note also that the locally preferred solution may not be appropriate in some other life cycle step.
2) The results from the local preferences are merged to create an overall view on the suitability of different solutions to the problem.

In order to evaluate public-key deployment models, we define a theoretical research context involving different actors and entities. The research context does not exist as such, however, it reflects quite well many real-life contexts. The following entities are assumed to exist:

The “Node” is the basic unit of this research. Node is an entity that is part of a telecommunication network, and it needs to create a trust relationship to the rest of the network (mainly represented by the “Operator”, see below). We are not interested on the internal functionality of the Node or even the network. The Node has a lifecycle that is followed during the evaluation of public-key deployment models.

We also define three actors that are somehow related to the Node. In some models, the actor just ‘owns’ the node, and in other it may change the stage of the Node in the lifecycle. These actors are:

- “Factory”: an actor that manufacturers new Nodes. The Factory may have a trust relationship with the Operator, or even with the Nodes that it has produced.
- “Operator”: an actor that owns the Network. Operator purchases new Nodes from the Factory. The operator may also resell the nodes to a “Second Operator”. The Network itself is seen as a set of Nodes. Nodes in a Network have mutual trust relationships.

- “Mechanic”: an actor that maintains the network. Mechanics may be part of Operator’s organization, or they may be independent from the Operator. The trust between the Operator and the Mechanic is typically minimized.

4 Deployment models

We classify public-key deployment models using a two-dimensional framework (Figure 1). One dimension of the framework represents whether or not a Trusted Third Party (TTP) was involved in setting up the initial trust relationship. There is no inherent need for TTP involvement if the product’s owner or his representative can do the setup manually or if the trust is created using opportunistic methods. Another dimension deals with the way the trust is initiated, i.e. using off-line or online methods. Off-line methods imply the use of manual work in the setup of the Nodes. In on-line methods, Node establishes an on-line (“live”) connection to the Operator for the installation procedures. We will further analyze the four models distinguished by the framework: 1) Vanilla PKI, 2) Opportunistic keying, 3) Manual keying, and 4) Root CA rollover. There are other versions that include features from these basic models. These variants are out of the scope of this analysis.

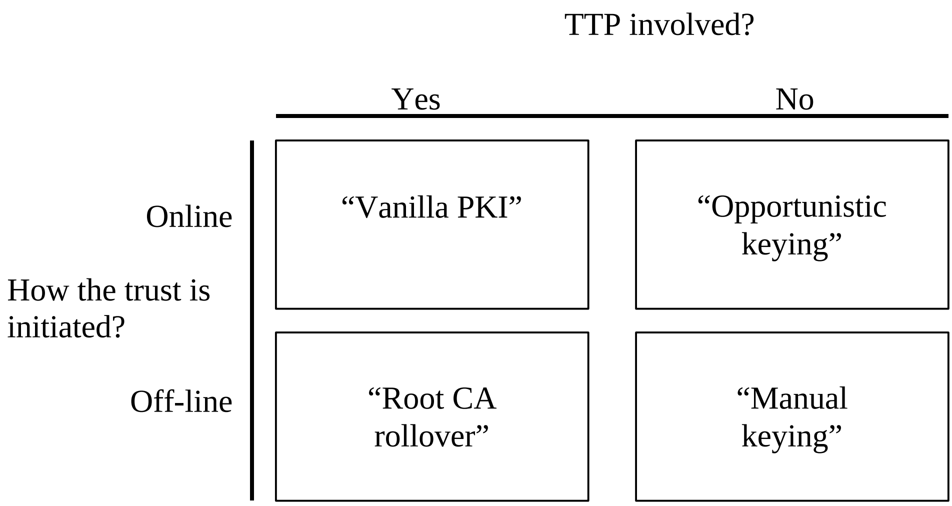

Figure 1: Classification of public-key deployment models.

In ‘Vanilla PKI’, the Operator is assumed to belong to some global PKI. The Operator must possess a certificate from an external CA (i.e. a hierarchical CA certificate, a cross-certificate or a normal end-entity certificate). The Node authenticates the Operator using the trust based on the external CA certificate. However, the Operator is not able to authenticate the Node unless some additional security measures are used.

The Factory manufactures the Nodes, and inserts the Root key of the external CA to the Node. Nodes can be delivered directly to the site where the Nodes are installed to the network. At the installation phase, the Node is able to authenticate the Operator (or the network) using the external CA. Node generates the keys, and an integrity protected certificate request is sent to the Operator. The Mechanic can protect the certification request with some pre-shared secret (cf. Manual keying below). Alternatively, the Mechanic could be seen as an instance of the Registration Authority (RA) being responsible for verifying the identity and the public key of the Node, and for delivering this information securely to the Operator. In order to restrict the access of other Operators to the Node, PKI can only be used for verifying the identity of the Operator. The Node must be supplemented with additional policy information about the access rights of other entities certified by the external CA. In practice, only the Operator is authorized to access the Node.

If broken, the Node is repaired either on field or taken to Operator's or Factory's premises. If old Security Parameters can't be restored to the repaired Node, the repaired Node is flushed and installed again as in the installation phase. If the Operator initiates the repair operations on-line with no physical presence, the risks are at the connection. If a Mechanic is involved, repair operations on field require trust between the Mechanic and the Operator. The Mechanic itself is a clear security risk. Also the repair operations on other premises cause additional security risks related to transport and storage.

At the end of the Node lifecycle, the Node is taken off the network, all Operator-related data is deleted and the Node is disassembled. The certificates of the Node are revoked. If the Node is not flushed on the field, there may be security risks at the transport and disassemble phases.

The three remaining deployment models represent instances of direct cross-certification, and they do not involve external CAs. There is no "infrastructure" to distribute public-keys; instead, the communicating peers exchange the certificates without "global", centralized control. Even though the "root CA rollover" model includes some kind of mini-infrastructure, it is only used during the initial authentication. In general, the certificates are used both for authentication and authorization, i.e. everybody who possesses a trustworthy certificate is also assumed to be authorized. There is no need for additional policy information related to the access rights – as in Vanilla PKI.

In "Opportunistic keying", the Node is manufactured without any security related initializations. The major difference to the Vanilla PKI case is in the installation where the Node and the Operator become aware of each other. Node generates the keys, and sends its public key and a certificate request or a self-signed certificate to Operator. Operator sends its Root key to the Node, encrypted with the public key of the Node. The first exchange is vulnerable to the Man-in-the-middle attack. However, the Opportunistic approach accepts the risk related to this first contact. Later, the certificates can be used to secure the communication.

The erase operations are somewhat different to the Vanilla PKI. In Opportunistic keying (and the two remaining deployment models below), the erase operations need to be carefully secured or somehow confirmed, because otherwise the potential new owner gets an opportunity to misuse the information.

In the “Root CA rollover”, the Node generates a cryptographic key-pair already in the Factory. Factory acts as a CA and Root. The operations are done off-line, which is rather secure and does not require external involvement. The Operator and the Factory must exchange certificates. In the installation phase, the Node authenticates itself to the Operator using the certificate from the Factory. The Operator's certificate is signed by Factory and sent to Node. Node takes the Operator as a new Root. Operator certifies the Node (Operator acts as a CA). The Operator needs to trust the Factory for the Node certification operations.

The “Manual keying” includes several variants. The common nominator for these variants is the fact that the security relationship between the Node and the Operator is done manually offline. The major difference between these deployment models and the previous ones – and even between the different variants of the Manual keying model itself are most visible in the installation phase.

- In “Variant 1”, the Operator has to insert manually its own public key to the Node as a Root. Node generates (offline) its own keys and delivers that (offline) to the Operator. Transport of the Node to the field may cause security risks because it already includes the security keys.
- In “Variant 2”, the Operator configures a separate security device with its own security information. The Operator delivers the device to Mechanics, which in turn uses the device to create a secured “tunnel” between the Node and the network. The tunnel can be used for certification requests and loading of Operator's root CA keys. Now the biggest security risk is related to the device – not the Node. The device is removed from the Node after the security parameters have been installed.
- In “Variant 3”, the Operator loads keys and certificates to the tamper-resistant devices – and not to the Node itself. Operator delivers the devices to Mechanics, who can plug them to the Node. Node uses the device to secure the communication with the network.

5 Analysis

Figure 2 demonstrates the detailed lifecycle of the Node. In the following, we evaluate how the public-key deployment models vary in each phase.

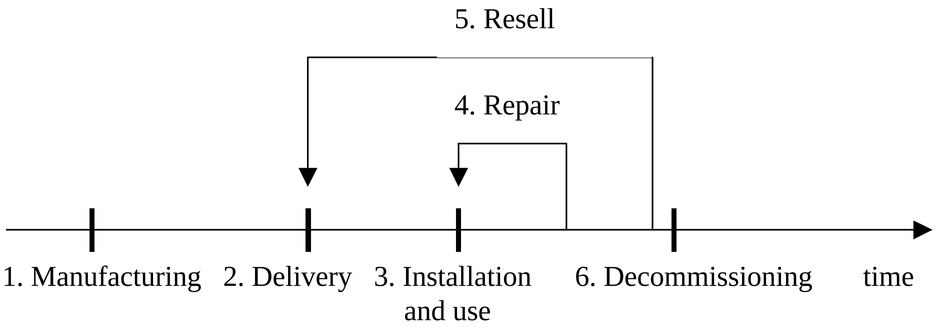

Figure 2: Lifecycle of a security-enabled product.

5.1 Manufacturing

This is the phase when the Node is born. Typically, the Factory assembles the Node from some electrical components. The Factory may already have information about the future owner of the product. The Factory may pre-install some security mechanisms and/or security parameters (e.g. keys, certificates, policies).

Opportunistic keying and Manual keying are manufacturing friendly solutions. They do not require product customization, and the non-customized products can be produced to stock in a mass production manner.

Vanilla PKI requires a little bit more product customization because the global root CA certificate is installed to every product. The same certificate(s) can be installed to every product, however, the certificate validity periods adds some complexity to the manufacturing and stock keeping procedures. Furthermore, the Factory must be able to secure the installation, and guarantee that right certificates are installed. This means some additional investments to the Factory in terms of educating and potentially monitoring the personnel.

Root CA rollover requires a lot of product customization, and consequently creates even more complexity to manufacturing and stock keeping, but also to selling and ordering procedures. Product customization may be acceptable if it creates competitive advantage or if the customers are willing to pay extra for it. Node certification in the Factory is done offline manually and it may include some security risks related to the personnel.

5.2 Delivery

The product has been manufactured and is delivered to the Operator. The Operator may install the required security parameters (e.g. keys, certificates, policies) in this phase.

Vanilla PKI, Opportunistic keying and Manual keying are better solutions for delivery than the Root CA rollover solution. This is because the customized products must be delivered to the right Operators. This is far more complex than if every product in the stock could be delivered to any Operator. Note that Vanilla PKI does not include this shortcoming even though it includes additional complexity in the manufacturing if the Operators trust on the same external Root CA.

Delivery of products, which include security related data, may be perceived as a security risk because the sensitive data could be manipulated during the delivery. In other words, the delivery itself must also be secure creating additional security requirements for the personnel. However, if a competent tamper-proof device guarantees the security, the risks of delivery are not significant – unless they are stolen and corresponding certificates invalidated. This increases the costs of the Vanilla PKI, and Root CA rollover.

5.3 Installation and use

At this phase the necessary security parameters (e.g. keys, certificates, policies) have been configured to the product. The configuration may have happened already in the two previous phases. The product is taken to the field and installed to the network by the Mechanic. As the result of the installation, the communication between the Node and the Network can be secured.

In this evaluation, we assume that Operators want to minimize the number of external trust relationships when they build the security architecture for their own Network. At least the trust relationships between the Operator, the Factory and the Mechanics are assumed to create uncertainty and potential security risks. From this perspective, Opportunistic keying and Manual keying are better solutions than Vanilla PKI and Root CA rollover because the initialization of trust does not involve external parties. Especially Root CA rollover requires a trust relationship between the Factory and the Operator. Vanilla PKI requires additional policy configuration work for identifying the authorized entities. It also assumes that the external CA identifies the end-entities correctly, and does not issue certificates with incorrect identity information. Some variants of Manual keying may require minor involvement of external parties, e.g. manufacturers of tamper-resistant devices, but this is not seen unacceptable.

Skills and expertise related to security also reflect the trust relationships between the entities. They also represent additional costs for the entity that must possess the skills. The Operators cannot really avoid having some sort of security expertise to protect their own Network; however, the public-key deployment models set different requirements especially to Mechanics. Manual keying and Root CA rollover are more attractive solutions than the Vanilla PKI and Opportunistic keying if one wants to avoid educating the Mechanics with advanced security skills.

The costs associated with installation involve the number of visits that mechanics have to make in the field, Node and device transport costs, and the need for skilled installation personnel. Opportunistic keying does not involve additional technology or expensive pre-configuration. However, the initialization of trust is insecure in terms of protocol steps. If additional security mechanisms are used, the costs are naturally higher. The protocol steps in all other models are secure but they includes more other costs. Root CA rollover is expensive for the Factory, but cheap for the Operator. The costs start already at the manufacturing phase, where Node is configured manually to initial (security) settings. During the installation phase, the Operator and Factory update the configurations. The costs of Vanilla PKI model come from the additional policy configurations, and from the certification requests from the Node to the Operator. This requires that the Mechanics are involved, and the installation costs are increased. However, Vanilla PKI causes costs only for the Operator. Manual keying variant 1 has costs from the manual work done by Mechanic. Variants 2 and 3 have costs from the configuration and from the (security) devices. Other costs are of the Mechanic’s trips to field and work with the Node. Variant 3 has no message exchange costs and it does not require skilled installation personnel, as variant 2 does. In general, Manual keying is only expensive for the Operator.

Operators are also assumed to appreciate interoperability. In other words, Nodes from different manufacturers should follow the same security set-up procedure, and the Operator should not be required to invest in several security architectures. This evaluation criterion is much dependent on standardization. Manual keying variant (2) is directly interoperable. In this variant, the security relationship between the Node and the Network is created using a secured ‘tunnel’. The Node and the Network can assume that security mode is created securely. Also the Vanilla PKI can be assumed to be compliant with standards. On the other hand, Opportunistic keying, and Root CA rollover would most probably require standards for implementing them, however, not all Nodes from different manufacturers support these standards.

Variant 1 of Manual keying must also be perceived as a less attractive solution because the Nodes are delivered to a central lab rather than directly to intended destinations (i.e. field). Other models do not require pre-installation in centralized premises.

5.4 Repair

The product has had a malfunction, and some security related data has been corrupted. Security problems, such as attacks or compromise of the secret keys, may also be a reason for repair operations. The product is repaired either on field or at operator’s premises. Either new security parameters are created or the old ones are restored into the system.

A backup node might be installed as in the last installation phase. If old Security Parameters can’t be restored to the repaired Node, the repaired Node is flushed and installed again as in the previous installation phase. This applies to Vanilla PKI, Opportunistic keying and variant 1 of Manual keying. However, in Root CA rollover model the repaired Node needs to be initiated again starting from the manufacturing phase. In variants (2 and 3) of Manual keying, the devices can be simply plugged into the repaired node, provided the devices themselves are not broken.

As the repair phase should be secure, it is essential to use only stabile trust relationships. The Mechanics are involved as the nodes are transferred and repaired. The use of plugged security devices requires that Mechanics are involved, but on the other hand no special skills are required in all models. The worst alternative is to repair the node at the factory and to use manual configurations. One-line trust models (Vanilla PKI and Opportunistic keying) are more convenient if the repair can be established by new installation on field. If the node can be repaired on field, the mechanics can flush old configurations and start the installation again as explained in the previous chapter.

On the other hand, Opportunistic keying and Manual keying solutions may be more practical than Vanilla PKI and Root CA rollover because the initialization of trust does not involve external parties. Therefore, also the repair operations might be easier and cheaper for them. Especially Root CA rollover requires trust relationship between the Factory and the Operator, which makes the repair operation more complicated. Alternatively, the use of the rollover approach should be limited to the life-cycle steps 1-3.

5.5 Resell

The Operator may sell the product to a Second Operator. Operator deletes the old security parameters and the Second Operator installs new ones. The operators may have a trust relationship. Also, the Second Operator may have a trust relationship to the Factory.

Mechanic removes the Node from the network and if needed, the Node is replaced with a replacing Node. All previous Security Parameters and data are erased from the Node. In Root CA rollover model, the Node is delivered to the Second Operator via the Factory and deployment begins again from the manufacturing phase. Alternatively, the rollover approach cannot be used in this phase. In Manual keying, the Node is delivered to the Second Operator and it is deployed again as in the corresponding delivery phase. Vanilla PKI and Opportunistic keying models are more flexible because the deployment proceeds from the installation phase. In variants 2 and 3 of Manual keying, the security device may also be delivered.

The manual deployment of a sold Node is more secure because the Mechanic can observe whether the configurations and operations are correct. In Root CA rollover and Opportunistic keying models, it is possible that the Node does not fit fluently to the new Operator network.

5.6 Decommissioning

The life cycle of the product ends. If the node is available (i.e. not stolen or broken), all security parameters must be removed. The node itself is disassembled.

In all deployment modes, the Node is taken off the network, all security related data is deleted and the Node is disassembled. If the Node is not flushed in the field, there are potential security risks at the transport and disassemble. The public-key of the Node must not be trusted anymore. In Manual keying variants 2 and 3, the security devices need to be removed but can be re-used with other Nodes. From the decommissioning point of view, the Manual keying seems to be the most feasible solution.

5.7 Overall evaluation

At this point, it is certainly clear that different deployment models differ a lot when they are evaluated in the phases of the product lifecycle. The strengths and the weaknesses of the models appear differently depending on the phase in the life cycle. Requirements related to the over-all system are also different for each role involved, i.e. for the Factory, Operator or Mechanic. A deployment model that is good for one entity may be less attractive for another.

If the deployment models are ranked for preferred order based on the overall process view, the order would be the following: 1) Manual keying, 2) Opportunistic keying, 3) Vanilla PKI, and 4) Root CA rollover. The difference between Manual keying and Opportunistic keying is not big, and the ranking order depends on which criterion is emphasized: scalability or process-wise flexibility and security.

Manual keying is ranked here as the best alternative. It does not require configurations during the manufacturing, it is safe, and does not rely on the skills and trustworthiness of the Mechanics. Manually keyed Nodes are also easy and secure to repair, resell and decommission.

Opportunistic keying gets the second place. It is cheaper than Manual keying, has no external trust relationships, enables mass production without security configurations, and is safe to deliver to the field. However, Opportunistic keying is insecure in the first initialization phase, and it depends on the skills and trustworthiness of the installation personnel. Also, there are more problems in the repair, resell and decommission phases if compared to Manual keying.

The strengths of the Vanilla PKI model appear mostly in the installation and the resell phases. This is because any Operator can use the trust created for the external CA. However, the Vanilla PKI does not solve the overall problem with certificates and it requires some additional security mechanisms, and configurations.

Furthermore, it also relies on external entities (CA and Mechnaics), and it includes more problems and costs in the early (manufacturing and delivery) and later (repair and decommissioning) lifecycle phases than the two previous deployment models.

The Root CA rollover solution is ranked as the worse alternative. It is more complex and expensive in every phase during the product lifecycle than the other models.

6 Conclusions

This paper studied different public-key deployment models in network context. The node life cycle was used as a framework for the analysis.

We identified four public-key deployment models: Vanilla PKI, Root CA rollover, Manual keying and Opportunistic keying. One thing the study demonstrates is the variety of deployment models. It also shows how the strengths and the weaknesses of the models appear differently depending on the phase in the life cycle. Requirements related to the over-all system are also different for each trust domain. A deployment alternative, which is good for one trust domain, may be less attractive for another.

From our analysis, it seems that we should say no for the Root CA rollover solution. Also, the Vanilla PKI deployment model was not seen as the best solution for this research setting.

Manual keying solution was ranked as the best solution even though it is more expensive than the second best approach, the Opportunistic keying. Even though we made this ranking, we do not think that there is an unambiguous winner among the deployment models. The best real-life solution is probably a combination of features from the two winning models.

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Developing a Design Theory for Dual Change Management Information Systems

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Abstract. Businesses need to align their information systems (IS) architectures to meet changing business needs. Change management organizations (CMOs) are responsible for alignment. They collect, store, and evaluate the change requests of customers, allocate accepted requests to vendors for implementation, receive software components, and co-ordinate their installation. Change management (CM) is challenging to implement for corporations operating in networked multi-partner, multi-project, and multi-site environments. Each actor should understand the objects to be changed, work flows, and the CMO to enable effective coordination of work, exception handling, and process improvement.

Groupware technologies foster coordination and the shared creation of knowledge in networked environments. Yet, without a theoretically grounded organizational and IS design, groupware-based CM information systems (CMIS) are likely to become institutionalized and hide their constructed nature from actors, thus falling short in helping CMOs to achieve their goals. Little theory-based guidance is available to design CMIS in a way that alleviates this problem.

Design theories support the achievement of goals. This paper draws upon the meta-design of Dual Information Systems (DIS), literature on CM, and a case study to start building an IS design theory (ISDT) for Dual CMIS (DCMIS) and to examine the validity and utility of the meta-design. The ISDT answers the following question: What are the necessary and sufficient properties of the DCMIS?

The meta-design is found well applicable for designing the ISDT. However, it leaves plenty of room for the subjective interpretations of the designers of the ISDT and requires an in depth understanding of the domain. The findings from the case study justify the importance of both the research problem and building the ISDT. The ISDT could be utilized to explain and generate possible solutions to the perceived problems in the use of a CMIS. We expect the ISDT to be relevant to CMOs and to vendors establishing software product businesses on top of the DCMIS solutions. Further research is needed to refine and validate the ISDT and study the applicability of the meta-design in other domains.

KEYWORDS: Change Management, Change Management Information Systems, Information Systems Design theory, Dual Information Systems

1 Introduction

Businesses need to develop their products and processes continuously in order to succeed and meet the needs of dynamic, international markets. Their abilities to reach these business goals depend significantly on how well they can leverage complex, integrated information systems (IS) architectures (hereafter referred to as “organizational IS“) in running and redesigning their business processes. The organizational IS rely on systems products (e.g., enterprise resource planning packages) that can be composed of thousands of components provided by vendors and internal development units. Products become outdated quickly unless they are systematically upgraded but managing change in a complex environment is nontrivial.

Change management practices (CM) and organizations (CMOs) are needed to maintain the operational effectiveness of organizational IS at customer sites and guide product development based on the change requests of customers. Requests are created at customers’ sites and collected, stored, and evaluated by the CMO. CMOs typically allocate accepted requests to vendors for implementation, receive software components implemented in response to the requests, and co-ordinate their installation in the sites. CM is challenging to implement especially for large corporations operating in networked multi-partner, multi-project, and multi-site environments.A CMO is a professional organization where each actor should have a holistic understanding of the objects to be changed, work flows, and the CMO itself to enable effective coordination of work, exception handling, and process improvement. Change management of mission critical systems is highly knowledge-intensive work. Creating and sharing knowledge is complicated partly because the CM activities of large companies are geographically distributed. Groupware technologies foster the shared creation of knowledge. Thus, they hold considerable potential as means of meeting the goals.

Yet, without a holistic, theoretically grounded organizational and IS design, groupware-based change management information systems (CMIS) are likely to become institutionalized and hide their constructed nature from actors, thus falling short in helping CMOs to achieve their goals. For instance, changing the CM processes through participative CM and CMIS design is almost impossible unless actors thoroughly understand the content and organization of work, including its computerized aspects. This design/use dualism of many IS in general and CMIS in particular is the problem to be addressed in this paper. Little theory-based guidance is available to design CMIS in a way that alleviates this problem.

Design theories support the achievement of goals. Walls et al. (1991, 37) argue that the IS “field has now matu-red to the point where there is a need for theory development based on paradigms endogenous to the area itself” and call for information system design theories (ISDT) to fulfil that need. An ISDT is “a prescriptive theory based on theoretical underpinnings which says how a design process can be carried out in a way which is both effective and feasible.”

This paper draws upon the meta-design of Dual Information Systems (DIS) (Käkölä 1996a), literature on CM, and a case study to start building an ISDT for Dual CMIS (DCMIS) alleviating the design/use dualism. The ISDT answers the following question: What are the necessary and sufficient properties of the DCMIS and how the DCMIS should be designed to best achieve the goals of CMOs?

DIS denotes the IS architecture providing services defined in the meta-design of DIS. The services (1) conceptually unite manual and computerized aspects of work, helping actors to understand their work holistically; (2) let actors zoom in on the details of their work practices and check shared databases for mistakes in order to deepen their knowledge and handle exceptions locally; (3) help actors draw on their improved knowledge to enter and interact in redesign project teams where they can share best practices and crystallize them into work process redesigns; and (4) store the created design knowledge in the organizational knowledge base for later reuse.

DIS supports complex collaborative knowledge work such as CM. There are also other factors motivating the application of DIS for designing the ISDT for DCMIS. First, CMOs need to be dynamic and active in their process development because they are enablers and drivers of organizational change (Nance 1996; Truex et al. 1999). If a CMO cannot proactively develop itself, how can it keep up with managing the changes required in the organizational IS? Second, actors in a CMO are usually well aware of the possibilities offered by information technology (IT). Käkölä (1996a) designed the DIS architecture for knowledge workers. The IT expertise of actors in a CMO far exceeds the novice level of IT expertise assumed in the meta-design of DIS. Actors are also experienced in organizational change because they are responsible for changing the organizational IS.

The next section characterizes ISDT and defines the components of an ISDT. Sections 3, 4, and 5 elaborate on the components to develop the preliminary ISDT for DCMIS. Section 6 assesses the validity and utility of the ISDT and the DIS architecture through a case study. Section 7 discusses the theoretical and practical contributions and identifies issues for future research.

2 Information systems design theories

Design theories have several distinct characteristics that differentiate them from other theories (Walls et al. 1991, 40-41):

1. They must deal with goals as contingencies. For example, the ISDT for DCMIS states that if the business goals of CMOs (shortening the cycle time of CM while improving the quality of the organizational IS and maintaining or reducing the total resources required) are to be achieved, then the DCMIS artifacts should be designed and used to support and redesign CM processes.
2. They prescribe both the properties an artifact should have if it is to achieve certain goals and the method(s) of artifact construction.
3. They can never involve pure prediction or explanation. For example, the ISDT for DCMIS explains what properties a DCMIS artifact should have and

how it should be built and predicts that a CMIS will support the attainment of the business goals to the extent that it possesses the properties and is built using the methods prescribed by the theory.

4. They are prescriptive, composite theories integrating explanatory, predictive, and normative kernel theories from natural and social sciences and mathematics into design paths that realize more effective design and use. They involve both the application of scientific theory to design artifacts and the use of the scientific method to test design theories (usually by building and testing the artifacts empirically).
5. Design theories tell “how to (achieve the goal)/because” whereas explanatory theories tell “what is”, predictive theories tell “what will be”, and normative theories tell “what should be (the goal)”.

For example, a theory about the role of redundant information, defined as “the existence of more information than the specific information required immediately by each individual” (Nonaka 1994, 28), might be devised. The sharing of ‘extra’ information makes it easier for actors to recognize their place in an organization, interact, develop a common direction, create new concepts, enter each others’ area of operation, provide advice, and even do each other’s jobs if necessary. The theory would (1) state that CMOs aim at improving communication, coordination, and collaboration by means of leveraging CMIS and (2) hypothesize that CMOs with adequate level of redundant information are more likely to achieve this goal. The purpose of the theory is not to achieve the goal but to predict that goal achievement is more likely when a certain condition (adequate shared knowledge) is met. Such theory development can only contribute to the foundation laid by this paper if it is done in the context and as a part of developing an ISDT. For example, the theory can be used to develop those aspects of the ISDT that guide the co-design of DCMIS and CM processes.

Walls et al. (1991, 42) argue that an ISDT must have two aspects: “one dealing with the product and one dealing with the process of design.” They define four components of the product aspect:

1. *Meta-requirements* describe the class of goals to which the theory applies. Meta-requirements for building the DCMIS are described in Sections 3 and 5. CM domain specific meta-requirements are derived from the literature review in Section 4.
2. *Meta-design* describes a class of artifacts hypothesized to meet the meta-requirements. The meta-design of the DCMIS and the underlying meta-design of DIS are presented in Section 5.
3. *Kernel theories* are theories from natural or social sciences and mathematics governing design requirements. They are discussed in Section 3.
4. *Testable design product hypotheses* are used to empirically test whether the meta-design satisfies the meta-requirements. Some hypotheses deal with the feasibility of building the product, while others address the effectiveness of the product. They are discussed in Section 5.

Walls et al. (1991, 43) define three components of the process aspect:

1. *Design method* describes procedures for artifact construction.
2. *Kernel theories* of the design process aspect are theories from natural or social sciences governing design process itself.
3. *Testable design process hypotheses* are used to verify whether the design method results in an artifact, which is consistent with the meta-design.

These three components are beyond the scope of this paper. They are discussed in Section 7.

3 Kernel theories and meta-requirements for Dual Information Systems

This section briefly explains the most important theoretical basis of DIS by drawing upon Käkölä (1995, 1996a) who extensively investigated kernel theories for DIS and derived meta-requirements of DIS from them.

All technologies are dual, that is, both constructed and institutionalized (Orlikowski 1992). Designers produce a technology to provide actors with resources and rules by creating and encoding work-domain related knowledge into it. Actors socially construct a technology by assigning it different meanings and using it flexibly in their work. However, technologies usually become institutionalized mediums of work over time because actors cannot continuously reinterpret or physically modify them if the actors are to accomplish their work efficiently. Technologies thus become increasingly inflexible over time unless countermeasures are taken (Eriksson et al. 1988; Orlikowski 1992; Zuboff 1988). This inflexibility results in part from actors with insufficient shared knowledge of: (1) the nature of social practices as a whole; (2) the articulation of these practices in time and space by the structural properties of organizations; (3) their own roles in the organization; and (4) the role of IS as a structural property mediating work processes.

One important reason for actors' unawareness is that the conceptual and material structures of computer software typically reflect the design/use-dualism of technology; during the institutionalized use of an IS the constructed nature of the IS is often masked by the software. Masking occurs when the processing rules and retention structures are hidden in the software and database schemas and the role of people as the producers and consumers of information is blurred (Nurminen 1988).

Institutionalized, inflexible IS pose several costly implications. Actors are restricted to using functions expressed in the software (Kogut and Zander 1992, 390). They also face considerable difficulties monitoring their actions since they cannot fully interpret and validate the meaning of information produced by the "black box" systems, and they cannot see and feel the outcomes of their computer-supported actions (Zuboff 1988, 79-96). Because of their limited ability to control all aspects of work, including computerized tasks, the actors cannot necessarily be responsible for their work as a whole. Finally, the actors' ability to intervene in and transform existing practices is limited because they cannot easily criticize and challenge the interpretations, resources and norms embedded in the algorithms and databases of the IS.

We have used the act-oriented perspective (Eriksson & Nurminen 1991; Nurminen 1988) to help actors regain control of their work (Käkölä 1995; Käkölä & Koota 1999). This perspective states that IS cannot be separated from actors' work because no IS can serve as a conscious actor and proposes a radical alternative for designing IS architectures: software modules should be designed so that they can be interpreted as computerized tasks that have one or more responsible human actors. The act-oriented perspective bridges the design-use dualism by seeing the knowledge encoded in software by designers in time-space context A as the acts of the responsible actors in time-space context B.

The meta-design of DIS meets the meta-requirements posed by the act-oriented perspective and provides actors with tools to understand holistically their work tasks and context, overcome breakdown situations, and enable constant development of work practices and supporting IS. The individual IS designed and integrated according to the meta-design of DIS and used in the context of an organizational unit form the DIS architecture of the unit (Käkölä 1996a).

