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Competence Systems

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Abstract

Today, more and more organizations rely upon the competencies of their staffs. This increasing reliance on competence has triggered many organizations to implement competence systems in order to support staff allocation and competence development. Competence systems can be characterized as systems that describe and present measures of individuals' competencies. Even though the implemented competence systems are seemingly well-designed, it is apparent that such systems are only sporadically used in competence management practice. In spite of the fact that competence systems are aimed at supporting knowledge-based organizations, it seems that the systems do not fit this type of organization. This thesis is about how to design competence systems so that they achieve their intended effects in knowledge-based organizations. The main research question of this thesis is: *How can competence systems be designed to support knowledge-based organizations?* The objective of this thesis is to produce design-specific knowledge for successful competence systems adoption in knowledge-based organizations. This thesis is based on an action research study covering six organizations. The learning outcome of the first action research cycle was that successful integration of competence systems requires system features conveying a technology spirit more in line with organizational knowledge work practice. On the basis of the first action research cycle, the objective of the second action research cycle was to develop and implement competence systems prototypes in order to understand and improve competence systems adoption in knowledge-based organizations. Based on the evaluation of the prototype systems, the general lesson learned was that an activating technology spirit of competence systems would facilitate their adoption in knowledge-based organizations. The thesis demonstrates that conceptualizations of people's interests are crucial for successful competence systems adoption in knowledge-based organizations.

Keywords **Language**

Competence systems, design, adoption, knowledge work English

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Preface

This thesis is a collection of six papers based on a 30-month (July 1999 – December 2001) action research study conducted as a joint collaboration between academics at the Viktoria Institute in Gothenburg, Sweden and practitioners in six organizations. The research focus of the thesis is competence systems. Since there is little research to be found on the organizational uptake and use of competence systems, this thesis can be regarded as a first contribution on the adoption of such systems. The objective of this thesis is to produce design-specific knowledge for successful competence systems adoption in knowledge-based organizations and the main research question is: *How can competence systems be designed to support knowledge-based organizations?* In addressing the research question, this thesis directs its attention to what features competence systems should have to facilitate their use as well as enable useful competence descriptions in knowledge work.

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Rikard Lindgren

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Introduction

Competence Systems

1. Research objective

For modern organizations in Western economies it has become increasingly important to focus on the competence of their staff members. It is no longer enough for organizations to hire people with the right diplomas. Instead, they have to engage in actively managing and continuously developing competence. One reason for the increasing importance of competence is the rapid technological development in society. An additional reason is that today's organizations are doing more knowledge and service work.

Many organizations implement competence systems to support management and development of the competence of their staffs. Mainstream competence systems can be characterized as systems that describe and present measures of individuals' competence on dimensions such as Java programming and project management. By handling competence descriptions, the typical competence system can, for example, support timely and resourceful staff allocation in consultancy firms. Moreover, competence systems can support competence development on both the individual and the organizational level by focusing on how competence is defined in the organization, how competence is applied in the everyday practice of the organization, and how the organizational members' competencies develop over time.

Although the implemented competence systems are seemingly well-designed, it is, however, apparent that such systems are only sporadically used in organizational competence management practice. Typically, competence systems are

marginalized to merely personnel administration systems that passively store increasingly inaccurate competence descriptions of little use to the organizations. This is a major problem considering the efforts and resources that competence systems implementations usually require, but even more so in terms of the missed business advantages a working competence system would have offered.

In spite of the fact that the competence systems are aimed at supporting knowledge-based organizations, it seems that the systems do not fit this type of organization. A general lesson in the information systems adoption literature is that successful adoption processes require a good fit between the system characteristics and organizational sources of commitment and incentive (see e.g., Hanseth and Monteiro, 1997; Orlikowski, 1996). Subscribing to this general lesson, this thesis shows that there is a misfit between the design principles that underlie existing competence systems and the practice of knowledge-based organizations. There is little research that explicitly concentrates on the organizational uptake and use of competence systems. In fact, this thesis can be seen as a first contribution on competence systems adoption. More specifically, the thesis is about how to design competence systems so that they achieve their intended effects in knowledge-based organizations. The main research question of this thesis is:

How can competence systems be designed to support knowledge-based organizations?

The objective of this thesis is to produce design-specific knowledge for successful competence systems adoption in knowledge-based organizations. This thesis includes an introduction and a collection of six papers. The papers are based on a 30-month (July 1999 – December 2001) action research study conducted as a joint collaboration between academics at the Viktoria Institute in Gothenburg, Sweden and practitioners in six organizations.

The overall structure of the introduction of this thesis is as follows. Section 2 discusses the shift from job-based to knowledge-based organizations and different approaches to competence

management. Section 3 outlines competence systems as the research focus of this thesis. Section 4 presents adaptive structuration theory as a theoretical framework for understanding and improving the adoption of competence systems in knowledge-based organizations. Section 5 outlines the applied research approach. Section 6 summarizes the six individual papers of this thesis. Section 7 presents a summary of the main research results of the six papers. Section 8 outlines the major conclusions of this thesis.

