

Project:
Requisite information collaboration and knowledge management

(SIRICUM Studies in requisite information collaboration and knowledge management)

Project objective:

Within an action research framework the project aims to contribute to a knowledge management enhanced vigilance and flexibility in software development at Scandinavian IT Group (SIG). The action research approach stipulates that researcher and practitioner have a joint venture and some common interest in addressing a selected set of real-life problems.

In the practice-oriented part of research, the researchers will collaborate with SIG to improve software engineering processes respecting the RUP methodology adopted at SIG.

We expect to find ways how SIG may better take advantage of internal and external resources, apply tools for project management and for distributed collaboration across geographical locations and develop fitting and efficient knowledge management practices within their new organization.

Also, we expect to develop knowledge management methods, mechanisms, and practices framed in a coherent framework (DOB) for analysis of an integrated business development process emphasising design, organisation and business value network and the interdependencies between these, leading to a model of requisite information collaboration and knowledge management.

Context of the project:

A new organization is to be launched by a major part of SIG in the autumn of 2002.

The management of SIG takes an interest in how performance in the new organization develops. Therefore the research group is invited to suggest measures of organizational performance and to take into consideration the use and effect of knowledge management tools.

The organizational development of SIG and its emphasis on new knowledge network support tools offer the research group a unique opportunity to address very interesting issues of application development and to work closely together with a major software company. The project is scheduled to run for three years.

The project also provides research opportunities to four PhD students.

Research outline:

The research group considers software development within a framework that is wider than those of classic models (see beneath for positioning within the research community).

Competitive advantage from innovative application development requires an integrated framework for software engineering. We consider the DOB framework as a set of propositions with which to approach this challenge.

The framework of the research project stipulates the interconnection between design, organization and business value network (DOB) as three focal objectives in (see table 1).

Table 1. The DOB framework

<i>Focal objectives</i>	<i>Conditions</i>	<i>Process</i>	<i>Performance objectives</i>
<i>Design</i>	Resources Structural and process conditions	Project management Participation Goal achievement	Operational efficiency and effectiveness
<i>Organization</i>	Entrepreneurship Commitment Ownership	New services Decision support Coordination	Process efficiency and effectiveness
<i>Business value network</i>	Purpose Finance Business partners	Assets management Form of competition Partnerships	Business effectiveness (profitability)

The figure reflects processes of application development present in all software engineering though not always highly integrated. We do not consider design, organization and business value network as stages in development (Soh & L. Markus 1995). We will focus on three mutual relationships outlined in figure 1 as relations between the focal objectives in studying software development because we find those relationships decisive to improve business value of software engineering processes. The objective of the DOB framework is to bring together the different units of the organization responsible for each part of the software.

The idea of software as both product and process to the designers, implementers as well as the end-users imposes an inclusive methodology, which will try to develop within the DOB-framework. We will research if distributed knowledge management above information management and communication add new insights and understanding to our methodologies and models of collaborative software development. And we will pursue the methodology of workflows and CSCW fully aware of their different positions. We will study if knowledge flows reaching into the business value proposition contribute significantly to software design processes and we will study if and how pre-requirement specifications can be enhanced by business value networks methodologies.