However, the act-oriented perspective had two limitations. First, well-developed local understanding of work is necessary but insufficient for improving work. Second, the IS architecture needed to align IS with the act-oriented perspective would be expensive to build. For example, traditional integrated IS often hide their constructed nature to the extent that they appear to actors as acting, knowledgeable subjects rather than media of work (Eriksson & Nurminen 1991). The redesign of these systems to reflect the act-oriented perspective would unlikely be attractive to organizations if the benefits from the redesign were limited to understanding better "what is."

Käkölä (1996a) drew upon Nonaka's (1994) hypertext organization design to hypothesize new meta-requirements for DIS alleviating the limitations. Hypertext organization is a dual organizational structure: it "coordinates the allocation of time, space, and resources within the organization" (Nonaka 1994, 33) so an organization can achieve high performance in routines and ensure long-term survival by creating and applying new knowledge. DIS has the same dual purpose: facilitation of effective routine work and redesign work. Therefore, the maximum benefits of DIS would more likely be realized if the meta-design of DIS reflected the hypertext organization structure.

Hypertext organization is formed by the dynamic combination of hierarchically organized business units and self-organizing project teams that pursue the equivocal visions of top management by drawing on and accruing an organizational knowledge base. It is comprised of three layers: knowledge-base, business-system, and project-system. The 'knowledge-base' layer "embraces tacit knowledge, associated with organizational culture and procedures, as well as explicit knowledge in the form of documents, . . . computerized databases, etc." (Nonaka 1994, 33).

Work routines are enacted by a bureaucratic organization in the ‘business-system’ layer (hereafter “business layer”). The ‘project-system’ layer (hereafter “project layer”) provides a field of interaction where loosely linked project teams create knowledge. Knowledge is also created through the circular movement of actors among the layers. Members of project teams are selected from different functions across the business layer. They interact with the knowledge-base layer and make an inventory of the knowledge acquired and created in the project layer. “After categorizing, documenting, and indexing the new knowledge, they come back to … business-system layer and engage in routine operation until they are called again for another project” (Nonaka 1994, 33).

Käkölä (1996a) hypothesized the following meta-requirements for DIS: it needs to help actors establish and join project teams to share knowledge of their work processes within and between organizational units and crystallize it into work processes that exceed the expectations of customers, realize the visions of top management, and create good jobs. The meta-design of DIS was enhanced accordingly (Section 5).

4 Concepts, objectives, processes, and risks of change management

This section presents different aspects of change management to create the CM domain-specific meta-requirements of the DCMIS. First, the main concepts of CM are defined. Second, the aims and processes associated with CM are briefly explored. Third, the common risks and problems of CM are considered.

4.1 Concepts and aims of change management

Change management refers to the coordination process associated with making changes to IS in production use. It deals with the concurrent processing of multiple changes, requires frequent iterations, and involves many interdependent actors (Joeris 1997b; Davis & Sitaram 1994). Coordination refers to “managing dependencies between activities” (Malone & Crowston 1994, 90). The concept of CM resembles closely to the IEEE’s (1993, 39) definition for *software maintenance* as “modification of a software product after delivery to correct faults, to improve performance or other attributes, or to adapt the product to a modified environment.” It refers to the management, control, and coordination of the individual maintenance efforts. The concept and associated theories of software maintenance define the set of software engineering activities for making changes to IS already in production use (Pressman 1997, 209). This operative-level view is important but insufficient to understand CM integrating both the operative and administrative work processes (Garvin 1998).

Change management aims at ensuring a continuous alignment between the IS and organization(s) using it by identifying change needs and institutionalizing procedures to incorporate the changes to the IS without endangering its usability or maintainability. This poses two requirements. First, changes must be made by using appropriate planning, testing, and quality assurance methods (Pressman 1997). Second, the tasks associated with making the changes must be coordinated and the knowledge of the changes made must be shared to all associated actors and preserved for future use (Pressman 1997, 209). This requires well-defined procedures and good communication and documentation practices (Joeris 1997a). This paper focuses on the second, management-oriented viewpoint.

Change needs are the drivers of CM. CM activities can be categorized based on the three types of changes requested: corrective, adaptive, and perfective (Swanson 1976, 1999). The corrective activities consist of diagnosing and correcting the errors detected in the IS. The adaptive activities are associated with ‘bending’ the system to correspond to changed needs. Perfective activities enhance the IS by introducing new functionality (Swanson 1976). More recently, the adaptive and perfective activities have been combined under the concept of perfective maintenance (Henry & Cain 1997; Stark & Oman 1997). This broader categorization is utilized in this paper to highlight the two types of maintenance activities and their effects on CM.

4.2 Change management process

The CM process consists of sub-processes necessary to carry out the desired change to an operational IS (e.g., Garvin 1998). The CM process model (Figure 1) is based on the work of Heikkilä (1999, 13). She has drawn upon the work of Joeris (1997a) to distinguish the sub-processes and to divide them into technical and managerial process categories. The process has also been divided into a requirements validation phase and a release phase (c.f., Stark & Oman 1997). These phases are referred to as the front-end and back-end of CM. Next, the sub-processes and the actors participating in CM are studied.

4.2.1 The front-end of change management

The CM process begins with a change need. The need has to be externalized into an explicit change request, which can then be used as a basis of further actions taken to satisfy the need (Pressman 1997, 220). The need can be corrective or perfective in nature and arise from any stakeholder associated with the IS (Stark & Oman 1997). The request must describe the need in enough detail so it is possible to understand which part of the system should be changed, which changes are needed, and why.

In the case of a corrective need, the request can be a simple report describing the problem and the necessary actions to reproduce it. In the case of a perfective need, the request can vary from simple task explanations (e.g., add a new data field) to large definitions, which resemble requirements specifications used in new product development (Salo & Käkölä 2003). Especially in the latter case, the request and its implications must be discussed with all organizational actors affected by the change.

When collecting requests, two things must be considered. First, the reporting of a need must be as easy as possible for everyone working with the IS. Otherwise, it is possible that workers use workarounds (e.g., inputting data in inappropriate places) to circumvent the problems, which might hamper the overall usability of the system (Gasser 1986). Second, the requests must be documented and stored because it is vital to know in the future not only what changes have been made but also the reasons behind them (Parnas & Clements 1986).

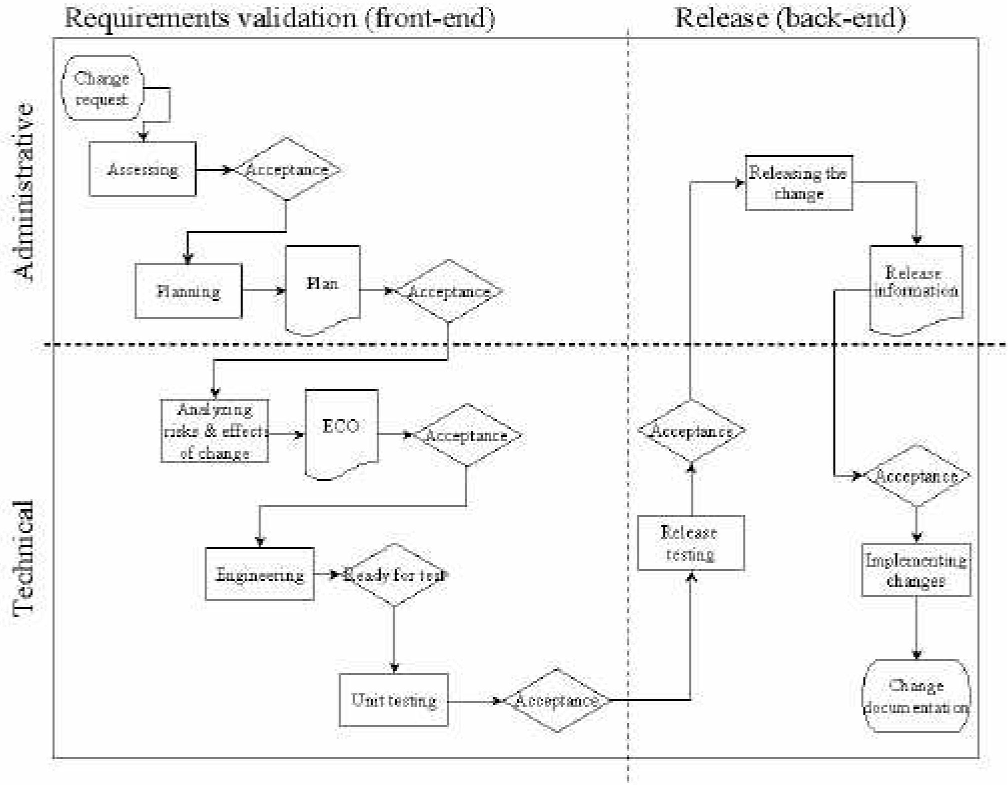

Figure 1. Change management process (adapted from Heikkilä 1999, 13).

The needs must be assessed according to their priorities and target system areas because a backlog of unfulfilled needs typically emerges in organizations (Sherer 1997; Stark & Oman 1997). In the assessment, the importance and urgency of a need must be compared to the effects the change would have to the existing system. Some changes may not be carried out because of the insufficient perceived advantages or lack of resources. The target area of the change can be used to group requests into larger development projects and identify overlapping and contradictory requests (Sommerville 1998, 681-682).

After the preliminary assessment of a request, a detailed systems-oriented change plan (i.e., an engineering change order) is produced (Pressman 1997, 220). It describes the actions, responsibilities, and schedules for carrying out the changes. Good knowledge of the structure of the IS is needed to define the components and system versions affected by the change. The sub-processes, which begin from collecting requests and continue until the engineering change order is ready, constitute the analysis phase of CM.

A change control authority (i.e., the person or group with the necessary technical knowledge and organizational authority to approve or reject the proposed changes) usually makes the final go/no go decision concerning the change (Pressman 1997, 220). The software engineering tasks and tools for carrying out and testing the changes are not described here. However, from the viewpoint of CM it is important to monitor these efforts actively (Haikala & Märijärvi 1998, 210).

4.2.2 The back-end of change management

The back-end of CM refers to processes associated with releasing a solution to a certain need. This phase involves testing of the solution in a real system environment (release testing) and releasing the components and documents needed to implement the solution in appropriate system configurations (Haikala & Märijärvi 1998, 260). The release can be done a change at a time or by grouping changes into larger batches (Sherer 1997; Stark & Oman 1997).

The testing performed during the development of a new component is necessary but insufficient to ensure that the component meets the organizational requirements. Preferably, the persons who will be using the system should test all system configurations, in which the new components will be used (Haikala & Märijärvi 1998, 260; Pressman 1997, 221). In this release testing, the fulfillment of the original need and the problems associated with incompatibility of a solution with certain system environments are assessed.

Changes are released to the system versions or environments in which they are applicable. The release should include the new or changed components and the changes in documentation and user instructions. If the implementation cannot be done by the CMO (e.g., when the use of IS is distributed), also the instructions for implementing the changes should be included in the delivery. In all cases, the implementation of the changes must be documented to ensure the traceability of changes (Haikala & Märijärvi 1998, 225; 229).

4.2.3 Actors in change management

Different groups and persons have distinct roles and activities in CM. The understanding of these functional roles is especially important from the viewpoint of the meta-design of DIS, in which each actor is assumed to belong to one or more groups with specific functional roles (Käkölä & Koota 1999a). CMOs can be organized in various ways depending on the size and focus of the efforts (Pressman 1997, 223; Swanson & Beath 1989; Swanson & Beath 1990). Individuals may also participate in CM in several roles. Due to these reasons, this review focuses only on the main roles in the CM process.

The *initiator* of a request can be an end-user, a designer or any stakeholder with an interest to change the existing system functionality (Stark & Oman 1997). It should be possible for the initiator to follow the actions taken in response to his/her requests and to test the changes made to fulfill them.

The *analysts* collect and prioritize the requests and analyze the possible changes required in the IS. Based on the analysts' work, the change control authority makes the go/no go decision of starting a process of changing the IS. It should consist of members with sufficient technical knowledge and organizational authority needed to understand both the technical aspects and the use context of the IS. It usually makes the release decision after the proposed changes are ready to be implemented (Pressman 1997, 220-223).

Engineering group is responsible for the development work and preliminary testing associated with the changes. It can have an internal division of labor (for more details, see Pressman 1997, 60). Version owners perform the post-release implementation of the change and release testing (Sommerville 1998, 683). A version owner is responsible for a certain version of the system used.

In the context of large IS, an additional group of coordinators can be used. They ensure the sharing of knowledge between all the CM actors, mediate in problem situations, negotiate with change initiators, analysts, and the engineering group when new system requirements are defined, monitor the engineering efforts, and control the overall flow and documentation of the process (Pressman 1997, 60-61).

4.3 Risks in change management

CM is characterized by the complexity of both the product (to be changed) and the process (Joeris 1997a). The complexity has been magnified with the increasing popularity of large integrated packaged software products and outsourcing of many IS functions (Lozinsky 1998, 1-2; Willcocks & Lacity 1998, 3-4). It results in many risks which can seriously affect the functioning of the IS and the organization using it. Sherer (1997) distinguishes three categories of software maintenance risks: project risks, usability risks, and maintainability risks. They can also be applied to CM.

The project risks materialize when the CM activities cannot be completed due to ineffective processes or lack of resources. They can be reduced by improving the motivation and work-related knowledge of personnel (Sherer 1997) and by enhancing the level of coordination of sub-processes (Kraul & Streeter 1995). Systematic documentation, formal and informal interpersonal procedures and networks, meetings, and electronic communications support coordination in complex software development projects (Kraul & Streeter 1995). They should also be enforced and enabled in CM.

Usability risks materialize when the IS fails to respond to user needs related to, for example, functions, performance, correctness, understandability, or financial benefits of the IS (Sherer 1997). The problems with usability can originate from poor construction and testing during systems engineering as well as the unsuccessful specification of requirements associated with change needs.

Maintainability risk relates to the decrease of the future maintainability of an IS (Sherer 1997). Maintainability refers to the ease with which maintenance can be accomplished (Swanson 1999, 164). It tends to reduce over time due to the degeneration of the IS because of poorly planned and documented changes (Sherer 1997; Swanson 1999). Extensive planning and documentation of changes made to different system components are essential to improve the traceability of changes, facilitate communication among stakeholders, and thus reduce maintainability risks. Therefore, both the technical version structure and the procedures used to make changes in it must be closely integrated (Joeris 1997a).

5 A design theory for the DCMIS

The goal of a CMO is to keep the organizational IS functional and aligned with the organizational needs. It must be achieved in an effective manner that minimizes the risks in CM. CMIS can be used for this purpose (Heikkilä 1999; Beresoff & Davis 1991; Hipkin 1996). This section first presents the meta-design of DIS providing domain independent meta-requirements for the DCMIS. Second, the CM domain specific meta-requirements are discussed. The next three sections present the components of the meta-design of the DCMIS and respective design product hypotheses to meet the meta-requirements.

5.1 The meta-design of DIS

In accordance with the hypertext organization design (Section 3), the meta-design of DIS has three primary layers (Figure 2) (Käkölä 1996a, 79). Actors on the business layer draw on *the business layer of DIS* to learn, enact, and coordinate activities and to zoom in on the details of their work and to deepen their understanding of the computerized aspects of work in order to handle unexpected (coordination) breakdowns. Self-organizing project teams on the project *layer* use *the project layer* and *the Knowledge Sharing Server (KSS) of DIS* to produce innovative work and IS (re)designs that can be enacted on the business layer. *The KSS of DIS* is a repository of explicit work and IS design knowledge in the knowledge-base layer of a hypertext organization.

Due to space limitations, we will not detail the domain independent meta-design of DIS here. Instead, we will detail all the services in the subsequent sections describing the meta-design of DCMIS and highlight the differences between the meta-designs of DIS and DCMIS.

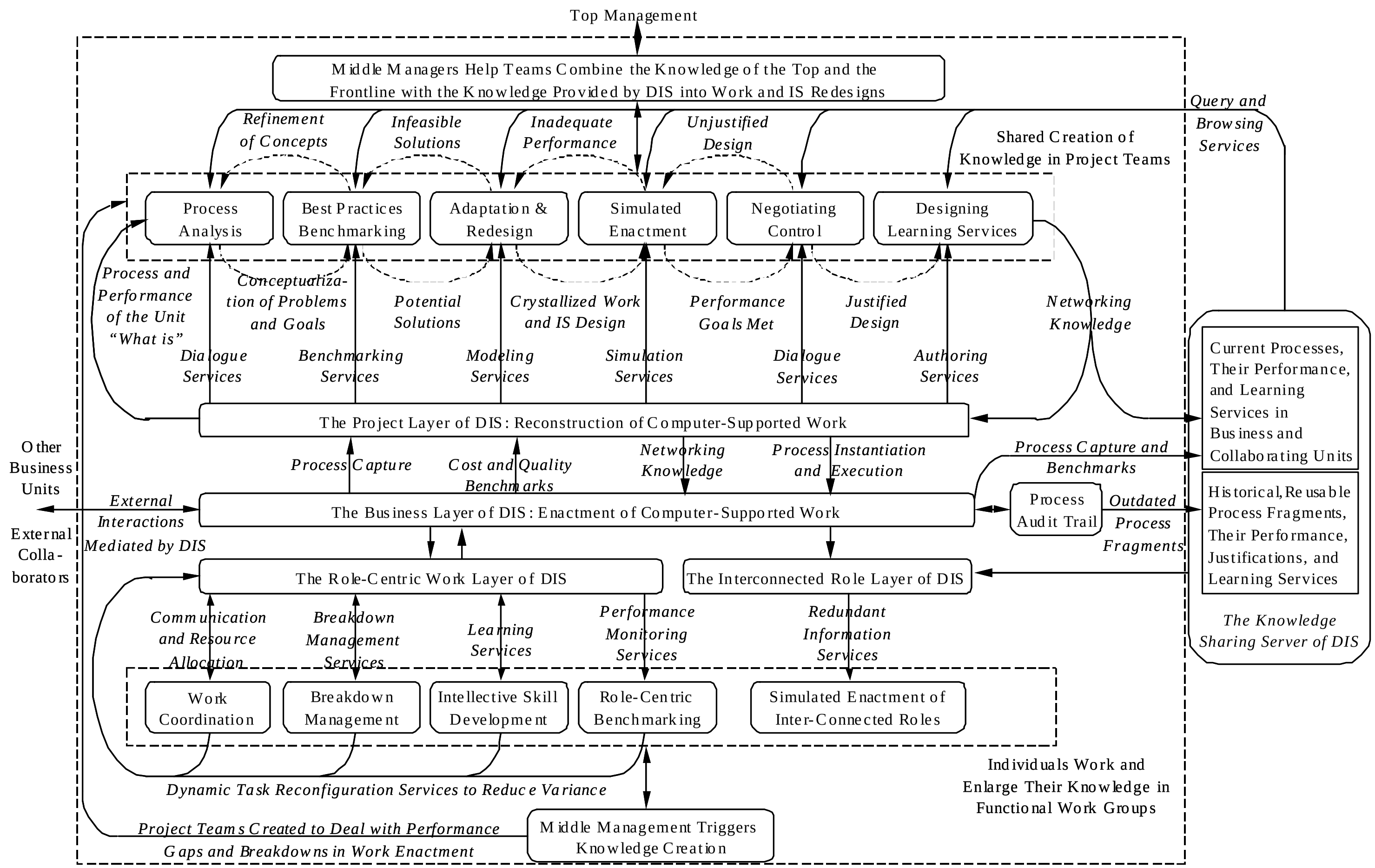

Figure 2. The Meta-Design of the DIS Architecture.

5.2 Change management domain specific meta-requirements for DCMIS

The CM domain specific meta-requirements deal with the services of the business layer and the KSS. The services of the project layer are relatively domain independent and thus directly applicable to designing IS for various domains.

CMIS artifacts following the ISDT for DCMIS support all CM subprocesses. The sharing and control of information associated with CM becomes increasingly important as the number of actors in CM increases (Beresoff & Davis 1991; Hipkin 1996). Both backward and forward traceability of requests and corresponding changes are essential (Beresoff & Davis 1991). Functions such as electronic communications, concurrency control, and automation of complex but stable tasks promote the coordination of technically complex, often ill-structured and concurrent CM tasks. The coordination oriented CMIS and the IS supporting more technically oriented management and modeling of different IS versions must be closely integrated (Joeris 1997a). The customers, the change initiators, should also be able to report requests easily and follow the actions taken.

The DCMIS must thus serve as an Organizational Memory Information System of the CMO, that is, a "system that functions to provide a means by which knowledge from the past is brought to bear on present activities, thus resulting in increased levels of effectiveness for the organization" (Stein and Zwass 1995, 89). It should automate the communication and control of information to the extent possible by establishing role-based workflows to ensure that the right information reaches the right persons at the right time (Salo & Käkölä 2003; Pressman 1997, 224; Beresoff & Davis 1991), be easy to use and accessible to all actors, offer extensive search engines and reporting tools for both standard and ad hoc querying, and make transparent the actions taken regarding to the requests (Beresoff & Davis 1991).

5.3 The meta-design and product hypotheses of the business layer of DCMIS

The business layer supports the end-to-end CM process and promotes workers' holistic understanding of their tasks and the process. It is divided into two sublayers: the role-centric work layer and the inter-connected role layer. It is based on the idea of actors working in a 'common information space' on shared objects (c.f., Schmidt & Bannon 1992). The main object is the change request document (CRD) (Sommerville 1998, 680-683). If it is approved, the change is constructed, tested, and released. A CRD should identify its current stage in the process, necessary background information, and all actions taken regarding to the change (Sommerville 1998, 680-683).

The information related to CRDs is stored cumulatively in the KSS (Figure 3). The information requirements are derived from Section 4 and examples of CRDs

(Sommerville 1998, 681; 683). Assigning a responsible actor to each subprocess and requiring mandatory input help ensure the existence of the necessary information in the KSS. Coordinators can contribute whenever or wherever necessary. The actions taken regarding to the CRDs and the actors and corresponding dates are stored in the KSS to enhance the traceability of the requests and related CRDs (Pressman 1997, 224).

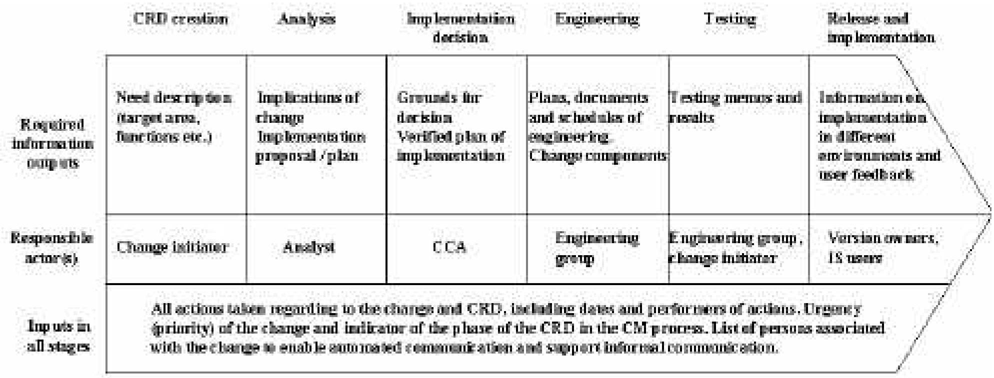

Figure 3. Information stored in the KSS in different phases of CM[1].

Querying functions help answer common questions (e.g., in which configurations of the organizational IS the changes related to a certain CRD have been installed) and serve ad hoc information needs (e.g., are there other CRDs related to the same system area as this one). They can be implemented by creating static views on CRDs and providing ad hoc search possibilities (Salo & Käkölä 2003).

5.3.1 Role-centric work layer

The services of the role-centric work layer help actors in functional roles perform their tasks and gain holistic views of their work, enabling them to understand the constructed nature of IS and take responsibility of their work as a whole (Käkölä 1996a).

Communication and resource allocation services

These services facilitate both formal and informal interaction because the complexity associated with CM requires communication across organizational boundaries and between many actors (Kraul & Streeter 1995). The formal communication includes the delivery of CRDs and changes in them to all appropriate persons. For this purpose, the layer offers automated messaging functions such as the utilization of e-mail recipient lists. Electronic bulletin boards

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[1] Two generalizations have been made to increase the comprehensibility of Figure 3: the concept of analysis refers to the sub-processes preceding the implementation decision (Section 4.2) and the concept of testing refers to both unit and release testing sub-processes presented in Figure 1.

and discussion databases are preferable for informal communication as they make knowledge and discussions visible for all actors.

Resource allocation is closely tied to the functional role of a person in the same way as in role-based workflow systems (Salo & Käkölä 2003). Resources should be allocated centrally so that the allocations (e.g., user rights) associated with both the layer and the organizational IS can be synchronized. This helps resource reallocation as the roles and groups in which people work frequently change (Mandiwalla & Olfman 1994).

Breakdown management services

The complexity of CM results inevitably in breakdowns in routines (c.f., Heidegger 1977). Breakdown management services collect information on common breakdowns in the KSS. Because breakdowns may occur when actors misunderstand the computerized aspects of work, the services also let actors follow the proceeding of the most complex algorithms used in the layer and cancel actions after they have been committed (Käkölä 1995). The services and the increasing understanding of work practices and good communication facilities provided by other services of the layer help prevent breakdowns and recover from them. The determination of the causes of a breakdown is facilitated by the enhanced traceability of actions provided by the layer. As the breakdowns cannot always be solved without experts, it is necessary to track the expertise cumulated in the organization (Davenport, De Long & Beers 1998), for example, by including the competence areas and contact information of all actors in the KSS (c.f., Käkölä & Koota 1999a, Salo & Käkölä 2003).

Learning services

Learning services help actors learn intellective skills (Zuboff 1988) making the interpretation and communication of meaning possible in computer-mediated work environments. Zuboff (1988, 59) distinguishes these from “action-centered” skills that become inadequate when new symbolic, computerized language is introduced. Action-centered skills are learned through bodily actions. The theoretical understanding of actions and their outcomes develops almost automatically because actors can see and feel the outcomes (Zuboff 1988, 187). When this shared action context is augmented or removed by IS, “meaning must be constructed explicitly in order to become implicit later” (Zuboff 1988, 192).

To transcend the design-use dualism, learning services make the learning of intellective skills as easy as is the learning of action-centered skills. They promote holistic understanding of manual and computerized tasks through training materials visualizing the roles, tasks belonging to these roles, and the IS functions used to carry out these tasks (Eriksson & Käkölä 1991). Traditional help systems are usually disconnected from the use context of the IS and they have to be separately browsed (Käkölä 1995). A better alignment between system use and learning is likely to be achieved by embedding the IS functions, that is, computerized tasks in the learning services (Käkölä 1995). In this way, actors are offered the most relevant materials and support functions proactively by the system on a just-in-time basis. Actors can focus on their work and learn to use IS functions by doing when computerized and manual tasks are linked holistically.

Learning services can be implemented quite easily. In practice, process models, task lists, narratives, or other extensive materials are always needed due to the complex and risky nature of CM. They can be made proactively available through the layer. Using simple and lightweight techniques such as contextual help in data fields and action buttons ensures the transparency of the layer when complex algorithms are not involved.

Performance monitoring services

Performance monitoring services collect information to support the assessment of work arrangements. It can be collected in the form of quantitative indicators to assess the overall process performance and contrast it with the performance associated with actors (Pressman 1997, 78). The individual level information should be available for the actors, so they can get feedback on their actions regarding to company standards and goals. The services also give the management of the CMO performance information. However, to ensure adequate autonomy of actors, this information should focus on work results rather than on precise measurement of tasks (Käkölä 1996a).

There are four types of process performance indicators in CM (c.f., Pressman 1997, 78-83; Sommerville 1998, 646-647; Haikala & Märijärvi 1998, 210):

1. Workload metrics (number of CRDs categorized by stage in the process, priority, assigned actor, or target IS areas) help actors allocate their resources and find bottlenecks in their work arrangements.
2. Process time metrics help actors evaluate and plan their work. They include:
   - Cycle time (from CRD creation to changes implemented).
   - Reaction time (from creation to analysis).
   - CRD processing time (from creation to change implementation decision).
   - Change engineering time (from implementation decision to accepted testing).
3. Quality metrics include the percentage of tests failed and the percentage of CRDs lacking sufficient information for analysis.
4. Process breakdown metrics (number of breakdowns, their causes and effects) enable workers to track down common breakdowns, eliminate their causes, and create procedures for recovery. They together with the quality metrics can be used to find suitable cases for process re-engineering work.

Careful inspection of the measuring principles is important to collect the metrics data in a reliable manner. Relevant information (e.g., breakdown situations) must be stored in the KSS and requests must not leak through alternative media (e.g., telephone).

Dynamic task reconfiguration services

According to the meta-design of DIS, a relatively high level of freedom in the use of the layer is to be provided. Actors must be able to experiment with their tasks and tailor the layer if it improves performance without magnifying the CM risks. Task reconfiguration requires built in flexibility in work tasks and the layer.

5.3.2 The inter-connected role layer

The inter-connected role layer aims at deepening the shared understanding among actors of the organizational context of their tasks. It provides actors in functional roles with redundant information about the work of other participants in the CM. As the interdependency of tasks is very high, this ‘enlarged’ understanding is especially important. It reduces the number and severity of breakdowns caused by misconceptions and provides the basis for holistic process understanding needed to assess the current work methods and the ways they could be improved (Käkölä 1996a).

Redundant information services

The redundant information services explain how the CM processes of a CMO are run, what are the responsibilities of different roles, and how actors in these roles interact. They complement the learning services with information on interaction between tasks associated with functional roles. Table 1 depicts the four dimensions of information providing a holistic understanding of the work arrangements. The dimensions differ according to the focus (manual and automated work tasks) and scope (own tasks and work context) of the work related knowledge.

Table 1. Learning and redundant information services contrasted.

	Focus on work tasks	**Focus on IS functions**
Learning services (scope on tasks)	How do I perform an installation of a new change?	Where are the new changes ready to be installed stored in the CMIS?
Redundant information services (scope on overall work context)	Who tests this new change and what information he/she needs to do it?	How do I inform the change initiator to test the new installed changes?

Redundant information is also promoted by enabling the actors to examine CRDs during all stages of CM. All actions should be explicitly stored in CRDs as this helps actors understand the work done by actors in other functional roles. The layer also provides a test environment where it is possible to simulate and actively experiment with different roles and corresponding tasks (c.f., Käkölä 1995; Käkölä & Koota 1999a). It does not allow actors to update any information in the business layer and the KSS. Otherwise, the responsibilities between functional work groups could become unclear.

5.3.3 The design product hypotheses of the business layer

The services of the business layer and their operationalization in CM are summarized in Table 2. Each sentence of the operationalization is transformed into the feasibility related design product hypothesis of the ISDT by writing it into the form of "It is feasible to design the services...." For example, the feature of breakdown management services "Actions can be cancelled" is transformed into "It is feasible to design breakdown management services so that actions can be cancelled." Effectiveness related hypotheses are also needed. The following hypotheses are the most essential ones but the list is not exhaustive.

Table 2. Services of the business layer.