2. Background

Building on the general insight that successful integration of information systems depends on a good fit between the system characteristics and organizational sources of commitment and incentive, this section provides a background for understanding why seemingly well-designed competence systems are unsuccessfully adopted in the everyday competence management practice of knowledge-based organizations.

2.1 From job-based to knowledge-based organizations

Historically, the job-based and the knowledge-based forms of organizations have been used to organize work in the Western society. This separation is based on a dichotomy that relates to the extensive literature describing typologies of organizational forms. The two main strands in this discourse are the bureaucratic form fitting a stable and predictable environment and the organic form appropriate for changing conditions and unforeseen requirements for action.[1] It is important to note, however, that job-based and knowledge-based organizations do not necessarily have to be mutually exclusive. In most cases, both ways of organizing can be

[1] For a thorough discussion of the concept of change in organizations, see Dahlbom and Mathiassen (1993, p. 15-22).

found in different areas, departments, or layers in the same organization.

The job-based approach to organizing work has been dominant ever since the development of the bureaucratic model of organizations (Lawler, 1994). Seeing individuals as "complicating elements" that obstruct the creation of efficient organizations, the job-based approach to organizing suggests that the contributions of individuals must be standardized. Limiting an organization's dependence on the initiatives and responsibilities of the individual workers is, according to this tradition, necessary in order to reduce uncertainty occasioned by human error. The job-based approach is based on the implicit assumption that jobs are relatively stable and that individuals can be selected and trained to do them for several years. Building on the principles of scientific management (Taylor, 1911), the job-based approach results in a command and control structure where each job is clearly specified in a formalized description. The best way to optimize organizational performance, it is argued, is to fill job positions with appropriately skilled people and motivate them to perform effectively through the payroll and other extrinsic rewards (Lawler, 1994). The bureaucratic tradition supposes that most work processes can be reduced to rules, laws, and formulas. Based on the idea that it is possible to find "the one best way" to carry out the work, the job-based organization has well-grounded recurrent step by step activities constituted of repetitive tasks and known problems (Blackler, 1995). Therefore, knowledge is encoded in procedures and roles and competence is defined and categorized in beforehand.

The job-based approach to organizing work is suitable for the mass production economy, which has dominated Europe and the United States during most of the 20th century. However, there are a number of trends that highlight the need for a different approach to organizing work (Lawler, 1994). First, production jobs tend to be replaced by knowledge and service work in the western society (Drucker, 1993). Because of this change, organizations need to be much more adaptive and to compete based on their core competencies and knowledge. An organization's ability to develop particular organizational competencies, rather than its size, financial or technological resources, creates competitive advantage

(Lawler, 1992; Prahalad and Hamel, 1990). Second, the role of the individual has changed. While bureaucratic systems tend to oversee the individual, the competence, knowledge, and learning ability of individuals are at the heart of today's organizations. Individuals can be seen as a key competitive asset of the organization (Leonard-Barton, 1992; Senge, 1990). Third, today's rapidly changing environment makes the basic idea of job stability dysfunctional and inappropriate. Often individuals have to change what they are doing and, in some cases, to develop the competence they have to perform new tasks in different ways. The process of keeping job descriptions to fit changing organizational structures and environmental demands becomes troublesome (Lawler, 1994). Fourth, the flattening of organizational structures requires that individuals be able to take responsibility for their own performance. In decentralized environments, individual autonomy is an important ingredient for self-management (Nonaka, 1994). Well-defined and formalized job descriptions, however, counteract horizontal moves of individuals by reproducing already existing work practices (Lawler, 1994).

The alternative to job-based organizing has been to design organizations in which the competence and knowledge of individuals are the primary focus. Work in the knowledge-based organization is, in contrast to the job-based, characterized by both rule-bound action and novelty (Tsoukas, 1996). Knowledge work is therefore problematic to describe in charts, manuals, and job descriptions (Brown and Duguid, 1991). In the knowledge-based organization there is no permanent assignment of work tasks to individuals since work is constituted of dynamic processes and self-governing project groups (Lawler, 1994). Work builds on co-operation between individuals having different knowledge and experiences for the purpose of solving common problems (Castells, 1996). To solve problems in known or unknown ways, knowledge-based organizations are, as argued by Starbuck (1992), relying on knowledge workers with a high degree of formal education, expertise, and skill, e.g., consultants, product developers, and researchers. In order to prevent themselves to be caught in competence traps (Levitt and March, 1988), knowledge workers need to develop new competencies. To sustain the ability to

perform, knowledge-based organizations must therefore continuously cultivate the competence of their knowledge workers (Drucker, 1999). Associated with processes of change, competence is thus seen as dynamic, emergent, and situated in constantly changing practice. Increasing knowledge worker productivity by rationalizations is not an issue. Instead, knowledge workers' commitment and motivation are important assets for creating new competencies (Nonaka, 1994). In order to encourage individual commitment and motivation, it has been argued that knowledge workers must have meaningful jobs with variation and autonomy.[2]