Figure 1. Relationships in the DOB-framework

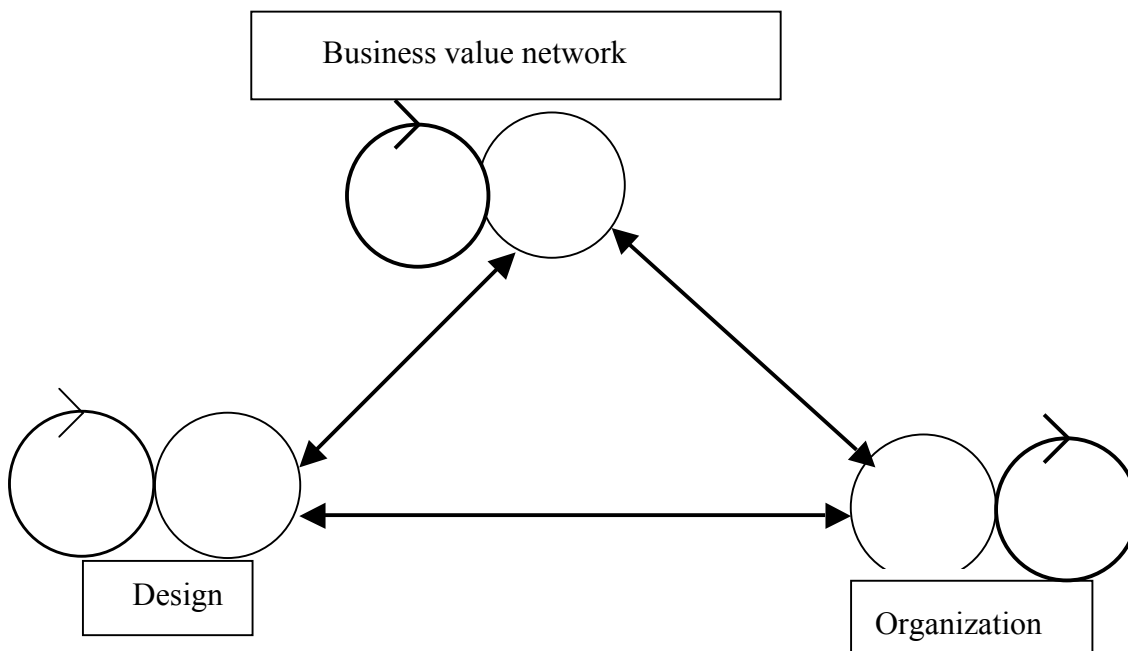


Figure 1 illustrates the relations between the three focal objectives: business value network, organization and design as mutual while at the same time as reflective interdependencies, which means that design (e.g. as methodology) reflects upon design (e.g. as processes) and organizing relates to organization, and business value reflects on a range of value processes. Briefly, we consider the interaction of the focal objectives, which at the same time are situated each in their respective rationality and set of conditions. Thus, we do not subscribe to any reductionist methodology. Beneath, we outline action research opportunities within the framework by following the three relations between and within the focal objectives in figure 1 suggesting four highly interrelated projects.

Project A:

We will look at the *design* process as a *collaborative* process with distributed knowledge and information workflows.

Workflows with distributed activities have been used for many years as buying, production, selling, logistic, and management often are distributed activities. Normally, these activities are managed manually but supported by computers' information processing. However, in recent years, many different transaction models have been proposed as a tool to manage workflows. Most of the new transaction models try to relax the ACID (Atomicity, Consistency, Isolation and Durability) properties in order to get better performance, parallelism, and availability (Frank 1999, Frank & Zahle 1998). CSCW systems and workflows can support distributed software engineering and knowledge management if coping with the ACID properties. Therefore the objectives of our research in transaction models are the following:

- Analysis of the problems in software engineering, which arise when the ACID properties are relaxed.
- Analysis of the special problems of using relaxed ACID properties in CSCW and Knowledge Management workflows.
- Analysis of old and new solutions to the problems.
- Evaluation of the different solutions.

The vision is to describe and evaluate solutions to the problems that occur when relaxed ACID properties are used. By using SIG as a case we hope that theory and practical problems can inspire to innovative solutions.

The design process is collaborative. Software engineering takes advantage of a multitude of tools amongst which collaboration tools (e.g. e-mail, conference systems, web-sites, document sharing, subject catalogues, keywords) are increasingly becoming vital to the progress and coordination with and between groups of developers (Bjørn 2002). How to successfully implement groupware in distributed collaborative settings needs exploring to answer: How one succeeds in getting distributed groups better to collaborate by the use of groupware? These questions we place as part of knowledge management issues focusing on the organization part of the DOB framework.

The organizational implementation of groupware technology is an issue that focus on how to introduce the groupware and start the collaborative process. Organizational implementation looks on how to establish the foundation of collaboration in groups. In a use-of-groupware context we need not only focus on the action but also on the exception handling - when the work is not going as we planned. Then we can identify the situated actions of the use of groupware, and use this knowledge to establish and maintain the collaboration suggesting a range of means and mechanisms. When working in a cooperative context there is also an issue concerning the actual collaboration between the individuals. This issue is especially difficult if in a distributed setting without person-to-person meetings. It may be hard to get an informal 'conversation' in distributed (virtual) groups unless social relations have been established previously. Without relation-building mechanisms developers may become in choose their collaborators conservatively reducing organizational dynamics and jeopardizing performance.

Since most groupware is developed as generic systems and therefore not adjusted to the specific situation or context of the company one of the main activities of a groupware implementation is the selection of proper technology. The joint venture of the action research with SIG concerning organizational implementation and use of groupware in distributed groups can be formulated as: How can we together explore ways to establish and support distributed groups and integrate the use of proper groupware?

Summary of project A:

Emerging relationship between *design* (software engineering workflows) and *organization* (collaboration in distributed groups) in order to explore: How to develop and calibrate characteristics of distributed knowledge and information workflows in software engineering to organize collaborative, distributed groups supported by groupware?

We expect to develop guidelines for organizational implementation of these new knowledge and information workflows supporting collaborative software engineering practices for better software engineering.