Services	Operationalization of the services in the DCMIS
Communication and resource allocation	Communication support is provided for automatic notification of changes to relevant persons and for informal non-structured communication. Resource allocation is tied to functional work roles, which can be designed centrally and changed flexibly.
Breakdown management	Previous actions taken regarding to a CRD are made visible. Algorithms used are transparent and traceable. Actions can be cancelled. Knowledge about the expertise and authority of the personnel is made visible. Knowledge about the common breakdowns is accumulated and made available.
Learning	The manual and computerized tasks of work roles are integrated holistically. The services are not separate entities outside the IS use context.
Performance monitoring	Personal metrics on work load, cycle times, work quality, and breakdowns are automatically stored in KSS. Personal metrics are visible to the associated person. The goals, base lines, and current averages of the role and CMO level metrics are visible to everybody.
Dynamic task reconfiguration	The layer is flexible to use (only a few compulsory data fields, ability to skip sub-processes, etc.) and the user interface, searching facilities, and simple task support can be customized as long as the CM process is not endangered.
Redundant information	Process models and database views depict the responsibilities and inter-dependencies between actors in the CM process. Other actors' work is visible through CRDs and traces of performed actions. Actors can experiment with different roles in a test environment.

1. The DCMIS artifacts designed according to most or all the feasibility related hypotheses reinforce standardized, measurable, traceable, and transparent CM practices.
2. When hypothesis 1 holds, it is likely to increase the motivation and sense of responsibility of the actors.
3. When hypothesis 2 holds, it is likely to improve the planning and documentation of changes.

4. When hypothesis 3 holds, it is likely to enhance coordination and to reduce the number and severity of breakdowns and the time needed to recover from them.
5. When hypothesis 4 holds, it is likely to shorten the cycle time of CM, improve the quality of the organizational IS, and reduce the total resources required.
6. When hypothesis 5 holds, actors are likely to use the freed resources to improve their practices and the DCMIS further, for example, by better documenting breakdowns and their causes and accumulating more expertise and authority related information in the KSS.
7. As a result, the CMO is likely to perceive the DCMIS more useful and use it more actively. This positive, self-reinforcing cycle can continue from hypothesis 1.

5.4 The meta-design of the project layer of DCMIS

The project layer provides the services for cross-functional development teams of CM actors to assess and redesign the CM process and the services of the business layer. For performing these tasks, there are three prerequisites (Käkölä 1996a): (1) Actors must possess holistic understanding of their own work and work of others in the CM process. The services of the business layer help actors in this. (2) Performance measures must be available to objectively assess how the processes are run. They are available through the performance monitoring services. (3) Extensive knowledge of the current and past work practices must be available as the basis of redesigning processes. This information is stored in the KSS.

A development team must assess CM practices and their weaknesses. Argumentative dialogue services (Käkölä 1996b) support the conceptualization of work-related dilemmas and objectives. Benchmarking helps the team to increase its internal diversity and search for the best internal and external work practices. IT solutions supporting argumentation through semi-structured communication and group decision-making can be utilized in the project layer. For benchmarking purposes, the layer exploits the metrics data collected by the performance monitoring services. KSS preserves information about all work arrangements used and the project layer enables the statistical analysis of their results.

The team can use the modeling services to innovate new CM process and IS designs that best leverage the lessons learnt from benchmarking and suit the local conditions of the CMO. Simulation services enable experimentation with the designs. Those with little chance of meeting the redesign goals can be eliminated before implementation. Simulation links the design and implementation of work processes, helping bridge the design-use dualism. After the new solution has been decided upon, the generated process models can be used to design learning and redundant information services. If it necessitates changes in the application software implementing the business layer, the changes and associated training material must be implemented through the CM process. The training material can be constructed using authoring services, which include tools for making narrative and graphical instructions and, possibly, for utilizing virtual reality or multimedia.

The services of the project layer of DIS are relatively domain independent. Therefore, the mapping of the meta-design of the project layer of DIS to the meta-design of DCMIS is straightforward (Table 3). The feasibility related design product hypotheses of the project layer are created in the same way as in Section 5.3.3. Establishing the effectiveness related hypotheses is beyond the scope of this paper.

Table 3. Services of the project layer.

Services	**Operationalization of the services in the DCMIS**
Argumentative dialogue	Discussion forums and other tools support semi-structured argumentation.
Benchmarking	Statistical functions enable the analytical comparison of performance metrics. Standardized reports and metrics of the business layer help internal benchmarking.
Modeling	Process and data modeling functions enable the implementation and instantiation of these models in the learning services and corresponding software functions while reinforcing rigorous CM with respect to the changes of the business layer.
Simulation	These services support the simulation of alternative CM process redesigns.
Authoring	These services support the construction of the learning services for actors.

5.5 The meta-design of KSS of DCMIS

KSS serves as the repository of current and historical explicit work process information. The performance measures, process descriptions, and instructions are preserved and accessible in KSS. In the meta-design of DIS, this information is stored in an abstracted form including data on the level of work processes and functional roles, not on the level of individual requests or actors. In the meta-design of DCMIS, the role of KSS is enlarged to include the CRDs and information about common breakdowns, their causes, and solutions. This information can be used for process redesign but also utilized in routine work to learn from the past. The information in KSS is available to all members of the CMO. KSS provides query and browsing services for both standard queries, necessary for actors working in functional roles, and ad hoc queries supporting redesign projects and breakdown management.

6 The CMIS and change management practice - case Metso Paper

Metso Paper is the paper technology division of a global industrial consortium Metso. It is one of the leading suppliers of paper and board machines and automation systems in the world. Its global operations are enabled by an IS architecture called Profis that is based on the Baan application software package.

In the beginning of the research period, the installation of Profis in all intended sites (i.e., business units) was ending after five years of implementation. At this stage, the interest in Metso Paper had shifted from the design and implementation issues to the CM and further development of its new IS architecture. The CMO had been founded approximately six months before the research started. It focused strongly on corrective maintenance due to the early stage of the life cycle of Profis.

This section studies CM from the perspective of the corrective changes made in Profis. The IS supporting CM in Metso Paper are analyzed through the ISDT for DCMIS to study the validity and utility of the proposed theory.

6.1 Research setting and methods

This research validates and extends the meta-design of DIS by applying it in the domain of CM and CMIS in one organization. Thus, the research is a single critical case study (Yin 1994, 38). The case research method is well suited for studying complex phenomena such as CM in their own context (Yin 1994, 1; Benbasat, Goldstein & Mead 1987). The method is justified because the holistic scope of the meta-design of DIS hampers the application of accurate survey or experimental methods in researching it and the meta-design of DIS and its implications cannot be separated from the research context. The method has elements of descriptive, exploratory, and explanatory studies because the aim is to assess the meta-design of DIS in a context where this has not been performed before (Yin 1994, 4-15).

The case study proceeds in two phases. First, the similarities and differences between the CMIS of Metso Paper and the ISDT are analyzed (Section 6.3). According to the theory, many problems should be perceived in the use of the CMIS if the CMIS is not designed and implemented to comply with the theory. Second, the perceived problems in the use of the CMIS are collected by employing several methods and contrasted to the results of the first phase (Section 6.4).

To triangulate the evidence, three sources of data were used (Table 4). First, seven interviews were made during the research period of six months. Their duration ranged from 30 to 60 minutes. The interviewees represented all the roles participating in CM to ensure that multiple interpretations of the reality were respected (Klein & Myers 1999). They were told that the purpose of the interviews was to assess and develop the CMIS. Second, almost 300 e-mails, each consisting of one or more change requests concerning the CMIS, were analyzed to find out what kind of needs the CM actors had for the CMIS. The requests were categorized according to this need dimension and relative frequencies were examined. The requests dealt with relatively large CMIS oriented needs, not with the needs concerning the CM process. Third, during the first three months of the research, the second author performed participatory observation (Yin 1994, 86-87) while working in the roles of a researcher and an IS specialist in the CMO. A research diary was collected and later used to affirm and challenge the analysis of other types of data.

Table 4. Research methods used in the analysis of the perceived problems in the use of the CMIS.

	Focused interviews	**Change requests**	**Observations**
Nature	Qualitative	Mainly quantitative	Qualitative
Influence of researchers	Moderate (minimized by using an unbiased frame of questions)	Low (data was accumulated without any relation to the research purpose)	Varied depending on the level of participation
Collection method	Focused interviews with the members of the CMO	Change requests (e-mails) accumulated and stored	Field notes collected during the research process

6.2 Change management at Metso Paper

Several organizations participate in CM. Sites are responsible for the operational use of Profis. In addition, there is a layered support organization consisting of regional support centers and the centralized CMO acting as a global service provider for the sites. External organizations provide systems engineering and other services for the CM process.

6.2.1 Change management process

The local feedback and error reports are collected and processed by the main users and the site's local support organization. If necessary, the issues can be escalated to regional help desks for small local adjustments of the Profis installations. If the issue is of global concern, it can be further escalated to the CMO. The multi-layered approach is designed to offer fast relief in local 'easy-to-fix' problems and let the CMO concentrate on issues of highest importance.

In the CMO, the requests are prioritized and assigned to specialists with the requisite resources to assess them. After assessment, the CMO makes a decision regarding the implementation of the corrective change. Most of the engineering work is outsourced to third party vendors. The request initiator then performs release testing in the test environment provided and maintained by the CMO. If the changes are accepted, the new system components, installation instructions, and changes in documentation are delivered to all sites with a system version where the changes are applicable. The sites then implement the changes.

6.2.2 The CMIS

Metso Paper has been using its global Lotus Notes[2] application infrastructure for knowledge management and process coordination associated with CM. The CMIS supports communication and coordination in the CM process and functions as an organizational memory information system of the CMO.

The collection and assessment of corrective needs is supported by a helpdesk application, where new requests are filed in. The requests accepted for engineering by the CMO are further processed in another application. It stores information about all regional Profis versions and uses a layered document structure where solutions to a request are divided into detailed solution documents describing the implementation of the solutions in particular system version(s). Based on the solution documents and regional information, it automatically creates delivery documents for all sites using the system version that requires the change.

Both applications direct the CM workflow by linking each CRD to a certain stage in the process through status flags. Flow of a change from the initial requests to version-specific solution documents and site-specific delivery documents can be easily tracked. Statuses are also used to control the way a document can be edited, thus enforcing the standardization of the process.

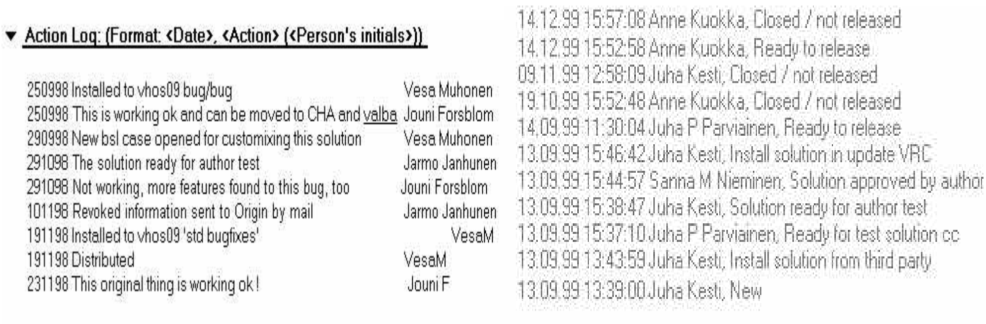

Figure 4. Tracking changes in CMIS. Manually filled Action log (left) and automatically filled edit history (right) are used in the CMIS to increase the visibility of actions.

6.3 Assessing the CMIS as to the design product hypotheses of DCMIS

Traces of functions resembling all the services of the business layer of DCMIS can be found from the CMIS. However, the resemblance is very low except for the communication, resource allocation, and task reconfiguration services (Table 5). The CMIS also expresses characteristics indicating non-transparency of technology. Hence, traces of problems associated with the black box nature of the CMIS should

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[2] Lotus Notes is a commercial groupware platform, on which applications with document sharing, e-mail messaging, and search functions can be built (see e.g. Lloyd & Whitehead 1996).

manifest in the CM work because many services of the DCMIS are missing in Metso Paper.

Table 5. Comparison of the business layers of the CMIS and the DCMIS.

DIS Services	**Assessing the CMIS with respect to the design product hypotheses of the DCMIS**	**Similarity**
Communication and resource allocation	Informal and structured automated e-mail functions are provided. The organizational transparency of communication is limited. CMIS resource allocation is based on work roles and can be reconfigured quite flexibly.	Moderate
Breakdown management	Document life cycle is visible. Algorithms used are not transparent and traceable. Actions cannot be cancelled. Information on the common breakdowns and the expertise and authority of the personnel are not accumulated.	Low
Learning	Learning material is partly outdated and can only be found in work instruction documents separate from the CMIS. The use of process models and role-based descriptions in the material is not extensive.	Low
Performance monitoring	Performance information is gathered about workload and cycle times but mainly used for managerial purposes. No targets or standards are stated.	Low
Dynamic task reconfiguration	Possibilities for customization exist but require technical expertise. Built-in freedom and flexibility are relatively high in system use.	Moderate
Redundant information	Other actors' work is visible through CRDs and views of shared document databases. No process-oriented organizational interface. Use of process models and narratives to describe inter-connections between roles is limited. No official training environment has been established or used.	Low

Examination of the services of the project layer of the DCMIS indicates that similar functions provided by the CMIS are elementary or non-existent (Table 6). Dialogue and benchmarking tools support to a certain extent the assessment of work practices but implementation and simulation support for process redesign hardly exists. The absence and primitiveness of functions associated with assessing and reconfiguring work arrangements indicate that the focus of CM work has been mainly on routine work. This can endanger the reinvention of work practices and supporting IS in the long run.

The work-related explicit knowledge is accumulated in the CMIS but it is physically and logically disintegrated. The lack of a KSS can have negative effects on routines and process redesign work, as knowledge about the past cannot be effectively used to inform current decisions. The multiple ways of searching for information available at Metso Paper can remedy but not fully compensate for this deficiency.

Table 6. Comparison of the project layers of the CMIS and the DCMIS.

DIS Services	**Assessing the CMIS with respect to the design product hypotheses of the DCMIS**	**Similarity with the DCMIS**
Argumentative dialogue	A CM discussion forum and informal e-mail messaging are available. Semi-structured argumentation is not actively encouraged.	Low
Benchmarking	Statistical views used to summarize process data help compare work arrangements to some extent. Consistent benchmarking practices have not been established.	Low
Modeling	Simple flowcharting tools are available.	None
Simulation	None	None
Authoring	Training sessions, meetings, e-mail lists, and user instructions are used. Learning services are not constructed for and provided on-line through the CMIS.	Low

6.4 Perceived problems in CM work and the use of the CMIS to support it

In this section, the problems in Metso Paper's CM work and use of the CMIS are studied from the viewpoint of CM actors. An overview of the problems most frequently found in the interview data is presented. The problems are then analyzed in more detail according to their relation to the services of DCMIS.

6.4.1 Overview of the perceived problems

Five problem categories can be pointed out. The only category expressed by all the interviewees was *problems in finding information in the CMIS*. Most of the statements in this category concerned the information in the CRDs but several interviews also highlighted problems in finding necessary work instructions.

All except one interviewee considered *the frequent breakdowns in work routines* a problem. In this category, statements concerning breakdowns in work arrangements due to technical and process related factors were included. The breakdowns manifested mainly as delays when documents were handed off from one sub-process to another.

All except one interviewee implicitly indicated or explicitly stated *problems they had in understanding the functions of the CMIS*. Most of these problems related to the complex algorithms and functions such as the automated delivery procedure stating the need to install a change in a certain site.

Closely related to the problems in understanding the functions of the CMIS was *the insufficient CMIS learning material and training*. This category directly related to a perceived lack of support facilities for CM activities and especially for using the CMIS. Problems belonging to this category were lack of training, inaccurate and outdated learning material that is hard to locate, and lack of built-in user support in the CMIS.

Missing understanding of the overall work process and responsibilities was identified as another perceived problem category. Several interviewees indicated that their responsibilities and tasks were not well defined or stable. In addition, the procedures and tasks associated with different processes were unspecified.

Interviewees in managerial role mostly expressed *performance-monitoring problems*, including the lack of process metrics and ad hoc reporting facilities. The workers were more sceptical about performance monitoring and doubted how well the measurement principles could reflect the complex reality of CM.

6.4.2 Relation of the perceived problems to the ISDT

The problem categories are analyzed in light of the differences between the ISDT and the CMIS to point out how the categories can be related to the CMIS by using the ISDT as an analytical tool.

Communication and resource allocation services

The CMIS played an important role in organizational communication according to all interviewees:

> "The databases [i.e., CMIS] are very important. They let you see who has done what, when, and why. Actually I think they are the main glue holding our organization together because we are so dispersed."

The actors were relatively satisfied with the way the CMIS promoted intra-organizational communications. This was aligned with the high resemblance of communication services of the DCMIS and the CMIS (e.g., presence of both structured and non-structured communication support). The analysis of the CMIS-related change requests indicated that the actors had very actively participated in the development of notification functions. Communication related services of the CMIS were thus considered crucial.

The resource allocation services of the CMIS were based on the definition of work roles and related access rights. Serious problems with these services were not found in the CMIS. Some work process breakdowns occurred due to workers' lack of authorization in exceptional situations. This is not entirely negative, however, as the risks in CM require careful consideration of actions in exceptional situations.

Breakdown management services

Both technical and process-related breakdowns were frequent in CM. They resulted partly from the technical and organizational complexity associated with CM but many of them also seemed to result from the missing redundant information and holistic process understanding.

> "The routine work procedure covers 80-90% of the cases. Managing the exceptions consumes a lot of time. They are usually caused by some unexpected technical problems."

> "I guess everybody thinks they know how this process [i.e. overall CM process] goes, but I don't think that many people really do."

Several interviewees indicated that especially handovers between processes were problematic.

> "The change requests seem to stall when the responsibility for them is transferred from one person to another."

> "I know that some issues have just been forgotten after they have been handed off."

One possible cause for this could be the users' inability to understand how their actions affected the subsequent steps in the work process. Interview data supports this interpretation.

> "I do not know what all the buttons do, I'm quite satisfied with knowing what I have to do and how to do it."

A good example of the importance of redundant information in avoiding breakdowns is the notification sending functionality of the CMIS. It was made transparent by enabling the actors to choose the recipients of notifications about a CRD from a list of prospects. This change caused some anxiety and communication breakdowns because actors had trouble deciding who should know about the changes they had made in a CRD. New inexperienced users generally either selected nobody or all persons available as recipients for notifications. The increased transparency of technology can thus increase the demand of redundant information in the organization, as the understanding of links between the roles and tasks of workers becomes vital. The example also provides support for the requirement of the ISDT that both technical and work related issues must be considered and developed in concert.

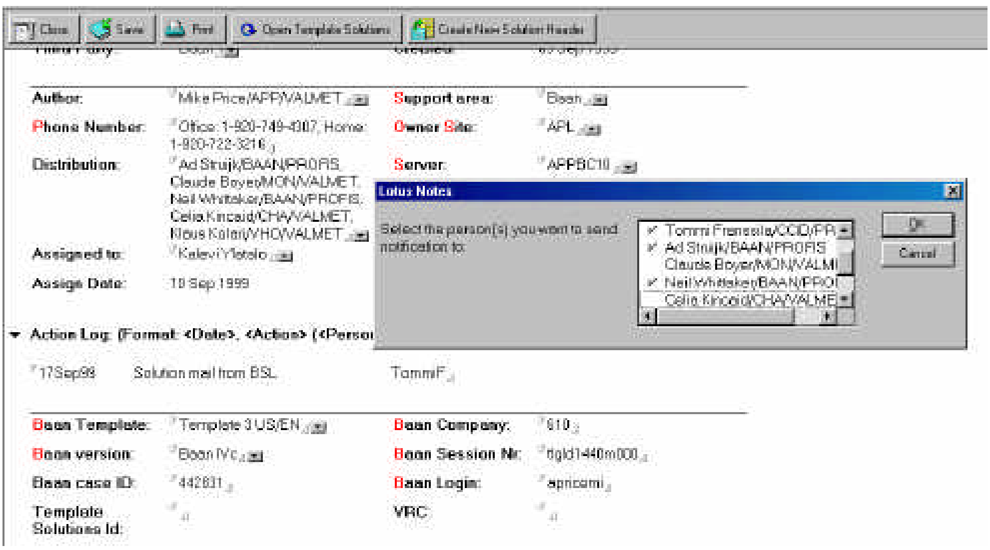

Figure 5. The functionality of the CMIS for sending notifications.

The problems indicate that the CMIS users might benefit from a repository containing interest and responsibility areas of all CM actors. This repository would help recovering from the breakdowns by making visible the expertise and authorization of actors in the CMO as recommended by the ISDT.

The lack of user training and inconsistent learning materials also cause breakdowns. Frequent breakdowns may result when actors view the CMIS as partly institutionalized and do not even try to comprehend or question its functions, thus becoming unconscious of the results of some of their actions. The situation is not made easier by the missing support for canceling and rolling back actions already committed.

Learning services

The workers understood the connections between their manual work tasks and CMIS functions weakly. Even the basic relationships between the CRD statuses and work tasks were blurry in some cases:

> "The change requests have so many statuses that it's hard to know what they mean and which ones to use."

This is not surprising as the interviews indicate shortcomings in CMIS-related training and work instructions.

> "It is especially difficult for me to understand the linking between the applications [of CMIS]. These links are not very well represented in instructions."

This issue potentially induces many of the other problems detected in the CM work and CMIS use. The poor understanding of the connections between manual and computer-supported tasks also facilitated the institutionalization of the CMIS.

Performance monitoring services

> "It is very hard to tell how we have managed to improve our process with new tools and personnel when quantitative information on the process performance is not available."

Based on CMIS change requests, efforts were made during the research period to introduce the performance monitoring functions in the CMIS. These functions were not fully exploited when the period ended but already at that time, managers were able to identify some bottlenecks in the work process. A manager stated:

> "Even on the basis of this [metrics] data we have been able to reduce some inefficiencies."

The services were mainly of managerial concern and used to identify the overall cycle times and the relative durations of tasks. In Metso Paper's context, performance measurement was not a service anticipated or required by the workers. In this sense, the practical use of performance measurement does not correspond with the design of Käkölä (1996a). It is hard to determine if this posed practical problems to using the CMIS. It is possible, however, that by using active performance measurement the workers could become more proactive and autonomous in searching for ways to improve their work routines, as argued by

Käkölä (1996a). In this way, the perceived problem of frequent process breakdowns can be connected to the lack of performance monitoring services.

	No	Short Description	Created	Closed	#	%	Cycle (days)	Third party	Author test
All issues (52)					52	100%	195,0	0,0	4,5
2000 (7)					7	13%	358,6	0,0	0,0
1					7	100%	358,6	0,0	0,0
99 Not defined (7)					7	100%	358,6	0,0	0,0
1999 (45)					45	87%	169,6	0,0	4,5
12					14	31%	240,1	0,0	0,0
10 Business stands (1)					1	7%	329,0	0,0	0,0
	191:1	Wrong accounts in tax entries created in connection with final invoice	22.01.99	17.12.99			329,0		
30 Problem (1)					1	7%	331,0	0,0	0,0
99 Not defined (12)					12	86%	225,2	0,0	0,0
11					23	51%	151,1	0,0	0,0
10					8	18%	99,1	0,0	4,5
					52	100%	195,0	0,0	4,5

Figure 6. An example of the performance measurement services of the CMIS.

Dynamic task reconfiguration services

The CMIS offers a relatively high level of flexibility in system use to help actors deal with the complex and unexpected work situations. However, this flexibility had both negative and positive consequences. It enabled the establishment of personal arrangements to support work tasks, as the member of the engineering group states:

> "We have made up our own coding system. This is the way I mark down for Jim [demonstrates this with the CMIS] that I'm working on the case."

On the other hand, the flexibility also caused several perceived problems. The variety of ways the system could be used especially hampered finding information from the CMIS:

> "It is sometimes difficult to find out how a change request has proceeded, because the request may have been processed by several persons who all have different methods of marking down their comments."

Redundant information services

The interview data revealed that the actors' work-related understanding was mostly restricted to their own work tasks and corresponding CMIS functions. This is explained by the fact that the overview of the CM process, responsibilities, and inter-connections of actors was not uniformly and clearly depicted in the learning material of the CMIS.

The inadequate redundant information could hinder the use of the more transparent functions (c.f., the sending of notifications) and cause many of the frequent breakdowns because workers did not know their responsibilities, were unsure which events required their response, forgot to act in proper parts of the process, and did not understand the consequences of their actions.

Services of the project layer of the CMIS

The near absence of the services associated with the project layer of the ISDT was due to the immaturity of the CMO and lack of resources. Scant consideration was given to the assessment of work practices because the focus of the CM activity was in processing the large flow of requests.

It is hard, if not impossible, to estimate the degree to which the missing or limited services of the project layer have caused the perceived problems. Because of the relatively young age of the CMO and the CMIS, no serious consequences were likely to be indicated in the research period. After all, the services are aimed at supporting the long-term effectiveness of an organization. However, the vast number of change requests concerning the CMIS shows that the needs of the actors were constantly evolving and the actors were genuinely interested in developing their work practices. The services of the project layer could thus be useful for assessing these needs and supporting their implementation.

KSS of the CMIS

The effects of the disintegration of the KSS in Metso Paper can be seen from several problem categories. Clearly, the problems in finding information from the CMIS were at least partly induced by the missing linking of the different categories of work-related explicit knowledge.

> "It's hard to understand how this process [CM] is run, because the important information about it is located in different places, partly outdated, and generally hard to find. I guess this is especially problematic for new workers."

Similarly, the disintegration of the KSS caused problems in implementing the learning and redundant information services and thus can be seen as a reason for the problems the users had in understanding CMIS functions and their work responsibilities. The problems in monitoring work processes are directly related to the lack of process performance information in the KSS.

6.5 Assessment of the empirical research findings

The case study provides insights on the applicability of the ISDT and the underlying meta-design of DIS in analyzing and further developing the CMIS to correspond more closely with the ISDT.

6.5.1 Insights from analyzing the CMIS

We have found that the ISDT could be used to analyze how different aspects of the CMIS corresponded with the ISDT. The differences between the CMIS and the ISDT could then be used to explain some of the perceived problems in the CMIS use.

Traces of functions resembling the services of the business layer could be found in the CMIS. The services of the project layer were largely missing in Metso Paper indicating that the focus of CM work had been to achieve robust and efficient routines in the short term. However, the limited emphasis on IS support for the assessment and redesign of work processes posed a threat to routine work in the long run. In addition, both the routines and process redesign were hampered by the disintegration of repositories. Due to the disintegration, the KSS of the CMO, as prescribed by the theory, was almost completely missing.

The ISDT can thus be used as a tool to identify the presence or absence of key services in an operational IS. However, the complexity and domain independent nature of the meta-design of DIS does cause problems in applying it as an analytical tool. The extension of DIS into a domain specific ISDT is not a trivial task and requires considerable effort and in depth knowledge of the domain. The design product hypotheses of the theory are crucial but particularly challenging to design in order to quantify the differences between the theory and an operational system.

Several perceived problem categories were connected to the characteristics of the CMIS. This was especially evident when redundant information was considered. As the notification e-mail example implied, the missing understanding of the overall work process resulted in breakdowns even when the technology was relatively transparent. Thus, the strength of the meta-design of DIS is that it underlines the transparency of technology but places technology in its organizational context.

6.5.2 Applying the ISDT to enhance the CMIS

The empirical research revealed three major development possibilities to remedy the perceived problems: promoting the holistic understanding of work, enhancing breakdown management, and introducing work process redesign support.

The use of consistent and clear definitions of work tasks and their interdependencies promotes the understanding of work. All CM actors can then use these definitions as an explicit reference. Käkölä (1996a) preferred the use of process models for this purpose. The learning materials used in Metso Paper utilized simple flow diagrams but they were inconsistent with each other and did not include exception handling and depict the actors responsible for processes, data flows between processes, and the role of the CMIS in coordinating and automating processes. When consistent modeling principles have been adopted and the process models and other learning materials have been instantiated, they should be stored in a centralized KSS, made available to actors, and maintained systematically. KSS and the CMIS could be interlinked through, for example, context sensitive drill downs from CMIS functions to related process models and detailed work instructions.

New tools could be introduced to help actors recover and learn from breakdowns. Breakdowns often occurred because actors did not know who possessed the knowledge or authority to resolve unexpected situations. This problem is especially common in CM because strict authorization mechanisms are used to restrict actions. As the ISDT indicates, the problem could be remedied by using the KSS containing the expertise and authority areas of the actors to enhance internal communication and prevent breakdowns resulting from communication gaps. The KSS would mainly be used to find the name and contact information of the person(s) who could help with a problem and to find out, which persons should be notified about a change.

In the long run, organizational designs, practices, and IS services for supporting process redesign are essential for a CMO. In Metso Paper, they neither emerged nor were actively established. No technical tools can compensate for the organizational unawareness of process redesign. However, if redesign project teams were established, tools for the teams could be incorporated with relatively low cost through the existing groupware architecture. The definition and modeling of the processes provide the basis for improvement of the performance monitoring and benchmarking services of Metso Paper. Leveraging the discussion databases already used could enact forums for redesign and provide project teams with support for non-structured dialogue on CM process-related issues. The groupware architecture does not support argumentation in a strict sense because no clear rules for argumentation and counter-argumentation are present. Yet, the issues can be discussed so that conversations are focused, visible, and stored for further reference.

7 Conclusions and future research

Large organizations are critically dependent on their ability to leverage complex IS architectures. They need CMOs to maintain the operational effectiveness of the architectures while shortening the cycle time of CM and maintaining or reducing the total resources required by CM. We maintained that the groupware-based CMIS could enable the process development of CMOs, thus serving as a means of meeting these goals.

Yet, the CMIS are likely to become institutionalized and fall short in meeting the goals unless a holistic, theory-based roadmap and adequate resources are used to design them. Therefore, this paper started to build an ISDT for DCMIS. As a part of building the theory, we examined the theoretical and practical validity and utility of the meta-design of DIS by applying and extending the meta-design for building the product aspect of the ISDT. Section 3 described kernel theories of DIS and Section 4 presented the CM domain to derive meta-requirements for the DCMIS. In Section 5, the product aspect of the ISDT was constructed, providing insights on the compatibility of DIS and CM and experiences from extending the meta-design into a domain specific ISDT. We found the meta-design of DIS to be well applicable for designing the ISDT. Yet, its application and extension are not trivial because the domain-independent and holistic nature of the meta-design leaves plenty of room for the subjective interpretations of the designers of the ISDT and requires an in depth understanding of the domain.

In Section 6, the CMIS of a CMO that had been constructed purely to meet short-term practical requirements was empirically studied. The findings justified the importance of both the research problem (i.e., institutionalization of the CMIS due to the design/use dualism of the CMIS) and building the ISDT to alleviate the problem. They indicated that actors perceived many problems, some of which could be attributed to the CMIS. The validity and utility of the product aspect of the ISDT and the underlying meta-design of DIS could not be empirically refuted because the ISDT could be utilized to both explain and generate possible solutions to the perceived problems in the use of the CMIS. The practical utility of the meta-design of DIS also proved high. With the ISDT as the roadmap and the global groupware architecture in place, companies like Metso can implement advanced services of DIS in a lightweight manner.

The ISDT proved useful in the context of Metso Paper. We also expect it to be relevant to CMOs in similar large organizations employing complex organizational IS and to vendors that can establish software product businesses on top of the productized DCMIS solutions. However, further research is needed to refine and validate the ISDT in other CMOs, thus extending the CM literature towards a deeper appreciation of modern communication technologies. Especially the validity and utility of the project layer of the DCMIS need to be analyzed. The applicability of the meta-design of DIS should also be studied in other domains.

In the following, we identify topics for future research concerning four aspects of the ISDT, that is, the kernel theories of the product aspect and the three components of the process aspect of the ISDT: design method, kernel theories, and testable design process hypotheses.