2.2 Competence management

Historically, most approaches to competence management have been based on job descriptions (Lawler and Ledford, 1992). In this tradition, competence consists of a set of properties needed to perform a specific job (Spencer and Spencer, 1993). Competence is therefore comprehended as the relation between humans and jobs. The concern is not about knowledge and skills in itself but rather what knowledge and skills are required to perform a specific job (McClelland, 1973). To identify the most important dimensions of competence in relation to work in organizations, different systematic attempts have been made (see e.g., Fombrun et al., 1984; Ghoparde and Atchison, 1980). Inspired by Taylor's (1911) "time and motion studies", the job-based approach to competence management is about classifying and reducing workers' competencies to rules, laws, and formulas (see e.g., Sandberg, 1994). On the basis of formalized explicit descriptions including tasks and required competence, employees' competencies are made visible and measurable. Although current competence management approaches are not based on time and motion studies, human resource practice in today's organizations is still under the influence of the idea of individuals holding jobs. Most organizations use job descriptions to support competence management related

[2] For a thorough theoretical discussion of knowledge-based organizations, see Paper 4. For empirical illustrations of activities of knowledge-based organizations, see section 5 in Paper 6.

activities such as career planning, pay determination, selection, and training.

Despite its widespread application, however, there are weaknesses with the job-based approach to competence management indicating that contemporary organizations need better strategies for managing knowledge workers (see Lawler and Ledford, 1992). First, even though the job-based approach pays attention to competencies of organizational members, competence is merely one dimension in a typical job description. The importance of competence may be diluted by factors such as the level of responsibility and the number of subordinates. Second, job descriptions concentrate on jobs rather than individuals. The rationale is basically to find and shape individuals to fit job descriptions. Third, job descriptions generally indicate an organization's past achievements. Therefore, job descriptions offer little support for the identification of an organization's future needs. Fourth, job descriptions fail to indicate individuals' capability to contribute in ways out of line with their present job. Since application and development of competence is managed within the boundaries of job descriptions, flexibility in competencies and career changes are discouraged.

The weaknesses described above have inspired the development of new approaches particularly targeted at competence management processes in knowledge-based organizations. Focusing directly on the competence used by individuals in accomplishing work, Sandberg (1994) presents an interpretative approach to human competence at work. As opposed to rationalistic job-based approaches to competence management, Sandberg's approach builds on the rationale that workers' conceptions of their work constitute the foundation of human competence. While rationalistic approaches within human resource management appreciate competence as primarily constituted of a list of attributes externally related to the work, Sandberg argues that the workers' knowledge, skills, and other attributes used in work are preceded by and based on their conceptions of the work. In light of the context-dependent nature of human competence at work, Sandberg questions the application of rationalistic approaches as basis for designing competence development

activities and managing human action in knowledge-based organizations.

An additional example is Lawler and Ledford's (1992) attempt to move away from the job-based tradition by introducing a skill-based approach to human resource management. Because the job-based tradition is designed for mass production, they claim, individuals are managed based on job descriptions. While such competence management, for good reasons, focused on filling jobs with individuals who could perform them, however, it misses its target in today's knowledge-based organizations in which the competence and motivation of individuals are the key resources. Knowledge work settings require competence management approaches flexible enough to cater for individuals expected to constantly learn and change their behavior. Designed to focus on individuals developing particular competencies, the basic building block of Lawler and Ledford's skill-based approach is the individual. Aligning competence management activities with the development of individuals rather than jobs, they argue, make the knowledge-based organization effective.

3. Competence systems

Many organizations implement competence systems in order to support their competence management activities. More specifically, such systems are implemented to support activities such as availability planning, goal and personal development discussions, finding competence when manning assignments, forming teams of individuals, steering missions, and recruiting.

Designed to support mapping, categorization, and visualization of an organization's competencies, competence systems store descriptions of individuals' competence in competence trees, e.g., a competence can be, for example, C++ programming, data management or project management. Normally, such hierarchical competence structures have a top level consisting of different competence areas where each competence area has sub-levels containing the competencies, e.g., Tools –

Programming languages – Java. Competence systems have a grading scale to indicate the level of skill for a particular competence dimension, e.g., beginner – some knowledge – experienced – expert. Usually, competence systems manage information about roles. In most cases, a role is the work task an organizational member has been assigned. Based on the information about competencies and roles in the organization, for instance, an account manager can compose a well-balanced project team.

