

# REQUISITE INFORMATION COLLABORATION AND DISTRIBUTED KNOWLEDGE MANAGEMENT IN SOFTWARE DEVELOPMENT

RESEARCH IN PROGRESS

## Abstract

*The paper suggests a framework advocating an integrated approach to software development stipulating the interconnection between Design, Organization and Business value networks (DOB). These three focus areas span collaborative development processes applying a range of facilitating tools, including distributed knowledge management product state models. The paper draws upon a series of discussion with Scandinavian IT Group (SIG). With an interest in how performance in their new organization develops SIG invited the research group to study measures of organizational performance and the use and effect of knowledge management tools in software development. The paper does not represent the viewpoint of SIG but outline our framework and major research questions.*

## 1. Introduction

Upon explorations within an action research framework in a software developing company the objective of this project emerged as a contribution to knowledge management enhanced vigilance and flexibility in software development upon further “Studies in Requisite Information Collaboration and Knowledge Management” (SIRICUM). Action research stipulates that researcher and practitioner have a common interest in addressing a select set of problems expecting to find how the company may better take advantage of resources, tools for project management and for distributed collaboration, developing fitting and efficient knowledge management practices. Knowledge management methods, mechanisms, and practices are captured in a framework, DOB (table 1) for analyses of integrated development processes.

### 1.1 Case Company: Scandinavian IT Group

Scandinavian IT Group (SIG) with 45 years of experience in building complex and business critical systems specializes in the development, maintenance, integration and operation of IT-solutions for the international airline industry, as well as for other service-oriented businesses, committed to continuously seek new ways for these industries to improve their overall performance.

SIG ([www.scandinavianit.com](http://www.scandinavianit.com)) employs more than 1300 people and has a turnover exceeding USD\$ 200 Million. SIG has developed more than 600 business solutions for the airline industry covering all core processes of an airline, ranging from management and planning activities to ticketing, check-in and aircraft handling, and delivering cost savings as well as expanded airline customer services. In particular SIG delivers airport and enterprise solutions. Airport solutions vary from mobile self-service applications to security and airport administration solutions. The enterprise solutions seek to support basic enterprise functions fitting the client organisations' needs technologically and financially. Within infrastructure management SIG delivers world record-breaking service levels for mission critical non-stop operations on all major platforms and advanced desktop, messaging, helpdesk and support services.

## **2. Positioning the Research**

Inspiration derives from a decade long research at Carnegie Mellon University where the “n-dim” group 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 may offer relevant lessons 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. Further, we also study the information flow (as one type of workflows) and how to conceive of knowledge workflows and (other) collaborative workflows (Majchrzak et al 2000).

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 Denmark, our long running tradition on socio-technical studies has been complemented with studies in software process improvement using the standard capability maturity model (CMM) (e.g. Mathiassen and Sørensen, 1996, Kautz et al. 2001). Another line of research is knowledge mapping where identification of who-has-what-knowledge takes precedence over information and knowledge workflows (e.g. Eppler 2001, Nielsen and Pries-Heje 2001/2002).

## **3. Research Method**

In our framework we expect to move beyond the technology-for-all issues of knowledge management in enhancing efficiency and effectiveness in software development where collaboration takes the form of participation, cooperation and partnerships. We employ a principle of inter-disciplinary teams of researchers each with a focus on the process-structure dualisms related to our framework.

Research will apply tools to capture and measure the organizational developments to discover ways of working and collaborating within SIG in using the RUP methodology and other support tools learning how the organization explore business opportunities and fulfil customer requirements.

From observations and data on workflows, ways and means of collaboration, and information flows within “groupings” (i.e. teams, organizational units, projects and subprojects) at SIG we develop four studies described below. To increase the value of each study 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.

Table 1. The DOB framework.

| <b>Focal objectives</b>       | <i>Conditions</i>                              | <i>Processes</i>   | <i>Performance objectives</i>  |
|-------------------------------|--|--|--|
| <b>Design</b>                 | Resources<br>Structural and process conditions | Project management<br>Workflows and knowledge exchanges<br>Participation             | Design efficacy (capability), efficiency and effectiveness               |
| <b>Organization</b>           | Entrepreneurship<br>Commitment<br>Ownership    | New services<br>Coordination and decision support<br>Goal achievement<br>Cooperation | Organizational efficacy, efficiency and effectiveness (goal achievement) |
| <b>Business value network</b> | Purpose<br>Finance<br>Business partners        | Asset management<br>Forms of competition and cooperation<br>Partnerships             | Business efficacy and effectiveness (profitability)                      |

The table 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 but as relationships decisive to improve the business value of software engineering processes by collaboration based alignment of units responsible for the software development where software is both product and process to the designers, to the implementers as well as the end-users.

The research group collaborates with SIG management in developing appropriate interventions and experiments in using tools and in applying principles derived from our studies. On workshops and seminars with SIG we will discuss findings on organizational performance and develop suggestions of new knowledge management tools, guidelines and organization as part of the overall action orientation. Finally, we will develop our framework as a research synthesis along with other research findings.

#### **4. Research Contribution**

Competitive advantage from innovative application development requires an integrated framework for software engineering.

Our research questions are the following:

- A: How to apply workflow models for distributed design activities using collaborative tools in a virtual organization?
- B: How can pre-requirement specifications be enhanced by business value network methodologies?