Kernel theories are theories from natural or social sciences governing design requirements. Meta-requirements for the DCMIS were derived from the CM process and the meta-design of DIS, which draw upon many theories. Future research is needed to identify and analyze other kernel theories to find out whether they pose new meta-requirements for refining the DCMIS. CMOs support and leverage the product and service development and delivery of the key vendors in order to achieve enterprise-wide process development. Kernel theories of the ISDT should thus integrate systems and software engineering, place CM processes in a holistic process, product, and service development context, and help the designers of the ISDT and the implementers of DCMIS artifacts to understand the context and communicate with CM actors effectively. Process assessment and improvement frameworks such as CMM-I (Software Engineering Institute 2000) meet these requirements. They are relevant because they have been abstracted from real-life practices and help build a common language by integrating various theories or management methods such as benchmarking and organizational learning.

Design method describes procedures for artifact construction. The in-depth investigation of the design process aspect of the ISDT has been beyond the scope of this paper. Yet, the design process has a critical role in the adoption of the meta-design of DIS in organizations. The meta-design of DIS may seem complex and difficult to apply because it is a holistic model. The experiences from Metso Paper imply that it can be applied in a lightweight manner and with reasonable costs through a staged adoption. The business layer and the KSS should be focused on first. The project layer could then be gradually implemented on top of them. Future research should focus on providing detailed prescriptive instructions for the staged adoption. Longitudinal empirical research is necessary but it should be complemented with constructive research to discover the most optimal ways of instantiating the DCMIS.

Kernel theories of the design process aspect are theories from “natural or social sciences governing design process itself” (Walls et al. 1991, 43). We have not applied kernel theories specifically to the design process because Käkölä (1996a) found that the separation between kernel theories of design product and process is somewhat artificial. He thus called for IS design and use theories. Structural properties of DCMIS artifacts cannot be separated from the design processes that constitute the properties and the use processes that are constituted by and reconstitute the properties. The kernel theories of product and process aspects need not be the same but they must be significantly overlapping so that the ISDT can be drawn upon to discuss, understand, and improve design and use processes using (to the extent possible) the same terms and concepts (Käkölä 1996a, 117). Otherwise, the coordinated, recursive development of CM processes and DCMIS artifacts may be hampered and the ISDT may not help CMOs to achieve their goals. Future research is needed to identify and further develop such kernel theories for the ISDT.

Testable design process hypotheses are used “to verify whether the design method results in an artifact which is consistent with the meta-design” (Walls et al. 1991, 43). The most important aspect of the design method is its ability to ensure that the organizational design of a CMO and the DCMIS artifact are successfully aligned and integrated in every stage of adoption. Design process hypotheses must thus be devised for each stage so that corporate-wide, productized DCMIS solutions can be obtained.

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Rescuing the Digital Immigrant

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Abstract. As different kinds of computer-based gadgets and systems have become commonplace, the requirements of the work place have also changed. In many work places, this means, unfortunately, that the work force has been divided into “digital immigrants” and “digital natives” (Prensky, 2001). In this paper, I reflect on the situation from the point of view of the digital immigrant, that is, the group of people who have been exposed to information technology later in life. Since time has not yet taken care of this group, i.e., released them from the working force, the lack of computer-related skills remains a problem for both individuals and organisations. Based on my experience in the academic world and in business, I will outline some ways that can be used to make the life of individuals easier and the organisation more effective.

1 Digital immigrants and digital natives

The new international division of labour seems to be that, in highly-developed countries, workers are required to be more and more productive or, alternatively, to make do with low wages which don’t cover basic living expenses. In many areas, there is a search underway to find a new type of labour division, somewhere between automated processes and human work. Thanks to the information systems in place and higher levels of education, workers are expected to have a much broader range of skills. Good examples of this can be found in both the private and the public sectors where the goal is, for example, one window facility or flexible manufacturing. The fact that workers need to be skilled in broader areas of work also means that they need more upgrading in their given areas of expertise, but, at the same time, they will have to learn to use technology that is supposed to assist them in the work tasks. The spectrum of IT skills needed should not be underestimated and, over the past few decades, technical courses have become one of the most significant sectors in adult education.

When upgrading skills needed in work practices, the utilisation of IT raises a note-worthy dilemma. At the moment, there are a lot of people who have very diverse skills and who, based on this experience, would be better qualified than others to successfully do their jobs which require understanding how their work fits into the wider picture; however, their ability to use IT to help them in new situations is much poorer. On the other hand, there are workers from the Nintendo generation who have good technical skills but who lack the experience and the broader vision that comes with experience to see how their work contributes to the goals of the organisation or the performance of their colleagues. Mark Prensky (2001) uses the term “*digital natives*” to describe the Nintendo generation as opposed to “*digital immigrants*”, i.e., those who have come into contact with IT later in life.

It is interesting to compare the learning history of digital natives and digital immigrants. A large portion of digital natives first came into contact with digital technology playing games and using electronic entertainment. Things are not processed much on a verbal level, i.e., teacher presentations seldom precede practice, but practical experience measured in time is significant. One cannot avoid making a connection between this learning style and observations made in connection with “*implicit learning*”. For example, Berry & Broadbent (1984) reported on experiments where test subjects had to learn to control various complicated processes, e.g., in a sugar factory simulation. The test subjects had to adjust the parameters of the simulation so that the set goal was achieved in the production process. Unless the directions were very well designed, they were, in fact, detrimental compared to independent trial and error. In practice, *trial and error* produced a much better result than learning rules. The positive effect of rules and directions was only noticeable when the test subjects had to fill in a questionnaire about the rules and directions. In other words, the conversion of experience-based tacit knowledge into explicit knowledge (externalisation) did not succeed in the way proposed by Nonaka (1994) in his famous model on organizational knowledge creation.

Typically, games that young people play try to use every bit of computing power in the PC and, therefore, installing programs is often difficult. In fact, within player circles, there are various “heroic tales” about installation problems and how they were solved. Recounting and understanding these stories requires a significant amount of technical knowledge and just by listening to these stories novice players usually learn a lot. In this way, players often form a community of practice (Wenger, McDermott and Snyder, 2002). The positive learning effects of these kinds of informal learning communities have already been reported by Orr (1986), who noticed that the narratives in the form of “war stories” enhanced the knowledge sharing in a group of photocopy repair personnel. These narratives were helpful, especially for novices as they covered aspects of the work that were not included in their formal training or in technical manuals. A social way of acquiring knowledge has also been observed among young mobile phone users. According to an ethnographically oriented study (Weilenmann & Larsson, 2000), teenagers use mobile phones collaboratively; that is, they share both the phone and its content (e.g. SMSs). Furthermore, they use mobile phones as social devices for purposes other than calling other persons; they do things together and the mobile phone takes part in this social action. This kind of collaborative use sessions are, of course, also a learning experience where teenagers become acquainted with different types of phones, their settings and functions - and get help with their own phone if necessary.

Training the work force, however, has traditionally relied heavily on classroom teaching within a course framework where verbal descriptions of complicated systems play a central role. Traditionally, a digital immigrant has been given an orientation over a 1 – 3 day period to use computer applications and information systems. Naturally, the emphasis in this training is on how to do things correctly. From the user's perspective, however, it might be just as useful – or even more useful - to learn different error recovery techniques. When navigating, one must learn to move both forwards and backwards.

Intensive courses have been criticised, and rightly so, for their information overflow. It sometimes seems that it would be forgotten that learning outcomes are mainly based on the learner's activity and not on the teacher's activity. Typically, the teacher tries to transfer enough information to the student all at once, but might there be better options?

2 Supporting the digital immigrant

As a starting point, we should note that utilising IT in one's work is just one part of a larger whole, which is the realisation of some explicit goal, for example, to write a paper or place an order. Moving the focal point from the training centre to the work place and to one's work in a broader context usually improves learning outcomes. If learning to deploy IT can take place as part of learning one's work tasks, it is better situated within actual practical work situations. In other words, people are learning how to perform their work with the system instead of learning how to use the system in general.

Learning at the workplace can also be done in shorter segments over a longer period of time; in this way, learning goals are easier to prioritise according to arising needs. One does not have to learn everything immediately if there is no need for it. And, actually, learning takes time, and a lot of practice is needed to master complicated systems. In practice, however, system managers and professional educators are often understandably concerned about whether they have mentioned every detail.

One part of the learning process might be the support that colleagues give in connection with problem situations whereby error recovery plays a necessary part. In general, if assistance from colleagues is available, it is also preferred instead of call centres or manuals. One factor that raises the value of peer help is that the feedback is immediate, which is important both for learning and for fluency of work. A problem situation also forms an important focal point in the learner's memory – solutions that one has found to one's own problems are remembered much better than lecture material. Personal "war stories" about problem situations form permanent memory structures. In connection with serious problems, these stories also form a part of the collective memory of the work place (c.f. Orr, 1986).

Despite all the positive features, on-the-job learning is not without its own problems. In order for it to work, it must be supported with the right people, time management and incentives. In order for it to succeed, the learner must have a support and safety network in the form of a mentor; time must also be put aside for learning, and mentoring must be a valued part of one's work. It is not possible, in the tradition of Taylorism, to move each problem to a specialised problem-solving department. One important role of the local mentor is to act as a "false-detector", someone who works to standardise practices and who tries to root out inefficient ways of doing things. This is especially important in cases where the users have learned to use the systems by themselves using the trial and error method, as inefficient ways of doing things may also produce the right result – often using excessive time.

At many smaller workplaces, there simply are not any suitable mentors within the organisation itself. In this case, it is often beneficial to integrate an outsider into the work group. This type of mentor will lend support with short visits, offer telephone support and possibly remote computer support.

Using information networks for guidance in smaller workplaces presents an interesting alternative. For years, there have been special educational networks in computer classrooms and current local and wide area network technologies offer better and better facilities for online guidance. However, easy-to-use systems are not common in this area.

Even if a pertinent part of IT training is given close to the workplace, it should contain the general principles of the systems used. It is not unusual, for example, for someone to produce and save hundreds of files in one and the same folder – and still have difficulties in finding the right one every time when one is needed. Or a colleague can not adjust the date and time of the PC. These kinds of situations demonstrate that the spectrum of general principles and small details is vast and an indication of the fact that new technology seems to call for a new type of solidarity among digital immigrants and even better, between digital immigrants and digital natives.

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E-Government: Between Development and War

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Abstract. In the present age of globalization, and global risk, the design of human-centred systems cannot ignore issues of geo-political context. This paper outlines a range of issues stretching from the micro design and implementation of e-government applications in a developing country, Jordan, up to the macro issues such as the durable war that characterizes that region.

E- government is being promoted by international agencies and G-8 nations as a means to obtain efficiency, accountability and transparency in the governance of developing countries. In particular, the model for good governance is the one advocated by New Public Management: the minimal, service-delivery state. The paper shows how e-government is difficult to implement, given the characteristics of the local administration, the socio-economic context and the dynamics of the technological infrastructure.

Next, it asks whether the marketisation of the state embedded in e-government makes sense as the paramount approach to improve democracy and foster development. The transformation of citizens into customers is problematic; and the correlation between good governance and minimal state with development can hardly be demonstrated historically.

A complementary explanation of the current rush to promoting and building e-government plans in less developed countries focuses on the emerging, intimate link between aid and security (as spelled out in the US National Security Strategy).

To wit, e-government appears to be a means for the rich metropolitan states to govern "at a distance" (through sophisticated methodologies and technologies) the potentially dangerous, weak borderland states. But IT applications may drift away from the preset targets and global, durable disorder within and between states may obtain intact. New approaches are desperately needed.

1 Introduction

Heidegger (1987), one of the continental philosophers most concerned with the role and essence of technology in our modern world, suggests that trying to figure out whether technology is a bad, good or neutral means is just a technical, instrumental quest. If one wants to get to the essence of modern technology, he or she should avoid falling into the trap of a technical discourse. The essence of a tree is not something vegetable. Thus, the essence of modern technology is not something technical. We can retain from Heidegger's investigation two basic ideas on the essence of modern technology.

The first is that technology is a way of revealing, a revealing that challenges nature, people, society, the world. Second, that the challenge posed by modern technology has a very special and consistent form, captured by the German word Gestell. In a way, Gestell has the characteristics of what we would call in information systems an infrastructure, enabling and aligning all the processes in an organization. But the idea of infrastructure has a static connotation (structure…), while the German word has the more dynamic component of the challenging. The word Gestell contains the root of the verb stellen, which means ordering and aligning.

The essence of modern technology is a way of revealing that challenges the world by ordering it, that is by ordering resources, processes, people, and relationships. All are made present, available through order, calculus, and formalization. So that they can be recombined, aligned, aggregated and made ready for …further ordering.

The interplay between ordering and revealing can guide our investigation on the deployment of information technology in the public administration and can help us in unveiling the complex phenomenon of e-government models, methodologies and policies deployed today by many governments and international agencies, with a special focus on the less developed countries (LDCs).

E-government is information and communication technology (ICT) applied at ordering at least three kind of processes. First, the relationship (transaction) between the administration and the citizen (customer) and the related re-engineering of the activities internal to the administration. A second level regards the way in which the boundaries between the state and the market are redrawn, by the creation of an electronic, minimal state, more transparent, agile and accountable. A third level deals with the purpose of aid policies aimed at introducing e-government into developing countries. Better accountability and improved transparency are the characteristics of good governance, and the latter becomes the conditio sine qua non for the rich states and international agencies to supply aid to the LDCs. The study of the way in which e-government becomes a technology of ordering at these three different levels unveils at the same time hurdles, risks and inner contradictions. The composite analysis of the ordering and revealing effects of ICT in government can offer a new picture of this phenomenon.

In Section 2 the Kingdom of Jordan as a case study of an innovative and extensive application of e-government ideas and models provides a paradigmatic example of how ICT are being introduced in a LDC and what are the risks of failure in implementation. Section 3 examines the implications of e-government and New Public Management in the transformation of the relationship between the state and the citizen. The next Section analyses the new emerging order linking aid policies and the new style of governance "at a distance" that rich, metropolitan states want to establish by funding e-government projects in LDCs. Again, attempts at increasing the levels of order and control may backfire and maintain the present international regimen of durable disorder. Concluding remarks follow, including ideas for further research.

2 E-Government in Jordan

Jordan is a textbook case for its vision to become the Singapore or Bangalore of the Middle East in the adoption of new information and communication technologies. In its attempt to follow some of the best practices indicated by international agencies, from the World Bank to the UN, and the donors of various leading Western and Far East countries, combined with the commitments expressed by the top of the State (the King himself and the newly created Ministry of ICT (MoICT)), Jordan incarnates the new thinking and practice on how to introduce ICT to enable rapid social and economic progress. There is a variety of initiatives that may attract the interest of the observer: they regard the creation of new jobs in the ICT sector and the launch of a software industry; second, the diffusion of ICT in rural areas and the promotions of e-learning (projects like “Connecting Jordanians”; or broadband to the schools), and last but not least the establishment of e-government. The e-government initiative is significant for a number of reasons. First, in Jordan the public sector is still the largest employer, thus representing a very important economic organization. Second, one can find in this domain many of the actors also present in the other projects: donors; public and private partnerships; foreign governments wanting to provide help, and so on. Third, there is the possibility to study the deployment of a new infrastructure inside a large, complex administration in the context of improving its efficiency but also to support the growth of the nation. This allows us to extend to the government organization in a developing country what we have learned in previous research projects about the strategic deployment and management of ICT infrastructures in the corporate world. (Ciborra et al., 2001)

The e-government initiative is being implemented under the direction of a task force, an 8-member public/private committee headed by the newly formed MoICT. The new Ministry has been created through the privatisation of the postal services and what was the Ministry of Post and Telecommunications. It is responsible for setting the telecom policy and coordinating the e-government initiative, besides attracting investment in the ICT sectors, and setting the ICT policy and strategy plan for the telecom and postal sector. In particular, the Ministry will issue the technical standards and articulate the policy for the various government agencies to bring their data, services and transactions on-line. (MoICT-Reach, 2001)

A number of Fast Track projects have been launched in 2001. They include motoring services, taxation (income and sales) services, and land registry. Next will be the G2B and G2C portals and a Government Personnel Directory. A new network is envisaged to enable government introduce knowledge management, empower and connect government staff. A Program Management Office will establish standards and protocols for interconnecting government services - together with the system integrators. Ditto for the development of a holistic view of a security strategy.

The following government departments are involved in the main Fast Track Projects:

- Income Tax Department (ITD)
- Drivers & Vehicles Licensing Department (DVLD)
- General Sales Tax Department (GSTD)
- Department of Land & Survey (DLS)

ITD, GSTD and DLS are under the umbrella of the Ministry of Finance.

Deloitte & Touche is the consulting firm awarded the contract for the analysis and design of the various processes and information requirements. Here are the principles guiding the consulting firm in this particular contract:

- Establishing proper governance structure for coordinating and promoting e-government initiatives in Jordan;
- Identifying and implementing e-services which can be deployed rapidly and provide visible benefits to citizens as a “proof of concept” for e-government;
- Implementing a common infrastructure whose services could be leveraged by all governmental entities;
- Considering using multiple channels (beside the Internet) for providing services, based on the level of their accessibility in Jordan;
- Identifying and applying the changes necessary in Jordan’s existing legislation system for enabling e-service delivery;
- Using a phased approach for implementation;
- Monitoring citizen feedback and continuously evolving e-services based on users requirements;
- Raising government employees and citizens awareness about e-government by proper communication and educational programs;
- Planning for and managing change.

In some cases, like ITD and DVLD, all the front office activities were analysed by the consulting firm. In the other two projects only a selection of front office services were studied due to time constraints.

Based on the projects’ final recommendations, the MoICT will issue a Request for a Proposal (RFP) to select partners for the purpose of creating the detailed functional and technical design, carrying out the implementation and launching of the relevant e-government services.

2.1 Emerging risks

Since in general e-government is about the deployment of a complex ICT infrastructure, it faces a number of risks relative to implementation, project management and policy, all risks that have to be appropriately managed.

It is still too soon to investigate into the actual risks of the Jordan implementation effort. The Fast Track projects are just completing the analysis and design phase. But already at this early stage a few difficulties, some of them unexpected, have emerged. Whether they are going to be just momentary hurdles, or severe obstacles is too early a call. Here is a flavor of the most important ones, those that in the private sector and corporate world have often proven to be cause of major disruption or at least significant drift in use.

The Jordan public administration is not a green-field site as far as IT is concerned. Rather, each Ministry, department and agency has been implementing over the years a number of applications. All these efforts come to represent the "installed base" of existing systems and applications with which any new e-government initiative has to deal with. There are Ministries or areas more advanced than others and a variety of infrastructures, often incompatible or plainly not integrated or networked. Thus, when considering the Fast Track projects, the one at ITD is relatively more advanced, or ranks higher on the "technical readiness" scale. In other services (e.g. Sales Tax) new systems have been introduced just at the time of the analysis, but due to lack of involvement and user participation, there is a resistance in acceptance. The DLS uses a database that does not support spatial techniques. Thus an upgrade is in order. These and others are stand-alone systems. The analysts have found duplications, redundancy and low quality of data. Note that these negative aspects have been observed not in relation to manual procedures and files but in connection with the already automated ones.

In sum, the IT readiness is uneven: it is a matter of technology (old and new platforms coexisting and being implemented all the time, often independently from the e-government projects); the de facto independence and autonomy of the Ministries; the different practices in systems implementation; sometimes inappropriate user involvement and training; the need for a deep culture change towards the new ways of working, and so on.

The high risks and complexities of such a transition point to what may be the dangers hidden in this apparently banal application. Put in a nutshell: successful implementation and delivery of e-services demands the transformation of some parts of the Jordan state from a security apparatus into a transparent (democratic?) service agency, where a driving license is not a public security or general intelligence document, but just a quasi commercial product.

For example, a mundane application such as the driving licence, chosen because of its low risk and high yield in terms of buying the citizens into the idea and experience of e-government, turns out to be already in the analysis phase a hologram in the small of the difficulties of e-government in a developing country:

extremely complex; high risk; and calling into question the role of the state in relation to its citizens: a service provider or public security?

Finally, note that the case shows the two effects of modern technologies: ordering and revealing. E-government allows an unprecedented ordering of transactions within the administration and between the administration and outside institutions, firms and individuals (citizens as customers). At the same time, though, its deployment can proceed only by revealing the nature of the administration, and more in general of the Jordan state, and the contradictory requirements for its transformation.

3 Customer service?

The epochal transformation of a government department from a public security/military culture into a market-like service is just one extreme instance of the changes implied by most e-government applications.

This is part of a wider shift whereby citizens become customers, as recommended by the New Public Management movement. (Barzelay, 2001) However, such a move has wide-ranging implications (Fountain, 2001), which can explain the difficulties today's prevailing style of e-government applications are encountering.

First, the notion of "customer" entails a number of market mechanisms, which cannot be completely transferred to a public administration possessing a monopoly of the service. For one thing, on a competitive market the customer has choice, which is not always the case for the citizens/customers (who else does supply driving licenses besides the DVLD?) Also, citizens have no real exit option and prices do not reflect the matching of supply and demand for this service.

At a closer look, another difference stands out: firms try primarily to satisfy shareholders and not customers. Customer relationship management does not have a value per se, but only as an instrument to increase shareholder value. And in order to do that, firms proceed to segment the market; to implement various forms of price discrimination, all tactics that can increase the inequality among customers. But equality of service is in principle the goal of an administration providing a universal service…

Furthermore, any attempt to govern transactions through market-like mechanisms implies a certain degree of standardization of the service provided. The less such a service can be standardized, the more the bureaucracy, especially the one facing directly the customer/citizen (the so called "street level bureaucracy"), will be involved in stereotyping, simplifying, and basically serving those clients who are easier to serve (given also the fact that the bureaucracy is subject to internal performance monitoring). This will generate a new form of discrimination not based on price, but on access and relative ease of interaction.

In the private sector service quality, customer service and handling of voicing customers correlate with socio-economic status. In the public sector the more service provision and customer complaint handling is market-like, the more it will end up reflecting citizens status inequalities.

More in general, the perfunctory equivalence between citizens and customers place them in a special role, the one of rational choice theory consumers. Whether this fiction works in actual markets or not is of secondary importance, given the fact that the variety of roles played by citizens cannot be reduced to the one of consumers with clear preferences influenced by prices and quality. The public administration operates in areas where goals and preferences are ambiguous, and hard to be identified and expressed. Especially for those vulnerable citizens lacking scope for choice.

Customers making choices within a market context tend to be involved in transactions of a narrow scope and instantaneous nature. The market is a wonderful means to aggregate such spot encounters between demand and supply. However, the more a transaction is specific, sticky and long term, the more markets tend to fail and must be governed by long term, integrative arrangements. The citizen, member of a democracy, a community or even a police state, is in for a long-term relationship, which cannot be fully split down into transaction bits to be aggregated. The expression of political, long lasting obligations and the development of a polity are hard to obtain through purely aggregative relationships. Such processes become possible only in the context of a participatory democracy, where popular sovereignty matters more than consumer sovereignty. State governing bodies and administrative apparatuses are all part of the effort to “govern” the population. They are the arm of politics, seen as the art of conflict resolution. But the latter is at odds with market segmentation and demand aggregation.(Fountain, 2001)

It is then not so obvious that by introducing more efficient electronic transactions, a bureaucratic, or military administration will become more transparent, efficient and market-like. First, it will maintain its monopoly. Second, it will be compelled to standardize services so as to be able to offer them electronically. But such a standardization will entail stereotyping, segmenting, and privileging those segments of the population that can access the services more easily. Democracy will not be increased nor competition; and favouritisms and bribery might simply be offered to new intermediaries. Is it all about agencies as efficient e-service providers or political institutions as instruments of democracy? The irony is that the two cannot be disentangled, and the provision of efficient e-service may require dramatic transformation in the governance of the population (an issue of governmentality, as Foucault would point out (Burchell, Gordon and Miller, 1991)).

In the case of the Jordanian public administration the e-government initiatives begin to reveal the incongruence of some aspects of the organization and institutions, which are not conducive to the implicit tenets of the new models. But more in general, e-government will further unveil the contradictions, already embedded in New Public Management, that is how the re-ordering of citizens as customers and the re-shaping of the administration as a firm operating on a market are bound to meet institutional mismatches.

4 On drift, aid and durable disorder

The trajectory of e-government in developing countries cannot be identified and understood by looking at the technological features only, or the dynamics of the local public administration in isolation, or development as a separate issue. Rather, it needs to be “reconstructed” bottom up by observing the interplay between the various actors involved in the automation initiative. In the case of the Kingdom of Jordan, they are the various international agencies; foreign governments; consulting firms; software and hardware vendors, and so on.

We have seen the inner contradictions and the limitations of the models and methodologies the main actors pursue, propose and deploy. To be sure, they invest into and support on an ongoing basis the idea of e-government. They are driven by the promises of the technical innovation, the key tenets of the New Public Management manifesto, and the marketisation of the state as the paramount means to achieve economic growth and social progress. But, we have observed, they seem to be blind: their blindness prevents them to appreciate the risks and pitfalls of implementing the new models.

One wonders, then, what keeps their thrust and gives meaning to their attempt at aligning development and governance through technology.

Our final analysis of the phenomenon of e-government initiatives for LDCs needs to place the specific tactics of the various actors into a broader framework, able to offer a new interpretation to their projects, initiatives and concrete actions. We find the elements for a new interpretation of the issues emerged so far in a document, the National Security Strategy of the USA (September 2002), which summarizes the fundamental traits of the present world economic and political order. It is this meta-order, which is set to frame the reforms such as e-government and envisages a common model of national governance centred on the idea of the minimal state and free markets:

> “ … the United States will use this moment of opportunity to extend the benefits of freedom across the globe. We will actively work to bring the hope of democracy, development, free markets, and free trade to every corner of the world. The events of September 11, 2001, taught us that weak states, like Afghanistan, can pose as great a danger to our national interests as strong states. Poverty does not make poor people into terrorists and murderers. Yet poverty, weak institutions, and corruption can make weak states vulnerable to terrorists networks and drug cartels within their borders.”

In the National Security Strategy the link is established between the danger posed by “weak states” and what can happen within their borders, and the need for a countering influence, based on the ideas of free markets, trade, democracy and development, to be pushed across the globe, in every corner of the world. Throughout this document aid, reform of the state, and free markets are intimately connected with the issue of security.

Let us, then, take the issue of security seriously, as the source of this White House document warrants, and look at the current efforts of e-government initiatives in developing countries according to this different, more global perspective.

Any successful technical and organizational innovation requires a stable alignment of the actors, from the designers, the vendors, the users, the sponsors etc. (Latour, 2001). The successful implementation of e-government is no exception. In this respect, what is striking for the Jordan case, as well as other cases of e-government in LDCs, is that the implementation of the projects takes place through multiple interventions of ministries and departments; aid agencies; consulting firms; NGOs; multinational companies; multilateral financial bodies; foreign states; regional entrepreneurial associations, and a variety of alliances between them.

Note that many of these actors are private organizations, and a first, superficial reading of the alignment required today by e-government consists of complex and articulated forms of private-public partnerships, where the presence of powerful intermediaries like the computer vendors, or the global consulting firms, indicates that aid in this domain is more and more delivered by non state entities.

This would be yet another sign of globalisation: the weakening of the traditional influence of the national states, in favour of a more fragmented, overlapping set of private and public intermediaries. And one could conclude that states are delegating, if not outright subcontracting their tasks and resources dealing with aid to more specialised and professional agencies. This would be part of the increasing externalisation of activities traditionally performed by states, now delegated to multinationals and NGOs.

The US Security Strategy document is important in this respect because it suggests a different interpretation. The public-private networks and contractual regimes of aid practice are the new means by which “metropolitan states” want to achieve security on a global scale. Underdevelopment is now dangerous, not only for the people directly immersed into it but for us as well. Under the rubric of human security the concerns for stability of the metropolitan states have been made to merge with the social agenda of the aid agencies. If poverty and underdevelopment encourage conflict and instability, then sustainable development, of which e-government initiatives are an essential factor, can also play a security role. The networks of aid practice become the ways for the metropolitan states to cross the borders of the marginal, weak states and implement flexibly new forms of governance, both of the economy and the state. (Duffield, 2002)

Typically, e-government and its counterpart, the self-regulating market, are technologies of control (Beninger, 1986) able to shape the networks and systems of opportunity within which LDCs operate. In this way, control by the metropolitan states is not direct or centralized but flows through a network of open circuits that are non hierarchical, but rhizomatic.(Rose,2000)

Note, also, that behind the notion of “good governance”, as supported by e-government, a subtle shift has taken place: underdeveloped, potentially dangerous states are now monitored and regulated as a social body. Through free markets, accountability, transparency, and corruption curbing policies, it is the very culture and conduct of people that needs to be impacted. In other words, through ICT and

New Public Management ideas what one tries to affect is the governmentality of the weak states, that is the way they think about their own functioning and reform, by providing a very specific approach to regulate the conduct of citizens, e. g. by transforming the latter in rational choice customers.

More in general, modern regulatory techniques create the possibility of modulating the behaviour of populations through controlling processes and networks, rather than disciplining individuals like in the old colonialism. And this takes place at a distance or with little territorial presence (of experts and functionaries), rather than through territorial occupation (as it used to happen with colonialism).

Like the computer & network-based systems they end up implementing, such techniques involve continuous measurements of conduct, risk and readiness. You “invest” in aid where you get the fastest and most reliable return. So, you need to measure throughout. The same applies to the management of the projects and the comportment of the experts. (Duffield, 2002) Information technology represents a driving force in allowing for the new way of accounting and risk analysis to take place.

The new flexibility and accountability of the development aid practice are valued because of the changing geopolitical situation. From a political landscape made of strong states facing each other competing through political alliances, nuclear deterrence and arms superiority, and where aid was a means for strong states to seek alliances with weak, but strategically positioned states in the less developed parts of the world, we move to a landscape characterized by low intensity regional conflicts; glocal terrorism, where the old forms of alliance and deterrence are not effective any longer. The present situation has been described as one of “durable, endemic disorder”.

We submit that e-government initiatives are part of that new portfolio of aid projects, for which “a new possibility of achieving security has emerged in which non state organisations now provide innovative forms of mobilisation, means of intervention...in the interest of global liberal governance. But far from solving in this way durable disorder, the latter continues to subsist as a side effect of the very way metropolitan states try to address the new security dilemmas and develop the new public-private systems of influence.” (Duffield, 2002)

A number of elements seems to support this interpretation. First, the changing nature of war and security in the last few years and the well-known events happening in various parts of the globe. In the borderlands nations conflict destroys the social fabric; widespread human right abuse and the fact the civilians are deliberate targets become organic components of the new stile of war; ethnic cleansing provides a strong justification for intervention and a stronger than before “will to govern”. Except than for the extreme cases like Afghanistan in the most recent past, this will to govern through reform cannot find an expression in a direct intervention. Rather, it becomes the engine animating the new style of governing at a distance through the public-private networks of aid and the reforms programs such as e-government.

There is a strong parallelism between modern technology as understood by Heidegger (see above) and development. Indeed, development has always involved some form of mobilisation for order and security. Today, order is achieved by allowing the archetypal self regulating process, the market, to install itself and expand, by creating and enacting those institutions that allow the free market to emerge. The minimal state accompanied by new public management and e-government ideas is the typical reform that the public-private network of aid practice seeks to deliver. Such networks set up originally as short-term remedial interventions tend to become a permanent framework giving coherence and linking aid and political actors. In Jordan, for example, the public-private network includes actors in the names of UNDP, USAID but also Cisco, Microsoft, EDS, besides the key Ministries.