Project B:

The relation between *design* and *business value network* emerges from the perspective of strategic alignment, which, in its current form is constrained by the fact that IT-designers – and in particular IT-design projects – seldom have the mandate to critically examine, evaluate (and develop) business related IT-strategies.

The challenge, how to get designers into business process modelling and how to get business consultants into design, has rarely been realized. In a deductive and linear system development (the waterfall approach) business objectives have been transformed into requirement specifications with little reference to business value opportunities. Adoption of new methodologies (the pre-assessment approach called MUST, cf Bødker et al) and further enhancements like performance-based procurement may transform the relationship between design and business value networks if properly supported.

In particular, an investigation of the value proposition from the company and the experienced value proposition of the customer may unfold a multi-dimensional understanding of direct and indirect performance-based measures and implications for process efficiency and effectiveness.

The research questions addressing these issues are which characteristics of value may be defined, and to what extent and how are the characteristics of value supported by or are goal-setting for the business processes?

In addition to this, we will search for patterns and recurrent processes that inform the MUST approach across software development projects. In stead of relying on self-reporting designers and developers we will introduce "friendly" software agents to reveal emerging content patterns applying filtering techniques based on profiles, search strings, work history and other "flags". Tools supporting distributed systems development and software engineering cannot survive if not proving conspicuously helpful yet acquired with little effort. The software agents we will introduce respect the fact that distributed collaborators need more than formal document exchange tools. People need informal support and the agents should rightly be perceived as "nice little helpers". Their design and their introduction in the organization could eventually be a joint effort of SIG and the researchers. We consider this an approach to interface e-learning as a tool for organizational learning.

Summary of project B:

The focus on innovative applications transform the business value network from a narrow efficiency approach to an application portfolio focus where business value derives from interconnectivity and compatibility amongst applications across businesses within a company and amongst business partners in the value network.

Systems development will be approached with a pre-requirement methodology integrating business objectives development to achieve operational measures at the value level directing designers to form the necessary understanding in a relevant context of user-applications. To stimulate interdisciplinary and cross-organizational collaboration various types of supporting tools may be conceived and experimentally adopted.

Project C:

A study of relationship between *organization* and *business value networks*.

Development of business value networks requires ways to decide value measures in a network context and the instruments of their measurement (Pedersen et al 2002). Linking these measures to the design of software must take place using models and methodologies that captures the interdependencies in the business objectives, values of performance, and ensuing design requirements.

In previous research a product model methodology has been suggested, and in this research it will be further developed as a decisive mechanism to interrelate business value, application development and *design*, hereby to address exchange of emergent as well as maintenance knowledge, and to address the extent to which product models may facilitate the knowledge exchanges (Pedersen and Larsen 2001, Pedersen 2001).

Exploring how knowledge management of the product model development processes may strengthen its support of both value networks and organization of information systems development (ISD) is a keen part of the research (Larsen and Pedersen 2002).

In relating product models to workflows, a synthesis of process and product models may be explored with the purpose of proposing a knowledge management tool for quality assurance and exchange of knowledge related to the development and the order fulfilment process (Pedersen 2002).

The process of ISD is distributed, as is the characteristics of a product model valid across several contributing business lines and business partners. How to integrate the stakeholders in a product model at the level of both transactions and knowledge exchange represents both a practical and a theoretical challenge.

Summary of project C:

The characteristics of business value as a network issue imply equally a distributed model of business, which we suggest in terms of a product model allowing for levels of specifications oriented towards the various contributing (supplying) business partners and at the same time offering a holistic model of the overall business objectives. Merging tools and methodologies bring an opportunity to work out how to bring business value to information systems (applications) development.

Project D:

The previous project outlines have had the DOB-framework objectives as reference. In this activity the very framework is the object to study. It is the ambition of the researchers to learn about practices in SIG and eventually to suggest a range of approaches and tools in an effort to create better software engineering, systems development and collaboration between participants while attending to business value networks.

In the framework a sequence of activities are mentioned, yet we will explore whether the objectives of product and process improvements are better suited by iterative, circular and recurrent activities across design, organization and business value network (Simonsen 1999).

Moreover, we will test the framework epistemologically for necessary and sufficient parameters, and hereby evaluate the robustness of the framework. Other projects have the same ambition. In our joint action research proposal mechanisms and ways of approaching issues identified in previous research and in practice will be subject to an overarching synthesis that may inform

future practice and research and generate positive performance effects in SIG.

We will therefore throughout the whole period keep working on proposing syntheses and conjectures and inform all participants to accumulate their responses and evaluations.