- C: How does the methodology of workflows and knowledge flows reaching into the business value proposition contribute to software design processes?
- D: How do distributed knowledge management models add new insights and understanding to our methodologies and models of development of software?

The relations and interactions between the three focal objectives condition collaboration processes and tools. Beneath, we outline our research questions.

#### **4.1 Question A: The Design Process**

We will look at the *design* process as a *participatory* process with distributed knowledge and information workflows reflecting development activities in a virtual organization.

Workflows with distributed activities have been used for many years as buying, production, selling, logistic, and management often are distributed activities usually manually supported by computers' information processing. Today distributed activities forming inter-organizational systems require integrated applications in business value networks. Many different transaction models have been proposed as a tool to manage requisite information workflows trying to relax the ACID (Atomicity, Consistency, Isolation and Durability) properties in order to get better performance, parallelism, and availability (Frank 1999, Frank & Zahle 1998).

In coping with ACID properties in design, we will explore how CSCW systems and workflows support distributed software engineering and knowledge management. How are relaxed ACID properties used in innovative solutions to requisite information interchange within collaborative design processes (Majchrzak et al 2000)?

The design process is collaborative taking advantage of tools (e.g. e-mail, conference systems, web-sites, document sharing, subject catalogues, keywords) vital to the progress and coordination between groups of developers and users. Successfully to choose and implement appropriate groupware in distributed collaborative settings implies getting distributed groups to collaborate on select, relevant issues in their work, which we position also as a knowledge management issue focusing on distributed development organizations.

#### **4.2 Question B: The Organization Process**

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 - rarely have the mandate to develop or to critically examine and evaluate 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 though often been advocated. In a deductive and linear system development approach business objectives have been transformed into requirement specifications with little reference to business value opportunities. Adoption of a pre-assessment approach (e.g. MUST, see Bødker et al 2000) with enhancements of performance-based procurement measures transform the relationship between design and business value networks, if properly supported, into a multi-dimensional framing of efficiency and effectiveness of software development processes.

The research questions addressing these issues include which characteristics of value may be defined, and to what extent and how are these characteristics of value supported in the development process?

### 4.3 Question C: The Business Value Network

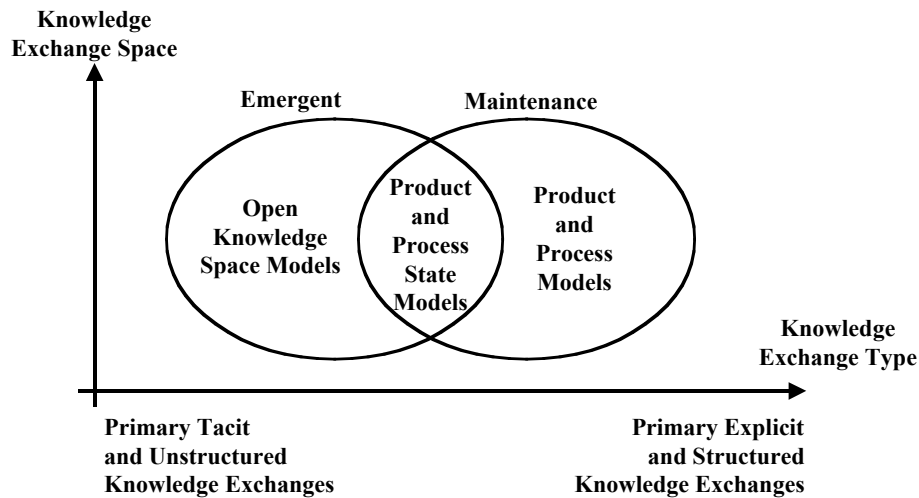
A study of relationship between *organization* and *business value networks*.

Development of business value networks requires value measures and to link these to the design of software using models and methodologies. Within a distributed knowledge framework these values would reflect various patterns of knowledge representing emergent and maintenance spaces and types of knowledge, cf. figure 1 (Davis et al 2001).

In previous research a product model methodology has been suggested as a mechanism to interrelate business value, application development and *design*, addressing exchange of emergent as well as maintenance knowledge and exploring how product model development processes may strengthen both value networks and organization of information systems development (Pedersen and Larsen 2001, Pedersen 2002).

Figure 1.

## Models Supporting Knowledge Exchanges of Emergent and Maintenance Knowledge



In relating product models to workflows, a synthesis of process and product models may be explored proposing a knowledge management tool for quality assurance in SW development and fulfilment processes.

In the DOB framework development processes are distributed, so we need to research if a product model approach is 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 extending the question how knowledge management systems support communication and analysis in design teams (Gray 2001).

#### **4.4 Question D: The Integrated Software Development Framework**

This research question focuses on our very framework. It is the ambition of the researchers to learn from practices in SIG, eventually to suggest a range of approaches and tools in an effort to enhance software engineering quality, systems development and collaboration between participants while attending to business value networks. The framework ignites a range of activities broader in scope than most design projects, yet required in application development for business networks. We will explore iterative and recurrent activities across design, organization and business value networks (Simonsen 1999).

Moreover, we will epistemologically test the framework parameters to evaluate the robustness of the framework. In our action research issues found in practice will inform our synthesis with the ambition to generate positive performance effects in practice.

### **5. Perspectives**

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

Though guided by the DOB-framework the research activities will reflect back upon this framework inspiring revisions and 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 customers, managers, users, developers and designers? And how do we as researchers ourselves take advantage of the framework in designing and implementing our research?

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