While on the surface the issues raised by the G8 Digital Opportunity Task Force cover the relative e-readiness of a developing country, the digital divide, higher levels of efficiency through marketization, and more transparency, the present study of e-government applications suggests that the G8 agenda may be a façade of what the phenomenon of e-government policies for developing countries is not. Below the surface, the driving forces are order and security in a new war context; the market as achieving self-regulating order without direct intervention; aid as a technology of control and ICT as technology enabling such strategies.

Development, here understood as a technology for governance, a way of ordering the relationship between people and resources to produced desired outcomes, meets the paramount modern technology for control: ICT. The meeting is triggered by the dangers of the new war and the ensuing concerns for security. E-government is linked to the idea of good governance and thus the two projects converge within a framework that wishes to reduce the role of the state, to encourage non – state mechanisms of regulation through privatisation, markets, private enterprise and techniques of new public management. Development and e-government: two technologies for ensuring order and control join forces to face the threats to security posed by the new war. Will this marriage deliver?

As shown for the case of sophisticated information infrastructures in large multinationals, (Ciborra et al., 2001) the deployment of ICT as a technology for control is never fully effective, and tends to generate a variety of side-effects and out of control dynamics that threaten the very management control strategy that dictated their introduction. We submit that the same may happen at the global, geo-political level. The metropolitan states wanting to control at a distance the borderland states through reforms and new infrastructures implemented through the flexible network of private-public aid agencies may fail, and their attempts backfire leading to more systems unevenly distributed within administrative departments and agencies, knowledge spread unevenly in the population, more autonomy and scattered resistance. The collateral effects of the new alliance may then contribute to procrastinate the durable world disorder, as well as corporate and administrative disorder, that is reinforcing a system of governance where systemic collapse is avoided through the constant crisis management and relentless introduction of sophisticated technologies, and at the same time not addressing root problems and creating new occasions for drifting of institutions, states and technical infrastructures.

5 Further research

A whole range of promising research topics related to e-government emerge from the last, more comprehensive perspective. What follows is a first selection.

ICT in actual development

Forget the dubious links between ICT in government, free markets and development. A new study of the role that ICT can play in developing countries should focus instead on the link with the "actual existing development". (Duffield, 2002) New scattered wars generate a variety of businesses: trans-regional supply and service chains transporting arms, people, documents, and so on generate a shadow economy opaque and non-territorial of impressive proportions, according to some observers. Organized, scattered violence generate an informal economy, labelled the actually existing development. The latter has emerged not because of "official" development: it has arisen despite of it. There are no statistics about the extent and quality of the use of ICT in this shadow sector of the economy. But whatever is being deployed, that would be an important evidence to illustrate the multiple roles played by technologies for coordination and information in actual development.

Risk analysis and other technologies of ordering

The vast deployment of the new technologies of control and governance at a distance is supported by the systematic adoption of the new public management models, whereby professional experts are substituted by managers and administrators, and new extensive accounting systems and performance monitoring techniques are applied. In particular, consider the logic of risk analysis (Power, 1996) through which every aspect of a complex reality is ordered and made calculable so as to be amenable to control and governance, from the degree of danger of a war zone, or the hazard posed by a rogue state, up to the e-readiness of a nation, the chances of success of an aid intervention and the risks of a systems development project. Risk analysis in itself is a technology aimed at ordering reality to set it up for calculation, reduce uncertainty and colonize the future.(Dean, 1999) But this way of proceeding creates new dangers, new ignorance, new uncertainties and…new risks.(Beck, 1987)

The new knowledge frontier

The increased ordering of resources and relationships made possible by the techniques of new public management, project management, quality control etc. may clash with the local, idiosyncratic knowledge which characterizes the scattered territories and communities in the new war. Frequent knowledge gaps are bound to appear whenever the two logics meet or most probably clash. These are the new zones of uncertainty, and hence risk. These are the pockets that keep disorder alive and thriving, where new knowledge is created, which flows outside the circuits of securitized development aid, and e-states. What are the characteristics and dynamics of these knowledge flows? How are they managed? What innovations at the margins does it generate?

If the analysis so far captures at least in part what is going on in this domain, it is highly likely that in the world of durable disorder institutions and organizations, both state and private, despite, or rather because of the relentless action of ordering, calculation, planning and control, end up operating more and more as pasted up assemblages. They do deliver governance and knowledge; and they plan and influence the allocation of resources and the conduct of people, but with much less overall coherence and consistency. They resemble as Foucault, and lately Rose (1999) remind us, a Tinguely's sculpture machine, full of parts that come from elsewhere, strange couplings, chance relations, cogs and levers that do not work as expected, but that produce nevertheless policies, actions and social dynamics. Its precise mechanical components and its disordered assembly create multiple zones of uncertainty, platforms for imagining new combinations and enacting local improvisations.(Ciborra, 2002) It is towards these interstices that attention should be given to identify those natural experiments, transgressive initiatives, and alternative practices in technology design and use. These could represent the seeds of models alternative to those based on the pursuit of order and control, being today deployed uniformly across the globe in private as well as public organizations, in developed as well as LD countries.

In a more normative sense, one would need not only to understand how many of the present models, methods and solutions contribute to durable disorder in corporations and states, but also to find out and actively cultivate all those instances of alternative designs and approaches, present in the knowledge-intensive business within the metropolitan states and in the communities of the borderlands states where new practices and models emerge daily.

Again, it was Heidegger (1987) to suggest, in discussing the danger represented by modern technology, that where the greatest danger lies, the all encompassing ordering effect of Gestell, the same essence of technology must harbour a "saving power".

Along the fragmented knowledge frontier traced by the advancing technologies of ordering and the resisting idiosyncratic practices, a frontier that cuts across organizations, states and communities in advanced as well as in LDCs, lies today the new laboratory for critical research on the dynamics of e-government, and more in general of complex ICT infrastructures.

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Is HIS View Still Relevant? Three Guys Glancing at Quality of ISs

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Abstract. Quality of information systems (ISs) and information and communication technology (ICT) products is still a difficult question. Quality is approached here as tradeoff between cost and profit. The actual quality is interpreted here as the result of a cultivation process, which aims to reach appropriate level on product's refinement degree. We use the potential invested in Nurminen's three perspectives, namely systemic-theoretical, socio-technical and humanistic to show market-oriented and evolutionary-based interpretations of quality in ICT products. In this paper, the first two comprise focus on technical quality and organizational support view. The humanistic approach (Nurminen 1988) and HIS-model (Eriksson and Nurminen 1991) is the locus of inseparability and act-orientation. We use marketing view from our experiences from academic ICT education as well as software business to reveal our thoughts. The result is that the quality of an ICT product as a degree of refinement fits nicely into the three perspectives offering some guidelines. The market-oriented guidelines concern individuals, companies and societies that are involved with the use of these products. Conclusion is that humanistic approach, as any of the three, has its strong position among other perspectives. The idea of degree of refinement attempts to avoid situations where some perspectives overcome others, or some perspectives are overlooked. Humanistic perspective provides useful concepts, insightful philosophy and welcomed values to culture our thoughts of ICT usage.

1 Introduction

We had the privilege to participate at Nurminen's lectures and seminars from late 1980's at Turku University. His thoughts and ideas were appealing, yet provoking, but still idealistic and thus fruitful. Still, we felt that amongst others humanistic approach was not easy to combine with other information, knowledge and experiences confronted at studies, and later in teaching and in ICT business. However, almost as often it provided us refreshment, a full-fledged paradigm that "takes a stand".

Nurminen presents an ideal of Human-scale Information System (HIS) that comprises of the essential inseparable features of a worker and his tools in an organizational setting. This is an appealing idea that caught our attention already in early 1990's. However, because the humanistic perspective "having emerged so recently, the forms it takes are still numerous and heterogeneous" (Nurminen 1988, 124) and it emphasizes the status of an individual, we still found difficult to clarify our thoughts of ICT development and deployment into unified set of principles. Here is one (more) attempt.

What HIS-model and ideas of inseparability and act-orientation (Eriksson and Nurminen 1991) gave us is another way to look at the ICT deployment "markets" (or networks) where software, applications, systems, information society strategies, education etc. "business as usual" is made. When observing and studying the use of ICT products, many views and approaches seem to fit at different phases and levels of action more or less accurately. Now we want to again (we did several IS evaluation projects during the 90's) look at some current trends in ICT from kind of marketing perspective.

The concrete applications of the three perspectives and especially humanistic approach are not evident, yet we understood that a connection between quality and the perspectives exists.

The role of and views to ICT in current society are manifold. This multiplicity of values and views can be regarded as a preferable state of affairs for the providers and the consumers of ICT. As being part of Information Systems and Computer Science research community for over a decade and having experience of the current ICT in ISs and software companies, we admit that in our work "daily routines" are quite vivid yet exhaustive. The intensity of developing new products and support systems, investigating possibilities of future technologies and last but not least, improving the status quo by delivering sort of legacy systems creates a "hands full" situation. There seems to be little time to stop, define exact measures and quality criteria for new ICT products because many of those are constantly evolving and redefined having short lifecycles.

We apply the marketing view to broaden our insight into quality of ICT products. From the perspective of a product's lifecycle, marketing view is used already during the investment of efforts and resources from the very innovation moments to a steady-stage of mass production. On the other hand, markets are constantly seeking new ICT "killer applications". Through marketing approach, we deal with applications that appeal interesting for different perspectives. We investigate with our subjective and contextual ICT sensitiveness some understanding or explanation to the concept of quality of ICT products for individuals, companies and society.

2 Degree of refinement

What is the measurement of quality of ICT products based on? The ever-increasing and evolving evaluation of ISs and software seems to be too manifold to be fruitful. Nurminen's three views offer a framework for interpreting individuals, organizations and societies using ICT. Clegg and Hardy (1999) see this kind of paradigmatic discussion as a signal of crisis in a positive sense in a research field. Thus, Nurminen’s work is an attempt to pinpoint the imminent situation and direction to where ICT is heading. Focusing on individual in this context certainly appears as contradicting approach.

ICT field is so emergent and turbulent that trying to keep up with the latest news makes things even more complex instead of clarifying the current situation. For example, “the associate editor of the Information Resources Management Journal articulates a way to position MIS for the future. Current enterprise systems do not work. Maybe the reason for this is that they are not based on careful empirical research. Neither are they based on proven methods from BPR, lean, or quality paradigms. If this is the case, what is enterprise systems based on?” (Paper 2003). We do know that “new technologies expand the limits of the possible” (Kling 1991, 87) and new systems support interesting means for reducing the complications of current work.

The difficulties of quality relate partly to the expansion of limits. As this can be seen happening in all areas, it is question for more than one perspective. We put quality concept aside for the sake of degree of refinement what we see as more “sensitive“, intentionally not trying to be too formal. Quality attaches too much to concrete measurements of quantitative and qualitative nature with minimum and maximum values. The degree of refinement is more subjective at its nature, and therefore, in a way, easier to apply. However, this creates pressure to the individual to identify the criteria. We formulate degree of refinement as the relationship or ratio between the ideal product and the real product. Degree of refinement of a product is high if the ‘raw material’ used are cultivated to a level where any additional attempt to increase the degree would be too resource (time, money, effort etc.) consuming compared to the gains. This means that a satisfactory degree of refinement is actually same as high (enough) degree of refinement in some cases. This seems usable approach for purpose of assessing the manifold aspects of ICT product’s quality issues, including the assessment of satisfactory level of an ICT project.

2.1 Confronting the Degree of Refinement

The three views relate here to three areas of ICT development that have different cultivation needs. The systemic-theoretical approach is tested when marketing basic data management and processing systems, or operating systems to organizations (or individuals as members of society). The socio-technical approach nurture views of organizations and individuals where the managers of organization are trying to optimize or create additional value into work processes. Finally, humanistic approach endeavors on the individual user and his ability and will to contribute to critical work approach (e.g. mobile and ubiquitous information systems).

Next, the degree of refinement is constructed with the combination of the three perspectives when evaluating ICT products. The systemic-theoretical approach is important in technical products, but it is not enough (e.g. experiences from mobile phone applications). Humanistic approach helps to evaluate the degree of refinement from the use context of an individual actor with his or her own personal use experiences. Socio-technical approach places the product into work collective in an organizational setting and questions social and work organization issues (e.g. decision making in work processes). Therefore, the degree of refinement is evaluated in the organizational and technical (tool, methodology, architecture) context, in which person's use experiences connect the product to the holon (Checkland and Holwell 1998) of related use and work situations.

How then to approach different situations of product usage and design? The three perspectives are situated. For example, when evaluating the usage of personal mobile phone, mobile phone applications certainly have technical (systemic-theoretical) dimension, and certainly some humanistic would be nice to stress the requirements in the actor's use context as a natural part of that actor's life. One could say that the socio-technical dimension is not so important in this case. On the other hand, especially the socio-technical dimension could be helpful to reveal the "work processes", communication and coordination patterns between one and many, individual and organization. We suggest that we need all three views to evaluate the degree of refinement but emphasis differs from case to case. Arguments for using emphasis with perspectives rise from "real-world"; the functional approach appraised with "quick and dirty, close to market output" functionalism.

We also suggest from market and product development perspectives that emphasis on the three perspectives evolves via products life cycle. However, there seems to exist no pre-defined pattern of how these three perspectives are used and how the evaluation criteria are recognized. Evaluators' experience and understanding of the product within the evaluation context is of major importance. One way is to proceed with technical gadget via socio-technical experiments into humanistic valuation, and back and forth, and all over again. However, one could start with humanistic-based conceptualization of one's work, and relate some systemic-theoretical and socio-technical issues along the product development.

For a product, we try to define a set of essential and basic criteria for each perspective. The conception of an ideal product that the degree of refinement is compared to allows us to make simple setting: the more criteria of some relevance we generate to each perspective, the more importance it has for that product in that evaluation context. If we do not generate all of the most important criteria or we make mistakes in selecting them, markets quite rapidly return the product to the design table. Either we have made an unfinished product or we have misunderstood the essential criteria. Therefore, the "markets" in the evaluation context are simply and in a cruel way the ultimate indicator and guide to identify the right evaluation criteria. Due to markets ever-changing nature, markets do not make it easier for us to follow what are the most important criteria and weight between different criteria at a particular point of time.

In these cases, we have to learn from our mistakes and fulfill our criteria and products, and try again. This is the cultivation process of product’s degree of refinement.

3 Cultivation process of degree of refinement of an ICT product

The cultivation process is about evolution of product and refinement of its criteria at different phases of the life cycle. Now we examine this from three views: development, marketing and use.

When marketing several types of systems, the three perspectives are valuable. The three perspectives and degree of refinement guide the process of designing and developing of ICT products. The dynamics of degree of refinement can be studied, and different settings can be built to construct products. However, in traditional settings we can find following situations:

- To develop a product we need all three approaches: emphasis varies in different phases, but because cultivation relates mainly to systemic-theoretical perspective, there is a danger that the humanistic perspective is left out.
- To market an application, we might have to build upon the three views. However, as the social and technical aspects are seen from managerial perspective, which culture the means of functionalist paradigm, there is a danger of neglecting the humanistic perspective.
- To use these applications and systems we need to consider the installation, training, integration and evaluation, including maintenance. These elude things from issues directly connected to the daily work of an individual worker, so emphasis is again on the two other views than humanistic.

The three perspectives have their own criteria. There are several ways how these form a coherent whole. Some kind of hierarchy of perspectives is possible. Also parallel model is possible. Yet, taking the marketing and financing into account, we have to admit, that in different phases of the life cycle of a product (or service) we need the product to have good enough evaluation in some criteria to further develop it or to justify its further use. Thus, there is no need to place order upon the perspectives, rather than in education of the developers to recognize and work with cultivation process of product’s degree of refinement. This can affect also from financing to product development, as they put emphasis intentionally on certain perspectives based e.g. on their intuition.

An example: if you have made an innovation, but you do not have enough capital to develop it further, then it should be enough to increase one perspective into appropriate degree to make the innovation appealing. After this the investors should be able to “see and feel” the justification for further development. Which one is the right perspective, depends on the case. The following phases in the evolution of product's degree of refinement add features to the total product and all perspectives. This elaboration continues until additional features are no longer in range of cost/benefit. The addition of features in the cultivation process is most likely a process of compromise in every sub-field.

4 An illustration

The cultivation process is now set up. Next, we illustrate the evolution of an ICT product by questioning the order and degree of refinement at each phase of the evolution. One assumption is that generally the original development work of an ICT product contains mainly system-theoretical perspective. In later phases, more and more socio-technical issues are emphasized, and finally humanistic perspective is applied (when there is nothing else left) to finalize the product.

We do not believe that the ultimate goal or result would be mainly humanistic emphasized system or product, rather than that the process for higher degree of refinement would have an inclining humanistic tendency. The phases of the process of cultivation could also explain why humanistic perspective seems to be neglected in tight-scheduled and resource-optimized development projects. In practice, emphasis seems to be mainly on technical, engineering and organizational issues, which are somewhat aligned with the emphasis in ICT education and personnel's backgrounds. The result is that development projects easily tend to mistreat the perspectives needed for each phase in question.

Next, we use HIS-model and the presented approach in intelligent mobile phone based applications to show some up-to-date relevancy, instead of more traditional examples, such as organizational ISs (e.g. ERP) and their development.

4.1 Systemic-theoretical perspective

It is easy to accept the observation that functionalist paradigm is still going strong (Goles and Hirschheim 2000), and that it seems to do exactly this domination as long as there are pressures for "quick and dirty, close to market output, both in teaching and research. This should keep functionalism alive and kicking…" (Willmott 1993, 706, in Goles and Hirschheim 2000).

From the systemic-theoretical perspective, we study products or services in mobile wireless applications. Typically, these products situate at early phases of the evolution as additional value for mobile phone users. In this category, the killer-application is SMS service. Clearly, the marketing has succeeded to fulfill the unspoken needs of mobile phone users. Alternatively, maybe also in this case a simple technical innovation has just contained the right mixture of refinement degree. There are, however, many services developed by companies that have not succeed.

The failures cannot have been avoided by marketing alone, because the development did not actually considered users' needs. Emphasizing use situation and usability of this product would not have been sufficient either, because the product was not seen useful or value adding from users' viewpoint in the first place. Thus working mainly from systemic-theoretical perspective is not sufficient, and we need other perspectives to create better versions for product and service evolution to gain success.

We can conclude that in general when having only technical functionality as the main criteria, SMSs etc. services fulfill these systemic-theoretical based requirements. Yet in this perspective, many so called services can be interpreted as vain, if we add additional perspectives to our analysis. This can explain some of the mistakes and failures in mobile phone applications. If we have to find something good in this, it might be that adding these somewhat experimental services to the technical architecture has been quite inexpensive, and at the same time, we have gained valuable experience. Adding other criteria from socio-technical and humanistic perspectives, we realize that the refinement degree of mobile phone has been quite moderate at the early stages of additional mobile services.

4.2 Socio-technical perspective

Socio-technical perspective relates closely to e.g. development of ERP systems. This contains ISs development in improving and innovating work processes.

This perspective provides our mobile phone example an integrated wireless task management and reporting applications. This system has its basis in simple system-theoretical solution, SMS. Intelligent mobile phone with so called smart form applications can receive, report and assign work tasks (e.g. service requests). A company using this system has attained significant improvement in work processes: payable work time has increased, customer service has improved and work management and planning have become more fluent.

Thus, the criteria used in development have broadened from technical functionality to improvement of work processes and ease of use in work situation. The system-theoretical perspective with its criteria is now parallel to socio-technical perspective and its criteria.

These socio-technical criteria can also affect the marketing of these systems. Intelligent mobile phone and SMSs as a technical application may already have fulfilled requirements of some target group. However, taking a broader perspective may provide us fields of human and social action that allow us to enter into marketing areas that seemed earlier non-productive, non-profitable and non-interesting. This expanded space of possible actions in development, marketing and use provides greater opportunities to success. Moreover, as we continue our analysis, we increased the degree of refinement of the ICT product.

4.3 Humanistic perspective

Wireless applications and mobility are becoming the new mega trend. This is for example the vision of CEO of Nokia, Jorma Ollila (Nokia General Meeting, 27.3.2003)

High-tech ICT products with full set of properties (e.g. intelligent mobile phones) still provide the basic one-to-one (or one-to-many or many-to-many) communication in various forms, e.g. SMSs. The technical apparatus and infrastructure, and developed applications create possibilities to integrate this to organization's ISs, such as work management. In addition, the user faces a lot more than this: the connection makes the user a member of the information intensive society and the internet containing increasing amount of public and private services. We conclude that it is not just one IS or product, rather than time and space independent part of several different system concepts.

The common view to this is the user and the possibilities offered by humanistic perspective to understand the complex object that always seems to escape its analytical captor. HIS model has concepts to analyze this perspective broadening the two previous in a valuable way. Development work applies new features and possibilities of ICT resulting as iterations and increments in products and services. This is quite characteristic to humanistic approach (Nurminen 1988, 157). In parallel with system-theoretical and socio-technical perspectives, the humanistic perspective helps to conceptualize the individual as an active, intelligent member in organizations and society.

In this last phase of product's evolution, the criteria of an ICT product should contain all three perspectives. The freedom of an individual, improvement of organizational performance and using the public services of our society can be used in marketing. Through this cultivation process, the degree of the refinement of our product reaches its highest potentiality that the current state of technology has to offer or needs to offer to survive and to be attractive for the markets.

One possible evolution of ICT products' cultivation process is then the proposed phases of system-theoretical, socio-technical and humanistic, in this order. In the next phase, the first version of communication device with SMSs was developed to a maintenance support system that was integrated to organizational information systems. In the final phase of this illustration, the potential within the product allowed efficient and effective environment for a mobile system to individual workers to use in an innovative way. Increasing the degree of refinement is always hard in the last phases. HIS model encapsulates the natural aspects of work situations even in these emergent and mobile settings with all-reaching service concept.

We believe that there are several types of development cycles in the cultivation process in addition to the presented chronological model. In addition, it seems more appropriate to adapt the perspectives parallel in the first place. However, it is obvious that with the concept of cultivation process and degree of refinement, the last phases of development are the most expensive. Nevertheless, because this degree of refinement is essential for the cultivation process, we cannot avoid it and strive just for ‘good quality’, as this can be property of a ‘wrong’ product. To develop, market and use successful products, the humanistic perspective and HIS model certainly are appealing tools for adding that final touch to ICT products and ISs. Certainly, it is not easy, but fortunately, we as researchers and practitioners, have the right to pursue even difficult things as a natural part of our education. Thus, one suggestion is that the ICT field overall is trying to increase themes such as humanistic perspective in development, marketing, and use, but a lot of work is to be done…

5 Conclusions

There is again a decisive moment that unfortunately is not sharp or evident. The potential of humanistic perspective remains in many forms that are less unified and “numerous and heterogeneous” (Nurminen 1988, 124), and the reason may be that humanistic perspective “has emerged so recently” (ibid.). However, this may be a good thing. Humanistic approach and HIS have given us new insights in our work, yet as usual, new questions arise all the time. ISs and ICT seem to escape the more you strive for them to capture their essence into compact model. On the other hand, this is just fine, as it provides new research opportunities. The concepts of an ideal product and degree of refinement fascinate new interpretations.

The presented development, marketing and use-oriented interpretation of product’s refinement degree and related value-adding cultivation process lead us to suggest to use the potential of humanistic approach and HIS. According to Nurminen (1988) all three perspectives are needed. The use of the perspectives must be parallel and rightly emphasized varying case by case in the product’s cultivation process. In addition, we must keep the resource-based view in mind, as we have only limited resources to work with.

We conclude with an approach often provided to us by professor Nurminen in situations requiring sharp and yet broad analysis. Markku has showed us that in tricky situations there are always at least two possible solutions, namely, A and B. Then, after presenting the two he continues with C in the case the two first do not succeed to address elementary properties of the situation.

Finally, the question about quality measurement as a degree of refinement has maybe some larger theme. Shakespeare wrote in ‘Antony and Cleopatra’ something about measuring love, which makes the love worthless. The message of Shakespeare is most likely that we should not measure or control issues larger than life, because there is danger that the original phenomenon damages. Maybe our cultivation process of product’s degree of refinement works into this direction.

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Designing Information Systems for eBusiness Networks: The Return of Productivity Paradox

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Abstract. In this paper we discuss productivity paradox and the origin of business value of ICT investments, especially as we see that the present approaches in building ICT-based value networks of companies raises new productivity problems. The findings indicate that the organizations can reap the benefits of ICT-investments in terms of productivity only by managing the long term process change both at operational and management levels to match the organizational capacity and competitive position. This is achieved not by building information systems only, but by balancing automational, informational and transformational effects in the business context. We analyze three alternative approaches for information systems development against this backdrop: software engineering, business process redesign and reversed quality life cycle (RQLC by Nurminen & Forsman, 1994). There is growing evidence in favor of RQLC in designing and implementing intra-organizational systems, so we apply its ideas in the design of inter-organizational information systems (IOSs). In the inter-organizational context the importance of building of trust, creating standards, and need for openness for new type of business partners will become vital in controlling the number of relationships and adaptation processes. Finally, building on the ideas above we synthesize a model for building an inter-organizational information systems ecology.

1 Introduction

It is generally believed that organizations may make their operations more efficient with information and communication technology (ICT). However, for example productivity effects of ICT have been difficult to establish, and in practice ICT systems have been found quite difficult to accomplish successfully, especially complicated it seems to be within inter-organizational environments (Morrel & Ezingeard, 2002). In this paper we present a complementary explanation on what is a very profound reason for our profession not being capable of designing successful ICT-systems in a constant manner. The explanation is based on Nurminen's and

Forsman’s (1994) Reversed Quality Life Cycle –idea pointing out the importance of learning from experiences of actual work and new practices, and reflecting these upon the design of the computerized systems.

First, we will discuss productivity paradox and the origin of business value of ICT investments. Then we describe three alternative approaches for creating this business value and expand our discussion to inter-organizational setting. It seems that organizations can reap the benefits of ICT-investments in terms of productivity only by managing the long term process change at operational and management levels to match the organizational capacity and competitive position. Since this is quite a tedious process, we cannot but predict a rather pessimistic scenario of the future of developing systems for a set of inter-related organizations, probably exceeding the severity of the former productivity paradox.

1.1 Productivity paradox

Despite the fact that information technology has attracted the majority of investment funds during the last years it is clear that the number of people working for the ICT is growing, so is the sheer number of data processing and transferring capacity. However, the effects of these investments are regularly under heavy speculation: in the nineties there was a lively discussion on the so-called productivity paradox, initiated by a Nobel Memorial Prize Laureate Robert M. Solow ("*we see the computers everywhere but in the economic statistics*”). Recently, the discussion has been on the burst of the recent techno bubble.

In their extensive study on the lacking productivity improvement of the information technology investments, Brynjolfsson and Yang (1996) induce that there are four possible reasons for the productivity paradox:

1. Mismeasurement of outputs and inputs, i.e., the researchers have not been able to identify proper measures and indices to reveal the true value of ICT-investments; for example the change may be qualitative in nature, so that official productivity statistics do not notice any change.
2. Lags due to learning and adjustment, which means that the pay-off period may be much longer than expected, after all, and realize only after a significant time lag.
3. Redistribution and dissipation of profits, i.e., the investors (or other parties) benefit at the expense of other parties, thus leveling out the productivity growth at an aggregate level. In a similar manner, the pioneer investors may not be able to reap the profit as they have to pay steep price to the technology developers.
4. Mismanagement of information and technology, which means that companies are misallocating their funds, timing the investments poorly, or not able to improve the productivity but rather creating slack (excessive resources).

Later, Brynjolfsson and Hitt (2002) present evidence that computerization really contributes to productivity of firms in long term[1], and that those investments have provided excess returns. They suggest that computers are part of a larger system of technological and organizational change that increases firm-level productivity over time (i.e., there is the time lag). They conslude also that computers are ‘general purpose technology’ whose primary contribution is to make new production methods possible when combined with “*large and small complementary changes, including changes in business processes, organization structure and innovations in customer and supplier relations*” (i.e., there is an evident need for the management of the technology implementation in the organizational context) (Brynjolfsson & Hitt, 2002, p.2).

This has been further evidenced by contemporary researchers at more micro-level: evidently this transformation process takes time and the results can be seen only after considerable time has passed from introduction of the new system - after the information system has been adapted to the actual use context and vice versa. In reality the causal chain seems to be such a complex one that it cannot be examined with simple correlation tests. Therefore meaningful investigation of this phenomenon and also development methods of new information systems requires perspectives of both technology and organizations, and their interaction (Mooney, Gurbaxani and Kraemer, 1995).

1.2 The origins of business value

Mooney et al. (1995) propose, building on Zuboff (1988), that IT can have three separate but complementary effects on business processes. First, *automational effects* refer to the role of IT as a capital asset being substituted for labor. Within this dimension, value is obtained primarily from impacts such as productivity improvements, labor savings and cost reductions associated with operational processes. Second, *informational effects* emerge primarily from IT's capacity to process information to help decision making, coordination, communication and control processes (Mooney et al. calls them management processes). The value accrues from improved decision quality, employee empowerment, decreased use of resources, enhanced organizational effectiveness, and better quality. Third, *transformational effects* refer to IT's ability to facilitate and support process innovation and transformation. Within this last dimension the business value comes in form of reduced cycle times, improved responsiveness, downsizing, and service and product enhancement as a result of redesigned processes and organizational structures. The source of higher orders of value is the extension of the automational effects of IT to management processes, and the extension of informational effects to operational processes. Figure 1 below provides an illustration of dimensions of IT Business value by Mooney et al. (1995). It should be noted that the realization of

[1] In firm level analysis using five to seven year differences.

potential benefits requires that also development funds should be allocated accordingly (Reijonen & Heikkilä, 1999; Heikkilä, Saarinen & Sääksjärvi, 1991).

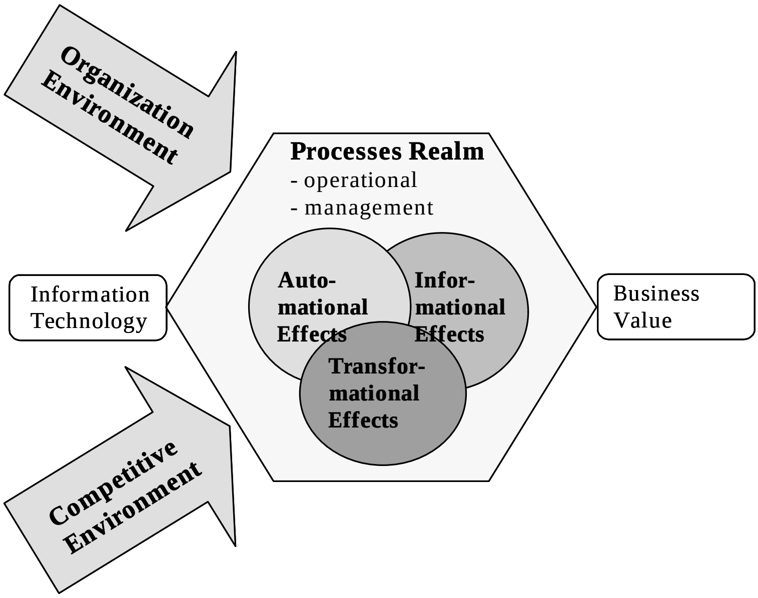

Figure 1. Dimensions of IT Business value by Mooney et al. (1995).

To summarize, it seems that organizations can reap the benefits of ICT-investments in terms of productivity by managing the long term process change at operational and management levels to match the organizational capacity and competitive position. However, although we know the panacea, there are still many companies that are not still able to do that (e.g., Paper, Tingley & Mok, 2003; Larsen & Myers, 1997; Sarker & lee, 1998).