Summary of project D:

Though guided by the DOB-framework the research activities reflect back upon this framework maybe inspiring revisions and new suggestions. From the project activities studied at SIG we will add new mechanisms to help specifying the framework making it more useful and powerful to both practice and research. How far does the framework take us towards an integrated methodology? By which mechanisms and tools does the framework come alive to management, users, developers and designers? And how do we as researchers ourselves take advantage of the framework in designing and implementing our research?

Perspectives:

The four issues have been described in terms that reflect both questions of business, organization and technology since we perceive these as highly interrelated and therefore to be studied in close connection.

For each of the three focal objectives we would like a PhD student to take part in the research since the collaboration with SIG creates a unique opportunity to learn and observe and to do a dissertation.

We conceive the overall framework of this research as an exciting challenge to systems development and software engineering approaches. A PhD project studying the overall framework and its usefulness would complement the more project studies generalizing findings and comparing methodologies across a several research projects that we relate to.

Positioning the research:

The ideas guiding our research take off partly in our previous research and partly in continuation of research carried out internationally and in Denmark. In the research group we have accumulated experience in database research, workflow analyses, CSCW, requirement specification and systems development methodologies, product model engineering, distributed knowledge management, and business value networks (see cv's with lists of references).

The international inspiration derives from research carried out over a decade at at Carnegie Mellon University where the "n-dim" group has pursued in particular, information flows in product development in engineering manufacturing and recently has taken up their ideas in the context of workflow management systems and computer support for cooperative work applying the concept of information spaces for new product design teams (see: <http://www.ndim.edrc.cmu.edu/paperstop.htm>). This group has stressed the importance of participant action research as a necessary approach to develop models of information and knowledge management in relation to design and development. Their studies in product manufacturing engineering may not carry over to software design but will contain relevant lessons we expect. The "n-dim" group's focus has been on design teams in product development and their collaboration with other units in the company (e.g. engineering services support, development and research support). We

suggest an extended model to the n-dim incorporating distributed knowledge management within the business value network, called the DOB-model. Further, we also study the information flow (as one type of workflows) but want to study if and how to conceive of knowledge workflows and (other) collaborative workflows.

Another inspiration we draw from studies at Trento University where a group of researchers supported by European funds is studying the implication for architecture and technologies if adopting a social and subjective rather than an objectivistic epistemology of knowledge (Bonifacio et al 2002). They explore the enterprise portal as a distributed knowledge vehicle contingent upon a context description language with partial mappings between the local community (the team) and the organization wide context using links to semi-automatically map the one on the other. To overcome problems and limitations of simple matching this group suggest communication protocols to implement meaning negotiation between autonomous software agents. To bridge organizational units a broker is suggested to enhance the ability of a team to exchange knowledge across semantic boundaries. Like the n-dim group the suggestions of vehicles to cope with complex social interaction are confined relatively to the work group (design team) whereas the wider organizational universe is treated as a homogenous (outside) group. In our DOB framework we expect to move beyond the technology-for-all issues of knowledge management in enhancing efficiency and effectiveness in software development.

In Denmark a long running research tradition on socio-technical studies has been complemented with studies in software process improvement oriented towards the standard capability maturity model (CMM) (e.g. Mathiassen and Sørensen, 1996, Kautz et 2001). Another line of research is knowledge mapping where identification of who-has-what-knowledge takes precedence over information and knowledge workflows (e.g. Nielsen and Pries-Heje 2001/2002). We take advantage of this research where appropriate but do not want to explore CMM further nor to limit our knowledge approach to knowledge mapping.

Methods:

The research group collaborates closely with SIG management in developing appropriate interventions, like interviews, questionnaires, observations and other means and vehicles for information gathering and assessment during a period of three years.

Research will apply tools to capture and measure the organizational developments taking place at present with the intent to discover ways of working and collaborating within SIG and to map the diversity in approaches and routines in using the RUP methodology and other support tools for software development. We will thus learn how the organization works to fulfil customer requirements and explore business opportunities.

From observations and data on workflows, ways and means of collaboration, information flows, etc. within "groupings" (i.e. teams, organizational units, projects and subprojects) at SIG we will develop the four projects described above. To increase the value of each project we coordinate our research within the DOB framework and develop suggestions how to explore and exploit knowledge management issues and opportunities to enhance organizational learning, flexibility and adaptability.

In studies of value networks we may opt for tracing one or more previously conducted projects and compare them to on-going practice in new projects

conducted within the new organization at SIG to see how this change has been implemented with regard to business value.

We will conduct workshops and seminars with SIG discussing our findings on organizational performance and to develop suggestions of new knowledge management tools, guidelines and organization as part of the overall process of research and action orientation.