2 Approaches to designing IS for an organization

The field of IS, and especially IS-design has traditionally had an objectivist approach to technology: By presuming that technology is an object capable of affecting social systems, such research treats both technology and organization as objects (Orlikowski & Robey, 1991). This approach is challenged by a rich line of literature highlighting the importance of interplay between technical and organizational changes where investments in IT can be seen complementary to various organizational measures (Zuboff, 1988; Nurminen & Forsman, 1994; Robey & Sahay, 1996; Orlikowski, 1996; Reijonen & Heikkilä, 1999). They propose that organizational context influences the consequences of information technology

(Zuboff, 1988) and they also support an incremental, continuous vision of technical and organizational change (Robey & Sahay, 1996; Orlikowski, 1996). Coarsely speaking – these ideas correspond with the need of management of the technology assimilation in its context. In the productivity paradox this is negatively defined as one of the causes – mismanagement of information and technology.

An additional viewpoint to this is the social construction of technology (Bijker, 1987): Information technology in general belongs to the set of learning-intensive technologies requiring substantial adaptive learning (Curley & Pyburn, 1982; Heikkilä, 1995). "*This adaptive learning is argued to require both the training and iterative ongoing learning in the use context, where training, goal-setting, and feedback evaluation alternate*" (Heikkilä, 1995, p. 16). When the emphasis is shifted from the development to the use or exploitation phase of an IS, we can also view the whole process of applying ICT as a learning process. This learning process for the use of an information system in real terms is often a tedious and long-lasting journey (Heikkilä et al, 2003). There are multiple parties and actors with differing views and needs, and various interactions with other work tasks or activities, especially when we are taking about inter-organizational IS. Furthermore, as Leavitt (1965) points out, an organization consists of at least four variables: structure (the boundaries, administration and functioning of an organization), task, people and technology. These variables are highly independent, so that a change in one variable most often results in an intended or unintended change in other variables as well, which in turn cause new changes in the system. Against this backdrop it is evident that this transformation process takes and will always take time. To our understanding this is a feasible explanation to the time lag, which was another cause of the productivity paradox by Brynjolfsson & Yang (1996).

How well do then, the prevailing schools of thought in IS design take these two major factors in explaining productivity paradox into account? We distinguished three approaches to information, communication and technology development in the organizational context: *Software engineering*, *BPR*, and *Reversed Quality Life Cycle*. We shall next describe briefly what we mean by these approaches.

2.1 Software Engineering – constructing technical system first

The software engineering approach to ICT development was introduced in the very beginning of the computer system era (Nurminen & Forsman, 1994). In this technology oriented approach, the methods and models, such as traditional life cycle, were applied to reduce the complexity of the development of information systems by cutting the project to distinctive, controllable phases. In software engineering the unit of analysis is an existing function, and the goal is to automate the operations.

In brief, the life cycle goes as follows (see also Figure 2 for the effort curve): First, the specifications of the technical system are defined systemically in detailed level. Then the technical system is programmed to meet these requirements, so the better you define it the better it will serve the final purpose. Finally, the system is put in use, and the development shifts to a maintenance phase. Most effort is spent during the design and development, the major concern being to spend enough resources in the requirements specification in order to avoid undesirable recursive loops back to the higher abstraction levels. The objective is to make a complete system that is quick and easy to implement. If there happens to be an organizational mismatch, it can be sorted out by change management.

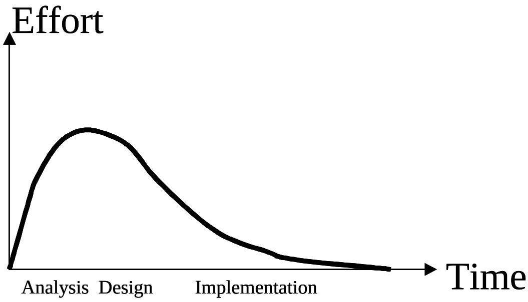

Figure 2. The effort curve for Software Engineering Process.

Software engineering is the prevailing mainstream approach, the growth of which has been boosted by the trend to outsource. This simply because of the fact that the object to be created must be fully specified in advance to avoid possible ex-post contractual disagreements.

2.2 Business Process Redesign – streamlining business first

In the 90's the IS literature started to suggest that business value is attainable only when the business processes are re-engineered prior to the application of IT (Mooney et al, 1995). Instead of functional improvement, process innovations were sought for achieving dramatic improvements in critical measures of performance (Hammer & Champy, 1993; Davenport, 1993). Previously the business processes hardly were designed taking into consideration the capabilities of IT (Mooney et al, 1995). Most traditional applications of IT were designed to automate existing functions and thus missed the real potential of computer technology to support entirely new models of how work is performed. The rationale for process re-engineering was typically to improve financial performance, most often by cost reduction. Other process-based objectives, including time reduction, improved quality, improved customer service, are assumed to result in higher levels of sales or reduced cost of production (Mooney et al, 1995).

Basically, what BPR-advocates do, they change the order of IS-design activities the other way round and put more emphasis on the business needs of the customers as the starting point for the design (see Figure 3. for the effort curve). The motto is: the simpler the better. Some studies have been able to show, that actually more emphasis should be put on the latter, implementation stages of the BPR process than originally suggested (e.g., Sarker & Lee, 1998), and that still there is a lot of unanticipated contingencies to be expected in the due course (e.g., Larsen & Myers, 1997).

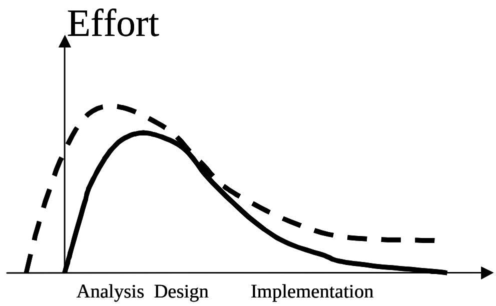

Figure 3. The effort curve for a BPR Process (marked with a dotted line) vs. Software engineering approach.

Because of the heavy burden of redesigning of business activities, the popularity of BPR has been probably less than expected. But it is still the way to approach especially inter-organizational systems (see e.g., industry-wide initiatives such as Collaborative Planning, Forecasting and Replenishment *www.cpfr.org*, RosettaNet or similar integrated systems, Kopanaki & Smithson, 2003) in order to harmonize and simplify interfacing processes.

2.3 Reversed Quality Life Cycle – change the focus to human behavior

Markku I. Nurminen and Ulf Forsman (1994) questioned the separability postulate widely applied in the traditional information system literature. Their message was that an ISD project could not be separated from the activity it is intended to support (see also the division in socio-technical design, e.g, Mumford & Beekman, 1995). According to Nurminen and Forsman the intention of the development activity is to create a system that is to be exploited in a certain context, the emphasis should be put on the use phase of the lice cycle, instead of the development of the computerized artefact. Similarly, instead of product oriented quality of the software, we should evaluate the systems based on their exploitability in their use context.

Their suggestion was that ”*the traditional life cycle model should be reversed so that the analysis would start in the last phases of the IS*” (p. 396). Then the most significant part of the process would be the use period of the system, which time to time might be interrupted by maintenance and development phases.

The reversed quality life cycle model thus ‘*expands the unit of analysis from a single IS to the entire work activity of the actors*’. In this view the actual software development phase is only a short period in the continuum of work activity. This view has also obvious implications also in the resourcing of the development activity: the phases before and after the ‘actual software development’ should be taken seriously and resourced adequately (see Figure 4).

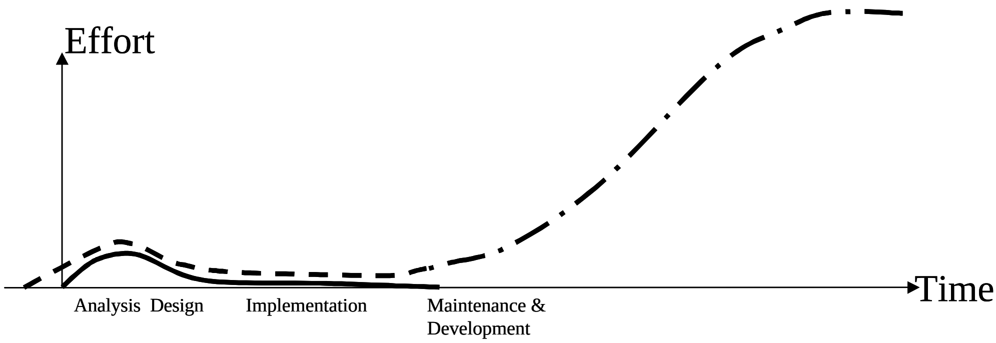

Figure 4. The effort curve for Reversed Quality Life Cycle approach (marked with dotted line) vs. Software Engineering approach.

It is interesting to note that Nurminen & Forsman have heavy support from the organization change literature: Beer et al.’s (1990) described in their series of studies how to revitalize (i.e. to introduce permanent improvement) to an existing company’s activities. Their results are well in line with recent studies on business process development (e.g. Sarker & Lee, 1998). First, the intentional change (in Table 1 called ‘Intervention’) should start from modifying informal behavior at the level of official social unit. This is to utilize the social coherence in order to achieve real change in the roles, responsibilities and relationships of the people. Only then should we start coaching, training, etc. at the individual level and make sure that the momentum remains by creating vision of the roles of the people in the near and long term future. It is also important to award good performance. Only in the last stage – after the social organization is more-or-less stable- is the time to introduce the formal systems (Beer et al., 1990). However, this does not exclude the development of the information system parallel to the organizational development, what Nurminen and Forsman actually suggest.

Let us contrast the above reasoning with the rational, process based design of IS: It supposes that the strategic IS planning (including investment payoff calculations etc.) and systems design have been carried out properly, and the aim of the software engineering, also BPR is simple: To line out how, and by whom, the work tasks are carried out using the new system, and to train the actors these new standard procedures. This is actually just the opposite from the solution observed and suggested by Nurminen & Forsman (1994), or Beer et al. (1990), who emphasize the importance of designing the intervention, aiming at changing informal behavior, before or in parallel with the design of formal systems.

Table 1. The order of changing activities in an organization (adopted from Beer et al., 1990.).

Intervention seeks to modify	***Level of Focus*** *Unit level*	*Individual or group level*
Informal behavior	1 Redefinition of - roles - responsibilities - relationships	2 Coaching / Counseling Training Process consultation Team building
Formal design	4 Compensation systems Information systems Organizational structure Measurement system	3 Replacement Recruitment Career pathing Succession planning Performance appraisal

To summarize, we can draw further conclusions – in order to reap productivity benefits, an organization should change first the behavior of the people to the new activities supported with the IS. The IS is to be designed in parallel with the development of the activities, in order to get sustainable changes in the activities. Unfortunately, this is laborious, and it will get even more burdensome when we start designing systems for inter-organizational use.

3 Designing IS for networks of organizations

In business networks there are multiple independent, but interrelated parties. Thus, it is typical for such a network to consist of multiple sets of organizational values, cultures, standards and IT architectures. Also their *production typologies*[2] differ, hindering the implementation of uniform processes. As van de Ven indicates (already in 1976), the companies are looking for complementary resources from other companies, but as they do not know each other too well, building the trust and knowledge upon each others is a crucial adaptation process: "*The emergence and functioning of an IR (inter-organizational relationship), therefore, is a cyclical process of: need for resources – issue commitments – inter-agency communications to spread awareness and consensus – resource transactions – and structural adaptation and pattern maintenance over time*" (Van de Ven, 1976, p. 33).

Mooney et al. (1995) pointed out the three differing means for how IT may affect business process, and suggested that the most powerful effects are gained when these effects are mixed and applied to both operational and management processes. This clear picture becomes more complex, however, when we think

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[2] i.e. Engineer-to-order, Assembly-to-order, make-to-order, make-to-stock, or a hybrid of the previous.

about the business process as a business value chain crossing firm boundaries (see figure 5.). Then the business value is a joint product of multiple companies benefiting from the automational, informational, and transformational effects. We should take into account all the three effect levels within the separate company but also within the networked organizations, and in the dyadic relationships between the co-operating companies. This soon increases the number of relationships beyond reasonable limits[3]. To benefit from the network, we should be prepared to meet the implementation success factors in each party and relationship. In other words, we should apply the implementation approach first within each individual company (marked with 1 in Figure 5), then in each dyadic relationship (marked with 2), and finally at the level of the whole network (marked with 3).

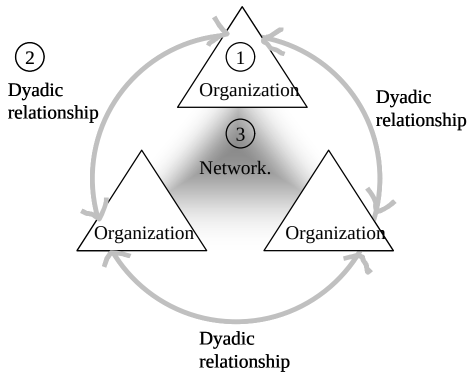

Figure 5. A simplified presentation of relationships within a network.

Now, when organizations are forming networks and are considering to use ICT to assist cooperation, it would be essential to learn from previous experiences and to apply the ‘right’ development approach from the beginning. Unfortunately, it seems that the present approach of introducing systems to a network of companies is unfruitful from this perspective (see e.g., Kopanaki and Smithson’s analysis on the strategic, structural, and operational level effects of an Continouous Replenishent System from different participant perspectives, 2003).

In line with the Reversed Quality Life Cycle there will be a multitude of simultaneous change processes within each organization. If we take seriously the lessons from earlier BPR-studies, organizational change studies, and Nurminen’s & Forsman’s reasoning for dismissing separability of technology and activities, and turning around the idea of engineering life-cycle, we soon realize the overwhelming effort needed in building inter-organizational systems for, say, electronic commerce

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3 Notice, that as the number of participants is increased to n+1, the number of dyadic relationships between the companies is increased by n. Thus, for instance in a development of an IT system for network of three companies we should study carefully the network constellation, three separate organizations, and three different dyadic relationships, altogether 7 points. When the size of the network grows to four, the respective number of study point increases to 11.

(see e.g., the constant revision of ISS needed by Dell Computer, Kraemer et al., 2000).

Against this backdrop, we anticipate three issues necessary for re-thinking the development of information systems for the networks of companies:

First, there is a growing need of *building trust* between companies by mutual adaptation and learning – ultimately, the companies are participating in order to attain their self-interest objectives (Van de Ven, 1976; Nurminen & Forsman, 1994; Andersen & Christensen, 2000). This will emphasize the importance of reversing the life-cycle: instead of building the information system in the first place that cement the operations and structures (Kopanaki & Smithson, 2003) a period of mutual adaptation and groping is necessary to define the objectives, roles, similarities and differences between companies for the common good (Andersen & Christensen, 2000). The role of trust is emphasized when there are power and size asymmetries between the companies participating to the network (Hackbarth & Kettinger, 1997; Morrell & Ezingeard, 2002). Information systems are a vital, inseparable part (Nurminen & Forsman, 1994) of this process of searching for core competences and co-operative capabilities.

Second, the first trend emphasizes *quest for standardization*: There will be a myriad of open, national, and international standards around that can serve the purpose of simplifying the interfacing of different systems. Instead of trying to integrate seamlessly anything, somewhat satisfactory standards are needed to meet the most basic needs of the business transactions at the three types of relationships.

Third, there is a *need for new intermediaries*. Van de Ven (1976) claims that the organizations are pushed into inter-organizational relationships, because of either they are having an internal need for resources or they are committed to an external problem or opportunity in the overlapping domains of organizations. Let it be either of the reasons, the company is facing a need for new resources in form of personnel, information, monetary or physical resources, or access to clients or markets etc. (Van deVen, 1976). These resources may be found from the traditional partners (overlapping domains), but it is most likely that, the companies *must also be open to new intermediaries* in the similar manner than in finance sector. These companies are providing value-added info-mediary type of services (consultancy, research, data warehousing, etc.) to the networks of companies by taking advantage of the increased amount of excessive information and consequent asymmetries between parties. In essence this would mean more middlemen taking over some of the complexities and information overload of the companies (see e.g., Wise & Morrison, 2000). From the design point of view, this would underline the importance of building relationships with the emerging companies and institutions beyond the original value creating system of the companies. To our mind also this emphasizes the idea of reversed life cycle.

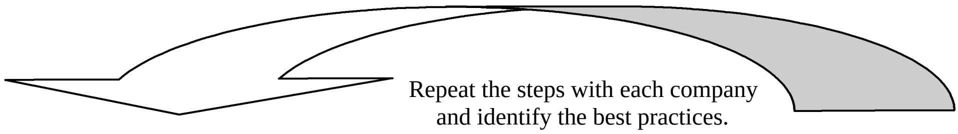
As suggested by Nurminen & Forsman (1994) the behavioral changes in each company should meet the real life performance criteria by improving the efficiency of the total "*Information Systems Ecology*" (ibid. p. 398). They state that "*The Information System Life Cycle has a meaningful existence only embedded in the Business Life Cycle*" and that "*The Business Life Cycle is here understood as the intellectual and practical manifestation of a given business idea of a given corporation, which encapsulates among other things the exploitation of IS, Life Cycle of the corporation in all its aspects*". To put it simply, the problem domain and information system serving it form a unity, they are not separate from each other, as suggested by software engineering, or BPR-approaches.

Hence, in the spirit of Nurminen's and Forsman's (1994) information systems ecology, we suggest the expansion of Reversed Quality Life Cycle to cover the simultaneous development of business activities, information systems, organizational capabilities, and trust in developing inter-organizational information systems. More specifically, we propose the necessary steps for creating an information systems ecology for business networks (see Figure 6, which is a synthesis based on Heikkilä et al., 2003 and the ideas of reverse life cycle and inseparability of ICT from its use context by Nurminen & Forsman, 1994):

1. When developing an ICT system for networked organization, the process should start with definition of objectives and targets for the future processes (note: not the ICT system) taking into consideration the needs within the organization, within all dyadic relationships the organization is involved and within the network itself. This should be done together with the management of the company – as they are best aware of the strategic and operational objectives of the company, and to ensure the commitment of the management for the project. However, simultaneously with the above, we should find out how the users work now and use this information as a starting point for improving the process. In this way, we should be able to ensure that the objectives are in line with good process design.

2. The second step is to start developing versions of ICT solutions for prototyping purposes. Again, simultaneously we should let the users to develop practices, generalize roles and rules, and align ICT accordingly. This is at the core of reverse life-cycle idea (Nurminen & Forsman, 1994)

3. The above-mentioned steps should be repeated in each participating organization. In the inter-organizational level design of information systems the seamless integration of all the systems should not be the primary objective. Instead, we should identify the best practices, and aim at developing standards for interfacing the systems between the participants to control the number of relationships and adaptation processes. Furthermore, we should try to find ways to transact new resources and interchange skills between the companies (Andersen & Christensen, 2000).



STEP 1.	STEP 2.
What: Define the objectives and targets for the future processes within the organization, in dyadic relationships, and within the network. Who: with the management of the networked companies. Why: in order to meet the operational and strategic objectives.	Start developing versions of IT solutions for prototyping purposes.
Simultaneously	Simultaneously
What: Find out how the users work now and use this information as a starting point for improving the processes. Who: with the users. Why: for achieving the objectives in line with good process design.	Let the users develop practices, generalize roles and rules and align IT accordingly.

Figure 6. Developing Information Systems Ecology for networked organizations (based on Heikkilä et al., 2003).

4 Conclusion

We are confirmed that designing IOSs as part of the business redesign and change processes remains a major headache for IS-managers, management and personnel of the companies in the Western economies for the foreseeable future. As Nurminen and Forsman (1994) point out in intra-organizational setting, it is a necessity to join technical, human and business perspectives in development of ICT solutions. Unfortunately, our greatest concern is that building complex *inter-organizational* systems in an outsourced and subcontracted environment is such a technical challenge that it will draw the attention away from the seminal issue of reversing the life cycle for developing more efficient operations pinpointed by Nurminen and Forsman (1994). This will be especially true in the present outsourced, subcontracted information systems development practice. We suspect that this may easily lead to strategically dysfunctional armchair business models, phenomenal misplaced investments, huge implementation problems and severe organizational clashes, as illustrated in some recent studies (Paper et al., 2003). This will inevitably lead to high failure rates, and reincarnate the notorious productivity paradox. In the worst case we shall see longer than expected lags and mismanagement of the technology, unless the lessons from organizational development, reversed quality life-cycle, and business process redesign are not taken seriously into account in the inter-organizational setting.

Therefore, we suggest an expansion of the Revised Quality Life Cycle approach (Nurminen & Forsman, 1994) for developing inter-organizational information systems. This means that the objectives and targets for the future processes should be considered within three levels in all the participating companies: within the companies, their dyadic relationships, and the network. This is important in creating trust and commitment between the participants that, in essence, are taking part in the co-operation due to self-interested reasons (in an intra-organizational setting trust was not a major issue). Simultaneously it should be ensured that the objectives are in line with good process design and that they are feasible, by starting the analysis by gaining understanding on the users and the management's actual work behavior. The second step is to start prototyping ICT solutions and let the users to develop practices, generalize roles and rules, and align ICT accordingly.

On the level of the network we should not try to integrate seamlessly all the systems of the companies into one mutual system. This is because there are so many relationships, consequent adaptation processes, which may not be compatible due to various operational, structural, strategic, or even institutional reasons. Instead, we should identify the best practices, and aim at developing standards for interfacing the systems between the participants. Furthermore, as the organizations incentive to take part in a network is to find additional funds, physical assets, personnel, information, access to clients or markets etc. (Van de Ven, 1976), emphasis should be put on acquisition and sharing of suitable resources in the sense of information systems ecology for improved productivity (in the sense of Nurminen & Forsman, 1994). These new value-adding resources may also be found outside the current network, such as intermediaries providing info-mediary type of services.

Our Life Cycle for developing ICT in networks builds on the idea proposed by Nurminen and Forsman (1994) that ICT solutions are inseparable from the use context, and built only after there is an emerging change in the behavior of the workers towards new practices (Beer et al., 1990). Instead of building the information system cementing the operations and structures (Kopanaki & Smithson, 2003), a period of mutual adaptation is necessary to define the roles, similarities and differences between companies for the common good and trusted relationships (Andersen & Christensen, 2000). Additionally, we point out the need for creation of standards, which simplify the interfacing of different systems within the network. Thus, instead of trying to integrate seamlessly the systems, somewhat satisfactory standards are used to meet the most basic needs of the business transactions. Finally, the companies should be prepared to build relationships with the emerging companies and institutions beyond the original value creating system towards information systems ecology.

Acknowledgements

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How Different is Similar?

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Abstract. One constitutive element of a community of practice is that its members carry out work tasks, including IS-mediated work tasks, in a similar, explicitly or tacitly agreed-on way. In the paper, the results of a case study, where a home health care organization was analyzed as a community of practice, are reported. The study was made after an IS was implemented into the organization. The principal objective of the study was to analyze in detail the degree of uniformity of IS-mediated work practices as an indicator of community coherence in the home health care. The results revealed that there were notable differences in work practices even though the applied information system was the same, the actors had received the same training, and the standard procedures describing how the work tasks should be carried out were the same. The organization seemed to be divided into sub-communities, where practices of their own had evolved after IS implementation. The heterogeneity of practices may produce harmful consequences for the work and co-operation as well as, at worst, for the result and quality of work. The results give us preliminary knowledge on the applicability of communities of practice as an approach in the analysis of uniformity and change of IS mediated work practices.

KEYWORDS: Community of practice, work practices, IS implementation, coherence

1 Introduction

Efficiency and financial benefit are typically pursued by organizational IS implementation, and as a consequence of that a pressure to improve the coordination of organizational activities usually increases. On the other hand, an IS may produce new coordination problems, which did not exist before the implementation and which the organization is not able to control because of the minor experience of ISs (see Kling et al. 1996).

An excessive heterogeneity of IS-mediated work practices is one dimension of the coordination “problem”, which may follow from an IS implementation. Coordination of cooperation necessitates that IS-mediated work practices are uniform enough between the workers. The degree of uniformity that is necessary depends on the function of an IS in question and its users. As a consequence of an excessive non-uniformity the work load may increase and the motivation of workers decreases – and, finally, the system does not improve the result. At worst, if the work practices are not uniform enough, an IS may become an obstacle to the work and cooperation.

One constitutive element of a community of practice (Wenger 1998) is that its members carry out work tasks, including IS-mediated work tasks, in a similar, explicitly or tacitly agreed-on way. In this paper, we report the results of a study where a municipal home health care organization was studied as a community of practice. The workers of the home health care worked with the same electronic patient record (EPR) and carried out the same work tasks. In the implementation process the description of the work tasks, which the EPR mediate, was made successfully and all the workers were given the same training. However, the work practices started to diverge immediately after the implementation. The home health care seemed to be divided into sub-communities, where practices of their own had evolved after IS implementation.

In the following, first we outline our theoretical framework, in which we combine the approaches of activity theory and communities of practice. After that we present our case study, in which the framework is applied.

2 IS-mediated work activity

2.1 Actor-Tool-Work task

Work activity can be analyzed as a human activity system (Leontjev, 1978, Engeström, 1987; 2001), which consists of three basic elements, the actor, the tool and the work task. The actor is a human being, the tool is a tool of any kind, and the work task is a procedure with some predefined goal, which the actor is supposed to reach with or without the tool. The action of the actor, aiming at a goal, is mediated by the tool. The basic elements of the activity system, actor, tool and work task, are interdependent; a change in one element produces change on other elements. The elements partly constitute each other.

The viewpoint is, of cause, a simplification; it cuts the basic elements from the other human and non-human elements with which they interact. Hierarchies between actors and the rest of an organization seem to be missing from the view. However, it can be said that the description of a work process is an operational definition of the organization, it tells us which actor performs a certain work task, in which order tasks are performed, with which tools, who controls the outcome and process, who uses the information produced, etc (see Nurminen et al. 2002). When every work process has been described, the whole of the organization has been described. Outside the relations of the actors, which the different non-human elements mediate, there is no structure, no hierarchy, no organization; they are rather the effects generated by the relations (comp. Engeström 1987). As Law (1992; 1994) argues, an organization is rather a verb than a noun. It is continually produced and maintained by human action, which the different non-human elements mediate. It has to be performed, made and re-made; it is a continuous effect.

2.2 Community of practice

A more detailed analysis of the structures of an organization shows us that it may consist of official units, departments etc. and of unofficial work groups and communities. The former are constituted by official rules and contracts, which mediate the interaction of actors; the latter by more spontaneous rules and conventions. The unofficial communities may be smaller entities within the official units, or they may cross the boundaries of them, or they may be overlap with them. Etienne Wenger (1998; 2000) studies this kind of unofficial communities as communities of practice (CoPs). In working life a CoP may be constituted for example by the mutual practice of the attorneys of a Public Defender's Office or of a smaller group of attorneys in the office (see Hara & Kling 2002) or of a financial planning group in the finance department of a large manufacturing organization (see George et al. 1995). CoPs are unofficial communities which the workers form and maintain by their mutual practice, but they are something more than what we usually mean for example by the term “work community”. Wenger (1998, p. 72-73; 2000, p. 229) describes three dimensions of the relation by which the practice is the source of coherence of a community. The dimensions are mutual engagement, a joint enterprise and a shared repertoire.

Membership in a CoP is a matter of mutual engagement. A CoP is not just an aggregate of people defined by some characteristic. The members form a CoP because they sustain dense relations of mutual engagement organized around what they are making, that is, they build their community through mutual engagement. They interact with one other, establishing norms and relationships of mutuality that reflect these relations. To be competent is to be able to engage with the community and to be trusted as a partner in these interactions.

The members of a CoP are bound together by their collectively developed understanding of what their community is about and they hold each other accountable to this sense of joint enterprise. To be competent is to understand the enterprise well enough to be able to contribute to it. The enterprise is not just a stated goal, but creates among participants relations of mutual accountability that become an integral part of the practice.

A CoP has a shared repertoire of communal resources. Over time, the joint pursuit of an enterprise creates resources for negotiating meaning. The elements of the repertoire can be very heterogeneous. The repertoire includes the explicit and the tacit. The explicit includes language, tools, artifacts, symbols, images, specified criteria, codified procedures, regulations, contracts etc. The implicit includes tacit conventions, subtle cues, rules of thumb, underlying assumptions, shared worldviews, etc. Consequently, one characteristic of a coherent CoP is that its members perform their work tasks, and in this case the IS-mediated work tasks, in a similar, commonly agreed-on way. The similarity can be based either on explicit contract or on tacit convention. The less uniform the practices are, the weaker the community is. Of cause, there are also the other sources of community coherence, as Wenger argues.

A CoP uses the communal resources for negotiating meaning. By “negotiation of meaning” Wenger (1998, p. 53) characterizes the process by which the members of a CoP experience the world and their engagement in it as meaningful. Negotiation of meaning takes place in the convergence of participation and reification. Participation refers to a process of taking part and also to the relations with others that reflect this process. It is both action and connection. Reification refers to the process of giving form to our experience by producing objects that congeal this experience into “thingness”. In the process of reification a certain understanding is given a form, which then becomes a focus for the negotiation of meaning, as people use a procedure to know what to do or use a tool to perform an action. The duality of participation and reification is a fundamental aspect of the constitution of CoPs and of their evolution over time.

Wenger (1998; 2000) argues that learning is a social phenomenon and that it occurs informally in CoPs. Lave & Wenger (1991) originally defined CoPs as scaffolding for newcomers to become part of a community or a profession. Newcomers start as peripheral members and eventually learn to become full members of the community. According to Wenger a CoP constitutes an informal learning environment in which both novices and experienced members of the community may interact, share their experiences of being in a particular profession, and learn from each other. In respect to IS-mediated work practices this means that the practices are rather learnt in the daily working environment than in the classroom.

3 IS-mediated work activity: Home health care

In this section, we present the results of a case study, in which the work practices and their change in the home health care organization of the municipality of Turku was studied by combining the approaches of activity theory and communities of practice. In the primary health care clinics – including the units of the home health care – of Turku City an EPR was implemented in 1998-2000. It was the first computer based patient record system ever in that organization. The case study was made in the post-implementation phase in 2002.

3.1 Study questions and method

The principal objective of the study was to analyze in detail the degree of uniformity of IS-mediated work practices as an indicator of community coherence in the home health care. The degree of mutual engagement and the similarity of the structure of working day were considered as indicators of coherence as well, but they were analyzed less intensively. The other objectives of the study were to analyze, what the mechanisms are that change the work practices, and what the consequences of heterogeneous work practices might be. The analysis was done by combining the approaches of activity theory and communities of practice.

There are total of four health care regions in the primary health care of the municipality of Turku since the beginning of 2002. Formerly there were eight regions, where the EPR was implemented in four phases in 1998-2000. In the four regions there is about 40 home health care districts altogether. In a district there are typically working two visiting nurses - one practical nurse and a nurse. A general practitioner (GP) usually visits once a week in an office of a district and makes home visits, when needed. In every region there are 1-2 head nurses, who are the nearest taskmasters of the visiting nurses. In every region there is also a director, who is a charge nurse or a directing doctor.

Nurminen et al. (2002, p. 70-72) followed and evaluated the implementation of the EPR in the emergency duty unit and noticed that the work practices started to diverge immediately after the implementation. The heterogeneity of practices originated at least from changes in actors, technique or work tasks. Based on the observations of Nurminen et al. (2002) and of Reijonen & Sjöroos (2001), according to whom the big number of the relatively independent home health care districts easily leads on to different practices between the districts, the home health care was chosen as a target of the case study. A head nurse of the home health care and a trainer had observed differences in the work practices of visiting nurses as well. Implementation of the EPR periodically in four phases was also supposed to be a factor leading on to divergent practices.

We entered the community of the home health care with five main themes for the semi-structured interviews. The themes were: 1) the basic information about the interviewee and her/his work unit, 2) the co-operation and interactions that the interviewee had in daily work situations, 3) the way the interviewee utilizes the EPR and her/his motivations for those actions, 4) possible divergent ways of transferring and storing the information and 5) the ways of learning and keeping up the skills to work with the EPR.

Two home health care districts of every four region were drawn lots to the study, eight altogether. From every district one visiting nurse, a substitute and a general practitioner were interviewed. In addition, the head nurses of home health care (total of five) and the directors of the regions (total of four) were interviewed. Finally, 32 interviews were made in spring 2002.

The interviews were made in the work environment, where the interviewees had an opportunity to use their own work stations to show, how the work with the computer was actually done. In the interviews the work of the nurses (and other occupational groups) was approached from two directions, firstly they were allowed rather freely to describe their work and its environment in the frame of our interview themes (see above), secondly they showed and described in a very detailed manner their daily work tasks and practices. We found it useful that they simultaneously showed how the work tasks were done and told about those tasks. In that way we were able to hear what kind of meanings and reasons they gave to their actions. Also the unstructured style of interviewing gave space to the interpretations and meanings of the interviewees.

The interviews were transcribed and analyzed function by function. In that way we were able to find out the differences and similarities in the ways the system was used in different work units, and analyze the effect of the spatial closeness of the units on the diffusion of work practices. The interviews revealed also the reasons for the nurses' and doctors' ways of acting and the routes where they had learned their work practices. The interviews gave us also means to evaluate the importance of homogeneity of the work practices for the whole care process.

3.2 Home health care as a community of practice

3.2.1 EPR implementation

The EPR implementation process in the primary health care in 1998-2000, including the home health care, followed approximately a procedure, which consisted of three phases: description, training and use. In the description phase, first the old work practices were described, what formed a basis for the invention of the new practices, i.e. those after the EPR implementation. Then the new practices, which the EPR mediate, were invented. Hence, the description told by whom, when and how work tasks are performed before and after EPR implementation. In the training phase, a half a day Windows NT training was directed to all end-users. The local support persons received on month training in the use of the EPR. They gave 1-3 day's training in the use of the EPR for the end-users of the regions. The training was based on the descriptions of work practices, which were made in the description phase. After the training phase started the use phase, when the workers had to perform their work tasks as they were described in the description phase and learnt in the training phase.

The procedure, which was described above, can be seen as an explicit attempt to ensure the coherence of the CoP. Hence, the workers of the home health care received the same classroom training, and the standard procedures describing how the work tasks should be carried out were the same for everyone. However, the system vendor updated the system several times during and after the implementation. The updating in the autumn 2001 was such a large one that an additional voluntary 2 x 2 hours' training was organized.

3.2.2 Sub-communities

The enterprise of the community of the home health care is to take care of the health of the patients, who need health care at home. The structure of working day and the timing of carrying out work tasks were very similar across the home health care districts, which partly indicates that the home health care was to some extent a coherent CoP. However, the degree of mutual engagement was stronger at the regional level than at the level of the whole home health care. In addition, despite that all the visiting nurses had received the same training during the EPR implementation process, the practices of their own were invented within the regions concerning some of the IS-mediated work tasks. Finally, the most coherent communities were still smaller. The analysis indicated that the home health care was divided into several sub-communities. They were constituted by one district or by a group of districts, where the workers were working in the same facility. In these sub-communities the degree of mutual engagement was the strongest, and the sub-communities had practices of their own in respect to most of the IS-mediated work tasks. Spatial closeness seemed to be a very important source of community coherence.

In the following, we describe first the EPR-mediated work tasks, which the visiting nurses carry out daily, and then as an example of the heterogeneity of work practices, the variety of the ways to prepare and update the information about the medication of the patients.

3.2.3 EPR-mediated work tasks

In the study six EPR-mediated work tasks were identified, which the visiting nurses perform in their work: 1) making and updating nursing care plans, 2) making and updating medication lists, 3) making and updating RaVa-index, 4) making notes of the actions that have taken place during the home visits to the nurses section at the health record, and 6) codifying by codes the actions that have taken place during the home visits to the function of compilation of statistics.

About every patient of the home health care a nursing care plan has to be made into the EPR. To the plan the need, the objective and the measures of nursing are defined. The plan should be updated, when ever there are changes in them.

About every patient a numerical index (called RaVa–index), which describes the physical, social and psychological capacity of a patient, is defined and updated, when needed, into the record. In some regions, but not in all, the index constitutes a performance-related pay system, according to which the nurses are paid bonus depending on the average of the index in the region.

Also, a medication list has to be maintained for every patient in the medication card of the system.

The nurses make the home visits almost without exception at 8-11 a.m. In the home visits they have an appointment list on them, which they have printed out in the preceding afternoon. At 12-13 a.m. they have a telephone hour. After the home visits and the telephone hour the nurses register every home visit, which they have carried out in the morning, into the function of compilation of statistics and codify by codes the actions that have taken place during the visits into it. The principal reason for a home visit should be coded first and then the other activities. Hence, statistics about either the principal reasons or all the reasons of home visits can be drawn.

In the case when nothing exceptional has happened in the home visits, the nurses should author weekly about patient’s condition on the nurses’ section of the EPR. About the patients, who are visited less than weekly, there should be documentation once or twice a month. However, every change in the health of a patient should be documented.

Finally, making the appointments for the coming home visits into the appointment function of the system is a necessary daily work task of the visiting nurses. The appointments are without exception made in the afternoon. There are two fields in the appointment function into which the nurses can freely make notes about the home visits. The fields are printed out to the list, which a nurse takes on her to the home visits. The program adds automatically the name and the social security number of a patient to the list. There are also three fields under the patient list of a district in the system, which the nurses can freely use.

3.2.4 Heterogeneous work practices

There were found differences in the practices in respect to every work task that was analyzed, excluding the making and updating RaVa-index. The factors, which had led on to different practices, were at least the following: the repetitive updating of the EPR-system, the mismatch between the work processes and the EPR as well as the mismatch between the norms concerning the IS-mediated work tasks and the work processes. In addition, the absence of norms in respect to the use of some functions of the system had led on to divergent practices in the different sub-communities. However, the divergent work practices did not constitute the boundaries of the sub-communities in the same way under every work task. Unfortunately, it was not possible to draw a precise map about the sub-communities in respect to different work tasks, because there were only eight districts out of 40 in the analysis. The interviews did not either give us sufficiently empirical material to draw conclusions about the impact of training on the constitution of the work practices.

Let’s see as an example what kinds of differences there were found in the practices of making and updating the medication lists. The different practices concerning the documentation of the medication of the patients are a consequence of the mismatch between the system and the work processes.

There are two places in the system, where the information about the medication of a patient should be documented to. There is a general medication function, where the information is composed of the prescriptions made by the GPs. The GPs have also the right to remove the old medicaments from the list. There is also another list of medication for every patient, a medication card at the “ward”, that is maintained by the nurses. These two are the official places to enter the information about patient’s medication, but – in practice – they are not the only ones.

It had become evident in respect to the nurses’ medication card that the information about the time of day, when a drug should be taken, would disappear within two weeks from the input. And the list had to be re-written every time a patient was signed in and out from a home health care unit, for example when visiting the hospital ward. The interviewed nurses told that they simply did not have sufficiently time to enter that information into the system repeatedly. Hence, excluding one sub-community, the nurses had stopped using the medication card. New practices had evolved instead.

The data in the general medication function was not in order either. The GPs used to neglect their duty to remove from the list those medicaments that were no longer in use. And only those prescriptions that were written in the units of the primary health care of the municipality of Turku would show up in the list. Hence, on the one hand, there were in the list medicaments which were not in use, and, on the other hand, the patients had in use medicaments which were never even entered into the list. Consequently, due to the non-uniformity of the practices there was eventually no place in the EPR where the correct medication of a patient would be found in 100 percent confidence.

This uncertainty had led to many different ways to act among the sub-communities. Some communities used manual cards to write down the medication of their patients. In two sub-communities the medication was written in the nurses' section of the electronic patient record (a module of the IS in question). In one of the communities there was a special book, where the medication was gathered. In some communities the nurses wrote also to the free fields of the system various kinds of remarks in relation to the medication.

The divergent practices in respect to registering the medical information may have severe consequences in such a "vulnerable" sector of work as health care. At worst, even the life of the patient may be at risk in the case of malpractice. At least unnecessary extra work will be needed because of the divergent practices. Regular staff in the home health care units can usually cope with the non-uniformities. Many of them know by heart the medication of their patients, but when a patient gets treated by a GP, for instance in the emergency duty, or some nurse from the home health care unit is absent and a substitute is needed, the harmful consequences of the different practices may become concrete.

4 Discussion

In the study Turku home health care was studied as a community of practice. The uniformity of IS-mediated work practices was studied especially as a source of community coherence. The daily work tasks of the workers of the home health care were the same, the applied IS was the same, the workers had received the same training in the implementation process, and the standard procedures describing how the IS-mediated work tasks should be carried out were the same. Hence, it might be supposed that the home health care is a very coherent CoP, where the EPR-mediated work practices are similar, but this was not the case. There were notable differences in the work practices in respect to different work tasks, which indicated that the home health care was broken up to more coherent sub-communities. However, the structure of working day and the timing of carrying out work tasks were very uniform in the districts of the analysis, what indicated that it was to a certain extent a coherent community as a whole.

When there are acting several CoPs in an organization, whose members carry out the same work tasks, it may happen that the IS-mediated work practices start to diverge between the CoPs immediately after the implementation of an IS. This may happen, even if the workers have received the same training in the IS implementation process, because the other work practices and routines of CoPs may be so strongly settled that the IS-mediated practices adapt to them, not the other way round.

In case a “sufficient” uniformity of practices has been achieved, they are nevertheless liable to change. There hardly ever is a state of work practices, where the practices are fully settled. The change of practices can originate from changes in the IS. The changes in the other resources and in the members of a CoP may produce changes in the work practices as well. In addition, the changes outside the local CoPs, for example changes in law and statutes, may produce changes in the practices. Also, a typical starting point for diverging practices is that there is mismatch between the IS and the work processes that leads on to working around. In this kind of situation CoPs may intentionally use computing in ways it was not designed or avoid its use and rely on an alternative means of performing work (see Gasser 1986). Turku home health care uses the module of the EPR, which was originally designed to be used within hospital wards, and that produces different mismatches between the system and the work activity of the visiting nurses. The phenomenon of diverging work practices is near the drifting phenomenon described by Ciborra & Hanseth (2000). Drifting means for example that the IT-solutions of the units of an organization little by little diverge from the centrally planned IT-solutions.

The different practices of CoPs are not intrinsically good or bad state of affairs. The practices of an individual CoP may be carefully planned and reasonable for its own activity. However, the differences of practices between the CoPs may produce problems for the work activity and cooperation as well as at worst for the result and quality of work. The consequences of uniformity can not be known beforehand, they can only be foreseen by studying, how, when and why information is entered into the system and how, when and why the entered information is utilized.

On the other hand, all the consequences of non-uniformities are not harmful. A worker is often the best expert of his own work and his know-how leads often to “good” practices in IS-mediated work activity, even if that means non-uniformities. A “suitable” autonomy given for the workers is in many cases for the best of the whole of the organization. The autonomy of workers is undoubtedly connected to workers’ job satisfaction, and has in that way influence on the productivity of the organization.

In the case of Turku home health care it can be supposed that the sub-communities existed before the IS implementation, even if more specified research is needed to clarify the boundaries of the communities. However, it seems that the implementation of the EPR did not increase the degree of coherence of the home health care as a whole. On the contrary, the consequence of the implementation seemed rather to be the strengthening of the sub-communities.

A conscious building and use of CoPs in organizations for encouraging collaboration across organizational lines, increasing knowledge sharing across departments, driving innovation, streamlining business processes, etc. seems to be a trend (see McDermott 2001; Hung & Nichani 2002; Yiu & Lin 2002; Plaskoff 2003; van Winkelen & Ramsell 2003; Konberg 2003), even if it is against to the idea of spontaneous communities of practice. In the case of Turku home health care there is a need to strengthen the coherence of the whole home health care by unifying the EPR-mediated work practices. This can happen by describing again the prevailing work practices and the uniformities in them, and then a sufficient uniformity of practices has to be agreed on. It is important that the nurses are conscious of who are the possible users of the information they enter into the record and why a uniformity of practices is necessary. The training which bases on the description could be organized around a combination of learning opportunities in classrooms and by the daily work activity (see Hara 2001).

On the basis of the study it can be concluded that the approach on communities of practice is a working tool, when uniformity and change of work practices is analyzed after IS implementation. Uniform ways of doing things, i.e. commonly agreed-on work practices, are a part of the shared repertoire of a CoP. But, according to Wenger’s definition of a CoP, uniformity of IS-mediated work practices is not the only constituent of a CoP, there are other constituents and sources of community coherence as well. A more specified further study is needed, where the different constituents of CoPs are analyzed. Then we understand more about the boundaries and strength of CoPs. However, there is an obvious difficulty to recognize and identify a CoP according to Wenger’s definition. What is a sufficient degree of mutual engagement or a sufficient number of communal resources to constitute a CoP? One solution to the identification problem is, not to study whether there is a Cop or not, but to study different levels of CoPs, which can be weaker or stronger.

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Software Development and IS Use

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Abstract. The differences in the world views of the two parties of organizational computing, computer scientists and information systems scientists, are rather large and seem to be persistent. There have been attempts to somehow merge or unify the field. In this paper I argue, however, that instead of a merger we need more definite borders around these domains. The two 'independent' domains (institutions) proposed are software development and IS use. I explore these institutions using Soft Systems Methodology and use the concept of institutionalization by Berger & Luckmann (1966) in interpreting the results. The conclusion of my analysis is that we should make a clear distinction between software development, which output is an artifact and an IS, which is cooperatively learned behavior, and choose our world view and methods as researchers and practitioners accordingly.

1 Introduction

Even though Information Systems Science or equivalent is a discipline in most universities and business schools around the word, there are hundreds of books on Information Systems and tens of journals concentrating on Information Systems research there seems to be considerable problems in defining what exactly is the field of study of Information Systems Science. Even the formulation of a commonly accepted definition of the object of interest, the information system (IS), seems laborious (Orlikowski, 1992; Falkenberg et al.. 1998; Alter, 1999). After about ten years of work the IFIP WG 8.1 Task Group (FRamework of Information System COncepts, FRISCO), the aim of which was to develop "simple, clear and unambiguous definitions of, and a suitable terminology for the most fundamental concepts in the information systems field, including the notions of information and communication, and of organisation and information systems" (Falkenberg et al., 1998, p. 1) states in its final report: "The real concern (the misunderstanding of what is involved in organisational communication) is still there - in spite of our studies - and one may fear that some of the problems are innate to the various interested parties" (ibid., p. 2). The task group accounts these problems to the different "cultures" of computer science and social sciences and states that "The FRISCO group itself underestimated these problems, in particular the existence of 'hidden agendas' of the interested parties" (ibid., p. 2). The term culture refers here to the different scientific traditions and corresponds to scientific paradigm (Kuhn, 1970), community of observers or standard observers (Maturana, 1988), and subuniverse of meaning or conceptual machinery of universe maintenance (Berger & Luckmann, 1966).

These two cultures define information systems quite differently (Falkenberg et al., 1998, p. 5). Computer scientists interpret an information system as a technical system, implemented with computer and telecommunications technology and social scientists as a social system, such as an organisation in connection with its information needs. Both the technical and social system can, of course, be represented as conceptual systems on different levels of abstraction. Because of the different interpretations also the object of inquiry becomes different. Basing on Berger & Luckmann (1966) Nurminen (1988, p. 12) argues: "The rules, as it were, tell us not only how to act but also how to think - and what to think". With only some exaggeration I can argue that computer scientists concentrate on systems development, emphasize technology, and exclude nearby all actors from their analysis (or treat them as objects among other objects) whereas social scientists are inclined to study the implementation and use phases and emphasize the role of actors (users, human agency). This classification matches with the two views of Orlikowski (1992, p. 399) on the different scopes of technology found in the studies of technology, i.e. technology as 'hardware' and social technologies.

The differences between these cultures are not superficial, but are based on rather different philosophical positions and "Weltanschauung" (world view). In short, the interpretation of an information system as a technical system is based on the assumptions of Logical Empiricism (objectivity, dualistic ontology, and positivistic epistemology) whereas the proponents of the social system interpretation base their arguments on the Hermeneutic-Dialectic tradition (subjectivity, non-dualistic ontology, and hermeneutic epistemology) (see e.g. Radnitzky, 1970; Walsham, 1993). In information systems research, different authors have appointed different names to these approaches. For example, Nurminen (1988) uses three perspectives in describing the different approaches: systems-theoretical (bases on the tradition of logical empiricism and places the machine in the foreground), socio-technical perspective (basically a positivistic approach which attempts to take into account both the technological and human aspects), and humanistic (hermeneutic-dialectical approach which stresses the primacy of the human being). The different approaches have emerged chronologically after each other and according to Nurminen (1988, p. 17) "The chronological order is also reflected in content; each new perspective can be seen as a response to the challenges which earlier ones failed to satisfy". Orlikowski (1992, p. 399) has described the contents of the different phases as follows:

> "The early work assumed technology to be an objective, external force that would have (relatively) deterministic impacts on organizational properties such as structure. In contrast, a later group of researchers focused on the human action aspect of technology, seeing it more as a product of shared interpretation or interventions. The third, and more

> recent work on technology has reverted to a "soft" determinism where technology is posited as an external force having impacts, but where these impacts are moderated by human actors and organizational contexts".

The chronological order of the approaches leads easily to the interpretation that the "newer" approaches would somehow be better or even superior to the "older" ones. This kind of interpretation can be drawn at least from Nurminen (1988) and Orlikowski (1992). The order of the emergence of the different approaches is a historical fact, but at the same time it must be remembered that the new approaches have not replaced the older ones but just increased the number of the communities of observers. In other words, the older approaches are strongly alive and continually applied in the research of technology. The coexistence of different approaches is found, however, disturbing. For example, the main goal of the FRISCO-group was to enhance the building of common terminology and definitions (Falkenberg et al., 1998). I argue, however, that the existence of different approaches is a positive thing and instead of trying to narrow the gap between them we should encourage the development of both main "cultures" and make the distinction between them more clear. My main argument for the proposal is that the problems attacked by the two cultures belong to different institutional domains and hence, different approaches are needed.

The two domains examined here are the domain of software development and the domain of information systems use. They are sub-domains of the research and practice of the deployment of information technology in organizations, i.e., the metadomain of observation is about how the development, implementation and use of information technology can be conceptualized, studied, and carried out.

In her paper discussing the concept and role of technology in organizations using the structuration theory by Giddens (1984) as a framework, Orlikowski (1992, p. 408) suggests that "… we recognize human interaction with technology as having two iterative modes: the *design mode* and the *use mode*". She makes, however, a reservation that the distinction is "… an analytical convenience only, and that in reality these modes of interaction are tightly coupled" (ibid., p. 408). I am in favour of a more clear distinction between the modes and support the position taken by Nurminen (1988, pp. 15 - 16): information systems development and use proposes a hierarchical system of institutions (institutional levels) consisting of *use of the system*, *systems development and implementation*, and *information systems research*. In short, he justifies the hierarchical structure by stating that IS development methods are created by the institution of research and used in an institutionalized manner during development and implementation and so causing changes in the use institution. In my treatment in this paper the question of the hierarchy of the institutions is not crucial but they are treated as institutions in the sense of Berger & Luckmann (1966). Treating the phases as institutions means, among other things, that both institutions have different rules, actors, and activities as well as processes of institutionalization and standard observers (see Table 1). In short, they are different versa of the multiversa (Maturana, 1988).

The goal of a software development project is to bring about a computer based artifact, which has the attributes and 'behaves' according to the rules specified in the requirements when installed on the specified technical infrastructure. In this process the future user is typically handled as an abstraction, which has certain attributes like rationality and skill in and aptitude for behaving according to given rules - and the outcome of the process is usually called an "information system".

Table 1. The differences between the institutions of IS development and IS use on some distinctive attributes (variables). The attributes are produced by the author based on research literature (e.g. Maturana, 1988; Nurminen, 1988; Orlikowski, 1992; Falkenberg et al. 1998; Kling & Allen, 1996; Nissen, 1999).

Distinctive attribute (variable)	**The institution of software development**	**The institution of IS use**
Activity	Software development	Work tasks using the software
Goal of the activity	Software functioning according to specifications	Derived from the work (context dependent)
Evaluation criteria of the process	Time and monetary budget of the plan of the project	Efficient performance of work tasks
Evaluation criteria of the outcome	Technically functioning software (comparison of the technical requirements to the materialized software)	Work well done (comparison of outcome to local group norms)
Role of the IS	Outcome of the development process	Tool deployed in work, i.e. an environmental constraint
Type of IS entity	Composite entity	Simple entity (work contexts as a whole is a composite entity)
Basic philosophical stance of (most) actors and researchers	Logical empiricism	Hermeneutic-dialectical, non- or pre-theoretical
Standard observer	Software engineer	Professional worker in some vocational domain
Conception of world (reality)	Objective, mechanistic, rule-based, predictable, causal	Subjective, socially constructed, unpredictable, emergent
Conception of man	Rule-obeying, rational	Free will, creative
Process of institutionalization	Application of professional development methods	User learning

I argue, however, that there does not exist an information system before users are deploying the hardware and software as tools in their work tasks, i.e. it has reached the status of an institution. Hence, the concept 'information system' should not be applied to the bunch of hardware and software, which is the result of a software development effort. Instead, the concept should refer only to the holistic entity which consists of (functioning!) hardware, software, knowledgeable users, real work tasks and processes, defined organizational structure and division of labor, etc. The development of an information system (IS) then becomes not the activity of software developers but the activity of users taking place after the installation of the software product. This development process is not a trivial task because information systems are artifacts, which have more or less profound effects on how their users can or must carry out their work tasks, can communicate with co-workers, are controlled, monitored, and rewarded, and what kind of vocabulary to use. Further, the implementation of an information system may change the division of labor, both between individuals and organizational functions inside the organization or even between organizations as in outsourcing. From the users' point of view all these effects are perceived as changes in the work environment. In order to adapt to the new environment users must be able to create a new, shared interpretation of their environment and, among other things, integrate the new tools into their work process. The adaptation process requires unlearning, learning, creation of new knowledge, and acquirement of new skills.

The discussion presented in this paper is important and has implications both for research and practice. First, it aids in clarifying the field of IS research by making the distinction between computer science and information systems science explicit. Second, it gives reason and justifies the differences between the cultures in their basic ontological and epistemological stances, concepts, and methods. From these assumptions we can then deduct what kind of problems are, can, and should be studied on each of the fields - and how resources should be allocated in practical IS projects. Third, it elevates the role of users by maintaining that they are the ultimate developers of every IS in use. As a whole, the paper tries to convince the reader that the two institutions, software development and IS use, probably can not or at least should not, be combined. What is needed instead is that the differences are made explicit and all parties are aware of the presuppositions of others and their own.

I proceed by first giving a short presentation of the Soft Systems Methodology (SSM), which I then use in manifesting and discussing the differences of the institution of software development and software use. In the discussion, I use the basic ideas of institutionalization as presented by Berger & Luckmann (1966) and compare my interpretation to that of Orlikowski (1992) who has based her study of the role of technology on structuration theory.

2 SSM and the institution of software development

I use the Soft Systems Methodology (SSM) developed by Checkland and his associates (Checkland, 1981, Checkland & Scholes, 1990, Checkland & Holwell, 1998) to further highlight the differences between the two institutions of computer based information systems, namely the software development and information systems use.

SSM is a general approach for making sense and giving structure to "real world" problems in order to make more informed proposals for their solution. Real world refers here to the perceived world in the same sense as Berger & Luckmann[1] define the main concern of the sociology of knowledge: "... what people 'know' as 'reality' in their everyday, non- or pre-theoretical lives". SSM is based on the ideas of General Systems Theory and hence the concept describing something which is 'a

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1 Berger & Luckmann (1966) give the credit for this fundamental insight to Alfred Schütz, who throughout his work "... concentrated on the structure of the common-sense world of everyday life" (ibid., p. 27)

whole' is very essential. Even though the concept 'system' has been introduced as an abstract concept it is often also used to describe parts of the real world. In order to avoid confusion about what is reality and what is an abstraction of the reality the concept 'holon' is preferred to the concept 'system'. According to Checkland and Scholes (1990, p. 22) this concept is coined by Arthur Koestler in 1967 and means "constructed abstract wholes, conceding the word 'system' to everyday language and not trying to use it as a technical term" (ibid., pp. 25-26). The overall aim of SSM is to take seriously the subjectivity which is a fundamental characteristic of human affairs and to treat this subjectivity, if not exactly scientifically, at least in a way characterized by intellectual rigor (ibid., p. 30).

The basic model of the SSM methodology is presented in Figure 1. The process of the SSM inquiry takes place in two different realities; it begins and ends in the 'real world' whereas the models of the systems (holons) are created in the world of abstractions ('systems thinking about real world'). This borderline is intended to remind the actors about what the 'soft' in the name of the methodology means: the perceived world does not contain holons as 'hard systems thinkers' propose. According to Checkland & Scholes (1990, p. 22) the question if systems are 'abstract' or 'real' causes much confusion in the systems literature. In order to make their point clear they state "… it is perfectly legitimate for an investigator to say 'I will treat education provision *as if it were* system', but that is very different from declaring that it *is* a system" (ibid., p. 22).

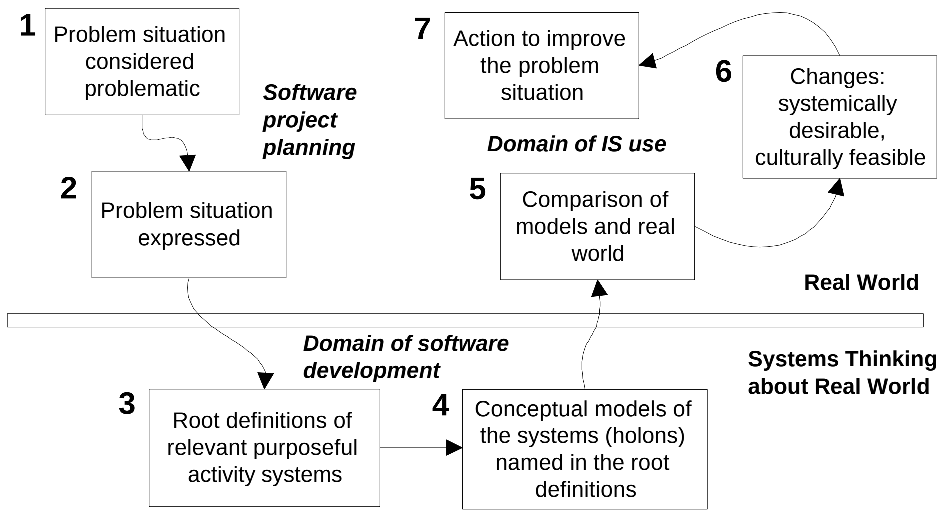

Figure 1. The conventional seven-stage model of Soft Systems Methodology (SSM), adapted from Checkland & Scholes (1990). The texts in italics added by the author.

According to my interpretation, when SSM is applied in IS development the phases 1 and 2 form the planning stage and requirements analysis, 3 and 4 the design and coding, and phases 5-7 implementation and use. If my basic interpretation is valid it has one very important consequence; the practice of software development is carried out in a conceptual domain outside the real world! I return to this notion in the discussion after examining the differences of the domains of software development and IS use applying the CATWOE analysis of SSM.

An essential tool in SSM for describing the problem situation is the CATWOE analysis. CATWOE is a mnemonic where C stands for Customers, A for Actors, T for Transformation process, W for Weltanschauung, O for Owners, and E for Environmental constraints. My proposals for these entities in the domains of software development and IS use are presented in Table 2. It can be readily noted that the two domains differ from each other in all respects. For example while the software is the object of the transformation process in the domain of software development, it is an environmental constraint in the domain of IS use.

The crucial part of the CATWOE analysis is the formulation of root definitions. "A root definition expresses the core purpose of purposeful activity system. That core purpose is always expressed as a transformation process in which some entity, the 'input' is changed, or transformed, into some new form of the same entity, the 'output'"(Checkland & Scholes, 1990, p. 33). My root definition for the institution of software development is the transformation process where *Software requirements → Software accepted by the customer* and for the institution of IS use *Installed software → IS in use*. I am aware that it is possible to create a great number of different root definitions - especially if the worldview is changed. As Maturana (1988, p. 7) has pointed out: "... there are as many domains of existence as kinds of distinctions the observer performs ... there are as many domains of truth as domains of existence she or he brings forth in her or his distinctions". I hope, however, that my root definitions do not belong only to my private reality alone but can become a shared versum.

Table 2. The elements of SSM according to its CATWOE mnemonic in the domain of software development and IS use (Checkland & Scholes, 1990, p. 35).

CATWOE element	**The institution of software development**	**The institution of IS use**
Customers (the victims or beneficiaries of T)	Managers of software vendors' customers	Workforce and customers of software vendors' customers
Actors (those who would do T)	Developers (participating users are also developers)	Users, managers
Transformation process (the conversion of input to output)	Software requirements → Software accepted by the customer	Installed software → IS in use
Weltanschauung (the worldview which makes this T meaningful in context)	Professional systems developers create functioning software in time	A change of the IS in use will enhance production of products and services
Owners (those who could stop T)	Managers (of software vendors and their customer's companies)	Managers of software vendor's customer's companies
Environmental constraints (elements outside the system which it takes as given)	Technical artifacts, rules of logic, development tools, software requirements, resources (time, money)	Software (later IS), norms, rules, procedures

From root definitions (phase 3, Figure 1), conceptual models of the named holons are created (phase 4, Figure 1). This process is logic driven and if the root definitions are expressed properly in the XYZ form ("*a system to do X by Y in order to achieve Z*", Checkland & Scholes, 1990, p. 36), the creation of the conceptual models is a rather straight forward process. I begin with the transformation process of the software development, where the *Software requirements* are transformed into *Software accepted by the customer*. When written according to the XYZ schema the root definition is *Convert the software requirements (X) by applying development methods (Y) to create a software product accepted by the customer (Z)*. In other words, the activity taking place is software development carried out by software developers under the environmental constraints named in Table 2. As is evident from any book handling software engineering, several different conceptual models can be created from this root definition.

It is obvious that the human activity system described above is a 'holon' according to the definitions of SSM. In declaring their position between real the world and human activity systems (holons) Checkland & Scholes (1990, p. 22) state:

> "... it is perfectly legitimate for an investigator to say 'I will treat education provision *as if it were* a system', but that is very different from declaring that it *is* a system. This may seem a pedantic point, but it is an error, which has dogged systems thinking and causes much confusion in the systems literature. Choosing to think about the world as if it were a system can be helpful. But this is a very different stance from arguing that the world is a system, a position which pretends to knowledge no human being can have".

In other words, human activity systems are holons, not 'real systems'. However, the outcome of the human activity system describing software development, the software product, has features which might justify us to say that it is a system - not just as if it were a system: a software running in a defined technical environment is a deterministic system the 'behavior' of which is totally predictable in the same way as a Turing machine: "… the operation of a Turing machine is completely determined by its functional matrix, so that two Turing machines with the same matrix are indistinguishable as regards what they do" (Trakhtenbrot, 1963, p. 61). So, even though the *process* of software development is a holon, the *object* of the process *is* a system, i.e. the conceptual model of the system is a complete, real world description of the system. This means that the rules of logic apply to this system and as a consequence,

- the behaviour of the system can be exactly defined
- its behaviour is always predictable
- the same input always produces the same output
- its output can be defined in measurable terms
- the congruity of its specifications (software requirements) with its behaviour can be experimentally tested and rather exactly measured
- and so forth

Under these circumstances, it is a rather obvious choice to lean on the philosophical tradition of logical empiricism, which offers concepts and methods for performing the process of software development. In this ‘world of conceptual models’ there is no need for intensive interpretations of the results and the risk that different observers would make different conclusions is minimal - presuming that the basic assumptions are shared by the observers. In short, the positivistic methodology is an appropriate choice in most of the efforts[2] performed during the process of software development. It must be remembered, however, that the output of a software development project is nothing more than a software product, an artifact with the pre-defined attributes.