We will consult research groups (i.a. those mentioned above) having done research in using collaborative knowledge management tools and eventual we will adopt some of these tools for further development in the context of SIG. Therefore, we may also on a voluntary basis set up small experiments in using some tool and in applying some of the principles derived from our studies in agreement with SIG management.

For each of the projects A to C we will look at the current state of information and knowledge management, develop our knowledge of the SIG organizational changes and their impact on software development, create suggestions and tools for support, assess the validity and value of these in properly scaled tests and experiments, leading to discussions of the results of these with SIG. And we will develop the DOB framework as a research synthesis along with other research findings within each project.

References:

Bjørn, Pernille (2002), IT-støttet projektarbejde – i geografisk adskilte grupper. Speciale, Datalogi og pædagogik, Roskilde Universitetscenter.

Bonifacio, M., Bouquet, P., and Traverso, P. (2002), Enabling Distributed Knowledge Management: Managerial and Technological Implications. *UPGRADE* vol. III, No. 1, February, 24–30.

Bødker, K., F. Kensing, J. Simonsen (2002), "Changing Work Practices in Design", in Dittrich, Y, C. Floyd, and R. Klischewski (Eds): *Social Thinking – Software Practice*, MIT Press, Boston.

Bødker, K., Kensing, F. og Simonsen, J. (2000), *Professionel IT-forundersøgelse – grundlaget for bæredygtige IT-anvendelser*. Samfundslitteratur.

Bødker, K., F. Kensing, J. Simonsen (2000), "Changing Work Practices in Design", in Svensson et al., (Eds): *Proceedings of IRIS'23 (the 23rd Information Systems Research Seminar in Scandinavia: Doing IT Together, Lingatan, Sweden 12–15 August 2000)*, Laboratorium for Interaction Technology, University of Trollhättan Uddevåla, pp. 45–60.

Davis, Joseph, G., Subrahmanian, E., Konda, S., Granger, H., Collins, M., and Westerberg, A. W. (2001), Creating Shared Information Spaces to Support Collaborative Design Work. *Information Systems Frontiers* 3:3, 377–392.

Frank, L. (1999), 'Evaluation of the Basic Remote Backup and Replication Methods for High Availability Databases', *Software – Practice & Experience*, Vol. 29, issue 15, 1999, pp 1339–1353.

Frank, F. and Torben Zahle (1998), 'Semantic ACID Properties in Multidatabases Using Remote Procedure Calls and Update Propagations', *Software – Practice & Experience*, Vol.28, 1998, pp77–98.

Kautz, K.H., Westergaard, H., Thaysen, K. (2001), Understanding and Changing Software Organizations. *Scandinavian Journal of Information Systems*, vol. 13, 31–50.

Larsen, M.H. & M.Kühn Pedersen. Strategizing for Distributed Knowledge Management. *IFIP Working Group 8.4 Second Conference on E-business: multidisciplinary research and practice*. Copenhagen June 9–11, 2002.

Mathiassen, L. and Sørensen, C. (1996), The capability maturity model and CASE. *Information Systems Journal*, vol. 6, 195–208.

Nielsen, Ann-Dorte Fladkjær and Pries-Heje, J. (2001/2002), Effektiv styring af viden i projekter. *Økonomistyring og Informatik*, Årg. 17, 575–596.

Pedersen, M.Kühn. Requisite Foresight in Knowledge Enhanced E-business. International Conference at the University of Strathclyde Graduate School of Business in Glasgow, UK. *Probing the Future: Developing Organizational Foresight in the Knowledge Economy*. July 11–13, 2002.

Pedersen, M.Kühn & Larsen, M.H. & Berntsen, C. Contested Hegemony: The Demise of Industrial Economics in Information Systems Analyses? *25th IRIS Conference*, August 10–13, 2002.

Pedersen, M. Kühn (2001), E-aktiver: Værdiforøgelse i den ny økonomi. *Økonomistyring & Informatik*, vol. 17, nr. 2. 137–159.

Pedersen, M. Kühn and Larsen, M. Holm (2001), Distributed Knowledge Management Based on Product State Models – The Case of Decision Support in Health Care Administration. *Decision Support Systems*, special issue on Knowledge Management Support for Decision Making, 31 (1) May 139–158.

Simonsen, J. (1999), "How do we take Care of Strategic Alignment? Constructing a design approach", *Scandinavian Journal of Information Systems*, Vol. 11, pp. 51–72.

Soh, C. and M. Lynne Markus (1995) How It Creates Business Value: A Process Theory Synthesis. *Proceedings of the Sixteenth International Conference on Information Systems (ICIS)*, Amsterdam.