3 The institution of IS use

My root definition for the institution of IS use is *Installed software → IS in use*. In the XYZ schema it can be expressed, for example, in the following way: *Enhance user learning (X) so that the Installed software (Y) becomes an institutionalized IS in use (Z)*. When this root definition is compared to the one given for the institution of software development it is readily seen that in this case competitive - and plausible - definitions are much easier to produce. Even though it is rather easy to produce a large number of different root definitions, detailed conceptual models seem to be nearly impossible to produce. According to my understanding, this has to do with the type of knowledge we have (and is possible to attain) from the field: when the knowledge about the ‘laws’ of human behavior (both individual and social) comes from an interpretation using a certain theoretical framework ,nearly every root definition seems plausible from the perspective of that framework. While discussing the different definitions of organizations found in IS literature Checkland & Holwell (1998, p. 70) note:

> “Such clear models are obviously helpful to inexperienced students, though they may make more experienced managers uneasy, since managers know how much of their time and energy is taken up, not with the substantive facts and the generic logic of their situations, but with the idiosyncrasies of interpretation of specific situations, and with the motivating myths and meanings which are as characteristic of organizations as the facts and the logic”.

Most of these root definitions can not, however, be transformed into a proper conceptual model, which could be compared to reality (see Figure 1). However, as “each versum of the multiversa is equally valid” (Maturana, 1988, p. 7), I will proceed with my root definition and use the proposals of Orlikowski (1992) and the conceptual model of the institutionalization process proposed by Berger & Luckmann (1966) to discuss the transformation of an installed software to an IS in use.

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[2] In my analysis, I have consciously neglected the first phases of the software development process, the decision to invest in IT and requirements analysis. Both of them are better understood as a social process where politics and power play a major role, i.e. they have many common characteristics with the institution of IS use.

As pointed out by Orlikowski (1992, p. 407), there is a time-space discontinuity between the design and use of technology[3], because development and use are accomplished in different organizations and the development of an artifact nearby inevitably precedes its use. This notion is actually the same as the main idea proposed by Berger & Luckmann (1966) except that they generalize the notion to the whole of our everyday reality: "... a world that originates in their thoughts and actions, and is maintained as real by these" (ibid., p. 33). As a consequence "users of technology often treat it as a closed system or a 'black box', while designers tend to adopt an open systems perspective on technology" (Orlikowski, 1992, p. 407). My interpretation is somewhat different: It is not the question about a time-space discontinuity but about skills-knowledge discontinuity, i.e. users do not posses the necessary knowledge for opening the 'black box'. This time-space discontinuity also contributes to the reification of technology thus hiding the human agency that initially produced the technology. Further, according to Orlikowski (ibid., p. 421) there exists the following causal link: "The greater the temporal and spatial distance between the construction of a technology and its application, the greater the likelihood that the technology will be interpreted and used with little flexibility"[4].

The conclusions presented above may be valid from the theoretical perspective used by Orlikowski but the results of my SSM analysis in combination with the proposals of Berger & Luckmann (1966) lead to an other interpretation.

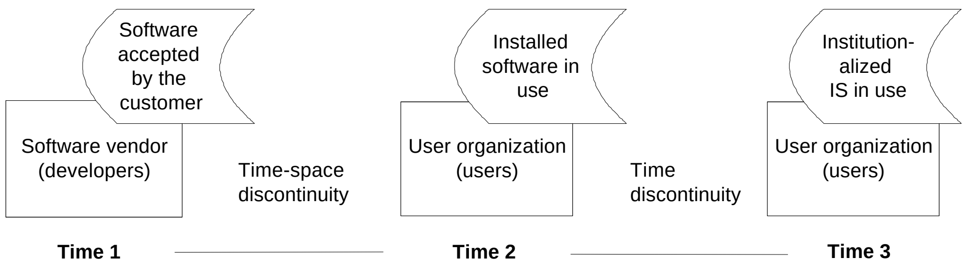

Figure 2. Time-space discontinuity of software development and IS use and the appropriate actors.

First, according to my SSM analysis the 'outputs' of the software vendor and the user organization are not the same: for the vendor the software is an object of work and for the user organization it should be a tool, i.e. it is a different human agency that has created the software and the institutionalized IS (c.f. the root definitions and Figure 2). As a consequence, also their interpretations are different. Under these

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[3] The main finding of this paper, which is based on the structuration theory, is that technology has a dual nature; technology is physically constructed by actors working in a given social context, and technology is socially constructed by actors through the different meanings they attach to it and the various features they emphasize and use (Orlikowski, 1992, p. 406).

[4] The term 'interpretive flexibility' is introduced by Orlikowski and refers to "the degree to which users of a technology are engaged in its constitution (physically and/or socially) during development or use" (Orlikowski, 1992, p. 409).

circumstances it is rather natural that parts of the software appear as a black box to the users, because they are interested in getting their work done, not to study computer science or programming. As Berger & Luckmann (1966, p. 57) have, introspectively, noted:

> "... a large part of the social stock of knowledge consists of recipes for the mastery of routine problems. Typically, I have little interest in going beyond this pragmatically necessary knowledge as long as the problems can indeed be mastered thereby".

Second, the separation of technological development from use may indeed enhance reification of technology, but I understand reification more as a result of a process than as the process itself. At least in this case, the process producing reification is user learning and it has to do with time but not with space. So, according to my interpretation, Orlikowski's claim that the time-space discrepancy between Time 1 and Time 2 (Figure 2) would have effect on the visibility of human agency, is false. Namely, the constructed nature of technology does not disappear because time elapses and the software is produced and used at different locations, but because users learn to use the software in their daily routines, i.e. the software is turned from a software product into a institutionalized IS. This learning process can not, however, begin before the Time 2 (Figure 2), i.e., before the software has been constructed. In this learning process, the space of construction is a rather irrelevant factor.

Third, the interpretative flexibility of technology does, indeed, diminish when time elapses[5]. I do not see that the spatial distance would make here any difference. The time count does not, however, begin from Time 1 but from Time 2, because the interpretive flexibility can not begin to diminish before the software is in use, can be learned, and become part of the objective reality of the users. So, the time discontinuity between Time 2 and Time 3 is of importance for the interpretative flexibility of the software. The reduction of the interpretive flexibility of a technology is not, however, a negative but a positive phenomenon: in practice, the coordinated use of an IS would not be possible if the interpretive flexibility of the IS would not diminish, i.e. the users must create a shared interpretation of the IS. As Maturana (1988, pp. 7 - 8) has noted, common knowledge is a presupposition of all coexistence of humans:

> "... disagreements between the observers, when they arise not from trivial logical mistakes within the same versum but from the observers standing in different versa, will have to be solved not by claiming a privileged access to an independent reality but through the generation of a common versum through coexistence in mutual acceptance. In the multiversa, coexistence demands consensus, that is, common knowledge".

The reduction of the interpretive flexibility takes place through user learning and leads to the institutionalization of the IS. According to Berger & Luckmann (1966, pp. 70 - 77), when any action is repeated frequently it becomes cast into a pattern,

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[5] If we are examining one, unchanged technology in one context. However, the interpretive flexibility of computers in general has greatly increased since the 1950s when computers were used for calculation - now computers are applied in every thinkable electronic equipment.

i.e. becomes habitualized[6]. When a group of people (e.g. users of certain software) form a reciprocal typification of certain types of habitualized actions, the typification becomes institutionalized. These typifications are built up in the course of a shared history of the group of people. When institutionalized, the typification begins to control human conduct irrespectively of the possible sanction mechanisms (the primary social control). It is important to note from this process description of institutionalization, that what gets institutionalized is not only the installed software, but also all other elements of work which are affected (changed) by the installed software. The number and type of affected variables is context dependent, but typical elements are, for example, division of labor, work procedures, and control structures. Users who join the organization after the institutionalization of the IS have only a marginal effect on the earlier established IS institution and they are adapted into the institution through the process of secondary socialization. In secondary socialization actors internalize the ‘reality’ of some institution. Secondary socialization can be defined as “the acquisition of role-specific knowledge” (Berger & Luckmann, 1966, p.158). The (obvious) differences between the learning process of the users who create the institution and who become socialized into an existing institution is an interesting question but falls outside of the scope of this paper.

The institutionalization process of an IS begins when a software product has been technically implemented and tested and people should begin to use it in their daily work tasks. According to the concepts applied in this paper, this means a shift from the institution of software development to the institution of information system use. Kling and Allen (1996) have called this phase organizational implementation. By introducing the term “organizational implementation” they want to highlight the position that implementation should not be considered as just coding a program but the effective use of computing requires further measures, which are social, psychological, and political rather than technical. Organizational implementation means “making a computer system accessible to those who could or should use it, and integrating its use into the routine work practices” (ibid., p. 269). This integration process is never an easy task and requires a shift of the perspective: “Organizational implementation is different from the strictly technical conception of implementation as coding a program” (ibid., p. 269). The way out of the problems encountered during the organizational implementation is according to Kling & Allen (ibid.) rather simple: the students of information and computer science shall be taught “… how organizations behave …” in order to avoid professionals “… who avoid working on both social and technological issues …” (ibid., p. 264). In their text, however, they do not make a clear distinction between when they are speaking about technical and social aspects of *artifacts in use* and when about the *development of artifacts*.

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6 Berger & Luckmann (1966, p. 70 - 72) prefer the concept ‘habitualization’ to learning. They may have chosen the concept habitualization because it refers as well to intentional as to unintentional learning. I prefer the concept ‘learning’ because its meaning is commonly understood.

To me their solution (knowledge of technical principles and ‘how organizations behave’) does not, however, feel right. In the contrary, to me this is an explication of the principle of technological determinism (technological imperative): if the principles of technology and the principles of organizations were known we would be able to calculate and plan the organizational implementation in the same manner as the technical implementation. I argue, however, that if the situation would be this easy the solution would have been already found, it would have become institutionalized, and replicated in all software development and implementation processes. This argument is supported by the fact that it is much easier to find descriptions of failures than successes in the research literature of IS (e.g. Landauer, 1995; Sauer, 1993; Star & Ruhleder, 1996). I think that even if failures are rather common in the ‘IS reality’ the overemphasis on failures has a methodological and epistemological grounding: It is easier to pick out some phenomena in a process, show that they are sub-optimal, and point out their possible causes than to show that a process is the best ever possible and show which all elements or factors are contributing to its excellence.

If my interpretation – the transformation process *Installed software* → *Institutionalized IS* is a learning process of the users – is correct, we should not spend all the resources on the technical infrastructure, software, or education of IS professionals. What is needed instead is that users have a reasonable chance and resources for turning the installed software into an institutionalized information system. In practice, this learning process can be promoted with user education and training, adequate support, and time.

4 Conclusions

The results from my SSM-based analysis of the institutions of software development and IS use suggest that it might be better to make the distinction between them clearer than to try to merge them. This conclusion is based on the notion that the scientific principles applied in natural sciences (logical empiricism) seem to support the efforts in the institution of software development whereas their applicability is rather limited in the institution of IS use, where the theories of social science (hermeneutic-dialectical) seem more appropriate. This is in accordance with what Radnitzky (1970, p. 1) states in his analysis of the major contemporary schools of metascience: “Hermeneutic-dialectical philosophy has a metascience to the human sciences only. ... Logical empiricists have not developed a special metascience of the human sciences” (If we neglect the idea of the unified science which means that the same principles are universally applicable to everything called ‘scientific’).

As noted by Nissen (1998, p. 194), the decisive point between the traditions is not between the methods of inquiry, but whether the object of study includes human beings or not. As a consequence, we should be flexible enough to change our basic philosophical assumptions according to the problem at hand, i.e. we should choose the philosophical stance which suits the solution of the problem rather than first choose a philosophical stance and then look what kinds of problems can be studied. My proposal for a classification of the problem domain has two categories, software development with an artifact as an output and IS use, which is cooperatively learned behaviour.

It seems that this distinction is gaining practical importance, because of the change from tailor made applications to off-the-self software, which is developed in ‘software factories’ according to the norms of industrial production. Future users have usually only a minimal role in this kind of production system and if users participate, they often come from a different culture (e.g. from the USA for software used in Europe). This distinction may also help to increase the relevancy of the research of the deployment of information technology in organizations, for example, in the field of information systems development research: According to the analysis of Iivari and Lyytinen (1998), there are a total of ten Scandinavian information systems development approaches and only two of them have gained some importance in practical use. These ‘usable’ approaches are ‘the infological approach’ and ‘the formal approach’ - and both of them have their theoretical roots in formal logic.

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Appendix (Markku I. Nurminen's curriculum vitae and list of publications)

Curriculum vitae
May 15, 2003

Markku Ilmari Nurminen

Born	11.6.1943 in Tampere, Finland
Student	1960, Tampere, Finland
BSc	1963, University of Turku, Finland
MSc	1966, University of Turku (Applied Mathematics, Statistics, and Philosophy)
Lic.Sc	1968, University of Turku (Applied Mathematics)
PhD	1976, University of Turku (Computer Science, Information Systems)

Military Service 1968-1969 (11 months); ensign

Full time positions held

1.1.1966-31.8.1967 Research assistant (applied mathematics) at the University of Turku

1.9.1967-31.12.1967 Research assistant (musicology) at the University of Helsinki

1.9.1969-31.7.1971 Mathematician at the University of Turku

1.8.1971-31.7.1972 Lecturer (MIS) at the Turku School of Economics

1.8.1972-31.3.1977 Assistant professor (MIS) at the Turku School of Economics

1.4.1977-31.12.1978 Acting associate professor (MIS) at the Turku School of Economics

1.1.1979-31.12.1981 Assistant professor (MIS) at the Turku School of Economics

1.1.1982-31.7.1983 Professor (informasjonsvitenskap) at the University of Bergen

1.9.1983-30.6.1988 Associate professor (Computer Science) at the University of Turku

1.1.1986-30.6.1986 Professor at the Åbo Akademi University (Computer Science), Turku, Finland

1.7.1988-31.7.1990 Professor (Computer Science) at the University of Jyväskylä, Finland

1.8.1990-31.12.1996 Associate professor (Computer Science, Information Systems) at the University of Turku

1.1.1997- Professor (Computer Science, Information Systems) at the University of Turku. Since 1.1.2002 part time (60%)

Major part time positions held

1963-8 Part-time worker (systems analysis and design, programming) IBM Finland
1.9.1972-31.5.1973 Associate professor II (MIS) at the Helsinki School of Economics
1.8.1983-31.7.1984 Professor II (informasjonsvitenskap) at the University of Bergen
1.7.1984-31.12.1984 On the leave for a research grant (Academy of Finland)
1.7.1988-30.6.1989 On the leave for a research grant (Academy of Finland)
1.3.1994-31.10.1997 Part time (20%) professor in Informatics (IS Development) at the University of Oslo, Norway
1.7.1994-30.6.1995 On the leave for a research grant (Academy of Finland)

Major research projects

1985-1989 *Knowledge and Work*, mainly financed by the Academy of Finland
1988-1990 *XTEND: System description embedded in the user interface*, mainly financed by the Finnish Work Environment Fund
1994 *IS Usability at Work*, Finnish Work Environment Fund
1994-1996 TEKES: Grant for unemployed recent Masters
1994 *Uniecon - Modelling the Economy and accounting of a University*, Ministry of Education
1994-1995 *Information System Usability and Exploitability: A Life-Cycle Model,* Academy of Finland
1996-1998 *New Dimensions of Skills and Knowledge – Deployment of Information Technology,* Finnish Work Environment Fund
1996 *ONION: Model of Information System Exploitation*, Academy of Finland
2000-2003 *Hanska: Implementation of ERP as an Organisational Learning Process*. A joint project with VTT and University of Jyväskylä. Finnish Work Environment Fund, TEKES and Ministry of Labour.
1985- Customer Projects, 11 organisations

Other interesting roles

1993- Head of the *Laboratory for Information Systems Research* at the University of Turku, named *Laboris*
Member of **ACM**, **AIS** and **IEEE** Computer Society
Member of IFIP's **WG 9.1.** and friend of **WG 8.2.**
Supervisor of eight **doctoral theses**
Per Flensburg, 1986, Lund University
Riitta Hellman, 1989, University of Turku
Inger Eriksson, 1990, Åbo Akademi University
Kristin Braa, 1995, University of Oslo
Timo Käkölä, 1996, University of Turku
Jens Kaasbøll, 1996, University of Oslo

Annita Fjuk, 1998, University of Oslo
Vesa Torvinen, 1999, University of Turku

Opponent or evaluator in ten **doctoral dissertations** (in four Nordic countries)
Göran Goldkuhl, 1980, University of Stockholm
Jouni Similä, 1983, University of Oulu
Andreas Munk-Madsen, 1984, Aarhus University
Gunhild Sandström, 1985, Lund University
Kalle Lyytinen, 1986, University of Jyväskylä
Pelle Ehn, 1988, Umeå University
Gro Bjerknes, 1990, University of Oslo
Kari Kuutti, 1994, University of Oulu
Timo Auer, 1995, Turku School of Economics
Hannakaisa Isomäki, 2002, University of Tampere

Member in the program Committee of **NordDATA 86** (Stockholm)

Program Chair of the IFIP WG 9.1. Working Conference on **Human Jobs and Computer Interfaces** in Tampere, June 1991

Member in the program Committee of the **Computers in Context** conference (Aarhus 1995)

The Finnish member in the editorial group of the **Scandinavian Journal of Information Systems** 1988-1993

Head of the Steering Committee of the **IRIS** (Information system Research in Scandinavia) Association 1997-1999

Head of the Board of the **Library of the University of Turku** 1996-2001

Coordinator of the National (Finnish) **Doctorate Program in Information Systems Research** 1997-1998

Numerous **reviews** for several international journals and conferences

Numerous **expert statements** on research proposals, doctoral and licentiate theses, qualification of applicants etc.

Evaluation of education in **five universities in Sweden**, March 1993, with Gordon B. Davis and Pertti Järvinen

Evaluation of the research activity at the Department of **Informatics and Business Accounting at the Copenhagen Business School**, October 1995, with Sten Jönsson

Principal clarinetist in Akademiska orkestern, Åbo, 1992 Sep -

Markku I. Nurminen
List of publications and research reports
April 15, 2003

1. *Etsintäprobleema yksinkertaisessa metsämaastossa* [Search Problem in a Simple Forest Terrain]. Unpublished Licentiate Thesis, **University of Turku**. 1968. 90 pages.
2. *Kolmen prinssin kosiomatka, peliteoreettinen pohdiskelu*. [The Courting of Three Princes, an essay on Game Theory] **RUK 129** [Publication of the Reserve Officers' School] , Hamina. 21.3.1969. 4 pages.
3. *Tietokone musiikin palveluksessa.* [Computer Aid in Music] **Uusi Suomi.** 27.10 1969.
4. *Suomalainen tango: analyysi ja sävellysmalli.* [Finnish Tango: Analysis and Composition Model] **Musiikki** 2, 1971, pp. 29-37.
5. *Ohjelmointikieli LISP. MIS-71 Työryhmän raportti.* [Programming Language LISP, an experiment] **Publications of the Turku School of Economics (PTSE)** CI-2:1971.
6. *Report of an Information Retrieval System for Linguistic Studies* with Y.A. Karjalainen. **NordDATA 72 Konferensföredrag** [Proceedings], 1972, pp. 1998 - 2010.
7. *Futsisuus - täsmällistä epätäsmällisyyttä.* [Fuzziness - Precise Impreciseness] **ATK:n tietosanomat** no 11-12, 1974, pp. 30-31.
8. *Some Problems in Automatic Process Grouping and File Consolidation,* with Timo Järvi. **BIT** 14, 1974, pp. 416 - 429.
9. *Informaatiojärjestelmä ja ohjausjärjestelmä* [Information System and Control System]. **Turun Kauppakorkeakoulu 1975 Tutkielmia [Research Papers]. PTSE** AII-1:1975, pp. 273 - 284.
10. *Informaatiosysteemin määritelmä ja informaatioanalyysi* [Definition of Information System and Information Analysis]. **PTSE** AI-2:1975. 54 pages.
11. *About the Fuzziness in the Analysis of Information Systems.* **Proceedings of the 4. European Meeting on Cybernetics and Systems Research**. 1978, pp. 337 - 345.
12. *About the Structural Restrictions in the Description of Information Systems.* **Tutkielmia ja tutkimusraportteja [Research Papers and Reports] 1976. PTSE** A-2:1976, pp. 143 - 161.
13. *Some Remarks on the Fuzzy Approach to Multigoal Decision Making,* with Antti Paasio. **The Finnish Journal of Business Economics** 3, 1976, pp. 291 - 302.
14. *Studies in Systemeering; On Fuzziness in the Analysis of Information Systems.* **Publications of the Institute for Applied Mathematics, University of Turku**, no 9, 1976. Doctoral Thesis. 204 pages.

15. *Deep and Surface Structure of the Information System.* **Tutkielmia ja tutkimusraportteja [Research Papers and Reports] 1977. PTSE** A-3:1977, pp. 140 - 152.
16. *Subjective versus Objective Systemeering.* **Proceedings of NOAK-77** [Nordic Conference on Operation Analysis]. 1977, 11 pages.
17. *Tietokanta ja informaatioanalyysi.* [Data Base and Information Analysis] **PTSE** A-9:1977. 13 pages.
18. *Eräitä huomioita systemoinnista hajautetun tietojenkäsittelyn yhteydessä.* [Some Remarks on Systemeering in Distributed Environment] **PTSE** A-10:1977. 22 pages.
19. *Properties and Problems of a General-Purpose Data System* **Summary Report of the Systemeering Research Seminar of Tampere 21.-24.8.1978**. Finnish Data Processing Association, 1/79. 1979, pp. 126 - 135.
20. *Systemoinnin teoriasta.* [On Theory of Systemeering] **Ajantasa** 2/1979. 2 pages.
21. **Report of the Scandinavian Research Seminar on Systemeering Models**. Dragsfjärd, 23.-25.5. 1979. Edited by <u>Timo Järvi</u> and Markku Nurminen. 161 pages.
22. *Some General Comments about the PSC Model of Systemeering* **Report of the Scandinavian Research Seminar on Systemeering Models**. Dragsfjärd, 23.-25.5. 1979. Edited by Timo Järvi and Markku Nurminen, pp. 92-95.
23. *The Role of the Information System as a Party to the Communication Process.* **NordDATA 80 Konferensföredrag** [Proceedings]. 1980, pp. 966 - 971.
24. *On Teleological Aspects of Information and Information System* **Report of the Third Scandinavian Research Seminar on Systemeering Models**. Saarijärvi, 18.-21.8.1980. Edited by Kalle Lyytinen and Eero Peltola, pp. 206 - 223.
25. *Sumeus systeemissä ja systeemityössä.* [Fuzziness in Systems and Systemeering] Paper published at the Symposium on Systems Development arranged by the **Finnish Data Processing Association** 3.-4.12.1980, 8 pages.
26. *Systemoinnin sekaannustila, yritys kuvata ja jäsentää nykytilannetta.* [Confusion in Systemeering, an Attempt to Outline the Situation Today] **Sytyke** 6/1981, 11 pages.
27. *Against System. A Human Perspective on Information Processing* **Report of the Fourth Scandinavian Research Seminar on Systemeering**. Oulu, 17.-20.8.1981. Edited by Pentti Kerola and Erkki Koskela, pp.141 - 147.
28. *Ihminenkö systeeminsuunnittelun hankalin ongelma?* [Man, the Most Awkward Problem in Systemeering?] Paper published at the Symposium on Systems Development arranged by the **Finnish Data Processing Association** 8.-9.12.1981, Helsinki. 14 pages.

29. *A Logical Model for Distributed Computer System* **Progress in Cybernetics and Systems Research** Vol XI. Mc Graw-Hill, 1982. Edited by Robert Trappl, Nicholas V. Findler, and Werner Horn, pp. 91 - 97. (Fifth European Meeting on Cybernetics and Systems Research, Wien 1980)

30. *Human-Scale Information System.* Lecture notes, **Institutt for Informasjonsvitenskap** [Department of Information Science], University of Bergen. 1982, 98 pages.

31. *Sumea joukko ja eräitä sen ominaisuuksia* [Fuzzy Set and some of its Properties]. Unpublished manuscript, intended as a chapter in a book with coauthors Christer Carlsson, Olavi Hellman, Jorma Mattila ja Hannu Nurmi. 1982, 23 pages.

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33. *Informaatiosysteemin olemus* [The Essence of the Information System]. **ATK:n tietosanomat** 6/1982.

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35. **Report of the Sixth Scandinavian Research Seminar on Systemeering**, Øystese, Norway, 8.-11.8.1983. Edited by Markku I. Nurminen and Harald Terje Gaupholm.

36. *Analoginen ja digitaalinen informaatio* [Analog and Digital Information]. Paper published at the seminar People's Systems and Systems' People. 9.-10.9.1983, 15 pages.

37. *Informaatioyhteiskunta tulee* [Information Society is Coming]. **Korkeakoulutieto** 1/1984, ss. 19-21.

38. *Tre forskjellige tolkninger av begrepet informasjonssystem* [Three Different Interpretations of the Concept Information System] Lecture notes, **Institutt for Informasjonsvitenskap** [Department for Information Science], University of Bergen. 1984, 17 pages.

39. *Values in Systems Development - A Humanistic Perspective* Paper presented at the **TIMS** (The Institute of Management Science) XXVI Conference, Copenhagen, 17.-21.6.1984, 24 pages.

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42. *Tietojärjestelmä, työ ja organisointi. Tietotyöprojektin esitutkimusraportti* [Information System, Work and Organizing; Preliminary Report of the Research Project Knowledge and Work], with Riitta Kalmi, Pirkko Karhu and Jukka Niemelä. **University of Turku, Department of Mathematical Sciences, Computer Science** A 43 1986. 126 pages.

43. *Kolme näkökulmaa tietotekniikkaan.* [Three Perspectives into Information Technology] **Werner Söderström OY** 1986. 214 pages.

44. *Tietokone kulttuuriesineenä/Datorn som kulturföremål* [Computer as Cultural Object] **Uusi teknologia, työ koulutus/Ny teknik, arbete, utbildning** Delegationen för Arbetslivsfrågor, Helsingfors 1986 (Svensk-finländskt seminarium 13.-14. juni 1986) pp. 23-36.

45. *Information Systems Quality versus Quality of Work: Is there any Difference?* **Report of the Ninth Scandinavian Research Seminar on Systemeering**, Lund 1986, edited by Hans-Erik Nissen and Gunhild Sandström, pp 1- 15.

46. *Use or Development of Information Systems: Which is more Fundamental?* with Riitta Kalmi, Pirkko Karhu and Jukka Niemelä, **System Design for Human Development and Productivity: Participation and Beyond, North-Holland 1987** (Proceedings of the IFIP TC9/WG 9.1 Working Conference Berlin, GDR, 12-15 May 1986), edited by P. Docherty, K. Fuchs-Kittowski, P. Kolm and L. Mathiassen. pp. 187 - 196.

47. *Different Perspectives; What Are They and How Can They Be Used?* **System Design for Human Development and Productivity: Participation and Beyond, North-Holland 1987** (Proceedings of the IFIP TC9/WG 9.1 Working Conference Berlin, GDR, 12-15 May 1986), edited by P. Docherty, K. Fuchs-Kittowski, P. Kolm and L. Mathiassen. pp. 163 - 175.

48. *How to Work with Paradigms?* **The Report in 10th IRIS Seminar**, Tampere 1987, edited by Pertti Järvinen, pp. 603 - 619.

49. *Raportti työ- ja tietojärjestelmätä elintaviketehtaan lähettämössä* [Report on the Work System and the Information System in a Food Industry Company's Inventory] with Inger Eriksson, Anneli Finneman, Jukka Niemelä and Marjo Snellman **Turun yliopisto, Tietojenkäsittelyoppi.** Raportti A 50, Joulukuu 1987. 68 sivua.

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51. *Är det informationstekniken eller människan som är den viktigaste strategiska resursen?* [Which is the most important strategic resource, information technology or people?] **NordDATA 88 Konferensdokumentation** [Proceedings] Helsinki. Vol. 3, pp. 153 - 158.

52. *Human Acts or Computer Functions?* **Report of The 11th IRIS** (10.-12.8.1988, Røros, Norway), edited by Jens Kaasbøll, pp. 441 - 460.

53. *People or Computers: Three Ways of Looking at Information Systems* **Studentlitteratur & Chartwell Bratt**. 1988. 202 pages [English translation of the publication #43].

54. *Palkanlaskenta ja tietojärjestelmä Kaarinassa* [Payroll Work and Information System in a Municipality] with Jukka Niemelä and Riitta Hellman **Turun yliopisto.** April 1988. 25 pages.

55. *Materiaaliosaston toiminta ja tietojärjestelmä* [Activity of a Purchase Department and its Information System] with Pia Ketola and Jukka Niemelä **Turun yliopisto, Tietojenkäsittelyoppi.** March 1989. 22 sivua.

56. *System Maintenance and Organisational Change* with Pål Sørgaard and Ulf Forsman **Proceedings of the 12th IRIS** (August 1989) (ed. by Susanne Bødker). pp. 567-586.

57. *Ihminen ihmisenä ja tietokone tietokoneena* [People as People and Computers as Computers] **University of Jyväskylä, Department for Computer Science** Tutkimuksia [Research Papers) TU-7, December 1989. 8 pages.

58. *Tietotyöprojektin loppuraportti* [The Final Report of the Project Knowledge and Work 1985-1989] **Turun yliopisto**, Tietojenkäsittelyoppi. 12.1.1990. 16 pages.

59. *Transaction Types and Information Systems.* **Organizational Competence in System Development A Scandinavian Contribution** (ed. by Gro Bjerknes, Bo Dahlbom et al.) Studentlitteratur, Lund, Sweden. 1990 pp. 149-172.

60. *Tietotyön opastusjärjestelmä: Kohti hallittua tietotyötä. Loppuraportti hankkeesta XTEND "Järjestelmäkuvaus käyttöliittymän osana"* [Support and Help for Knowledge Work: Towards Better Control. Final Report of the XTEND Project] **Turun yliopisto**, tietojenkäsittelyoppi. 30.12.1990. 58 pages.

61. *Information Systems in Transaction Networks*. **Information System, Work and Organization Design**, Proceedings of the IFIP TC9/WG9.1 Working Conference, Berlin, GDR, 10-13 July, 1989 (ed. by P. van den Besselaar, A. Clement and P. Järvinen) North-Holland 1991. pp. 3-21.

62. *A Subject-Oriented Approach to Information Systems* **Software Development and Reality Construction** (ed. by C Floyd, H Züllighoven, R. Budde and R. Keil-Slawik) Springer-Verlag 1991. pp. 302-311.

63. **Human Jobs and Computer Interfaces** Proceedings of the IFIP WG 9.1 Working Conference, Tampere 26-28 June, 1991 (ed. by M. I. Nurminen and G. R. S. Weir) North-Holland 1991.

64. *Preface to the publication #63* with George R. S. Weir. 1991. pp. v-ix.

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