Applying Hahn and Subramani's (2000) classification of different knowledge management support, competence systems can be portrayed as sophisticated expertise profiles and personal skill databases. Competence systems have certain characteristics that differentiate this type of system from traditional expertise profiles applications and personal skill databases.[3] While expertise profiles applications and personal skill databases are particularly developed for expertise identification and project configuration in operative daily work, competence systems are supposed to support the handling of organizational competence in both a short- and long term perspective.

The strategic dimension of competence systems requires features not typically found in expertise profiles applications and personal skills databases, e.g., features for competence and resource gap analyses. A competence gap analysis is about identifying whether or not the organizational members comply with the competence descriptions of different roles. This analysis indicates the competence gaps that exist within the organization with regard to both individual and organizational level. A resource gap analysis concentrates on the relationship between resource/competence status and competence demand. This analysis indicates to what degree existing individuals cover the organization's future competence demand. In sum, competence systems are designed to support both the assessment, development, management, and planning of the competence level of an organization and its members and the measurement and analysis of present and future competence levels.

[3] For a comprehensive overview of competence systems features, see Paper 1.

Since competence systems have received little research attention, there are few published contributions to be found on the design and use of such systems.[4] By researching competence systems features and practical usage experiences of this type of system specifically, the objective of this thesis is to produce design-specific knowledge for successful competence systems adoption in knowledge-based organizations. In the quest for designing competence systems supporting knowledge-based organizations, this thesis directs its attention to the following two-folded problem:

1. *What features should competence systems have to facilitate their use in knowledge work?*

2. *What features should competence systems have to enable useful competence descriptions in knowledge work?*

In addressing the two-folded problem described above, six papers have been published in conference proceedings and journals. The six individual papers constituting this thesis appear in roughly the same sequence as they were written. The papers of this thesis are listed below[5]:

1. Lindgren, R. and Henfridsson, O. (2002). Using Competence Systems: Adoption Barriers and Design Suggestions. Accepted for publication in *Journal of Information and Knowledge Management*, 1(1), pp. 65-77. A previous version appeared in the *Proceedings of ECIS 2000*, Vienna, Austria, pp. 701-708.

2. Lindgren, R., Hardless, C., Pessi, K. and Nuldén, U. (2002). The Evolution of Knowledge Management Systems Needs to be Managed. Accepted for publication in *Journal of Knowledge Management Practice*, 3.

3. Lindgren, R. Competence Visualizer: Generating Competence Patterns of Project Groups. Under consideration by *Journal of*

[4] For a detailed presentation of the related work on competence systems, see Paper 1.
[5] Section 6 summarizes the six individual papers of this thesis.

Knowledge Management. A previous version appeared in the *Proceedings of HICSS 2002*, Big Island, Hawaii, USA.

4. Lindgren, R., Stenmark, D. and Ljungberg, J. Rethinking Competence Systems for Knowledge-Based Organizations. Under consideration by *European Journal of Information Systems*. A previous version appeared in the *Proceedings of ECIS 2001*, Bled, Slovenia, pp. 775-786.

5. Lindgren, R. and Stenmark, D. (2002). Designing Competence Systems: Towards Interest-Activated Technology. Accepted for publication in *Scandinavian Journal of Information Systems*, 14.

6. Lindgren, R. and Henfridsson, O. Facilitating the Adoption of a New Competence Systems Agenda: Applying Adaptive Structuration Theory in Action Research. A shorter version under consideration by *MIS Quarterly* (special issue on action research in information systems). An extended abstract appeared in the *Proceedings of IFIP 8.2 WG OASIS workshop 2001*, New Orleans, Louisiana, USA, pp. 11-12.

4. Adaptive structuration theory

During the work with this thesis, adaptive structuration theory (AST) has played a role in the quest for understanding and improving the adoption of competence systems in knowledge-based organizations.[6]

Being both a theoretical framework and a methodological strategy, AST (DeSanctis and Poole, 1994) can be described as a detailed and practical approach for studying the role of advanced information technologies in organizational change. With its origin in structuration theory (Giddens, 1979, 1984), AST provides a framework for analyzing how social structures are produced and

[6] For a discussion of alternative theoretical frameworks to AST and a comprehensive description of how AST has been applied in the action research approach, see Paper 6. For an example of how structuration theory can be adapted for action research, see Rose and Lewis (2001).

re-produced when a particular information technology is adopted at a workplace. As a framework for investigating variations in organizational change triggered by the use of information technologies, AST concentrates on both the structure of the technology and the unfolding of social interaction as the technology is used. Consistent with structuration theory, AST focuses on the technology-action relationship and the social process in which these two types of structures iteratively shape each other (DeSanctis and Poole, 1994). AST's fundamental constructs, structuration and appropriation, help the researcher to understand both the type of structures included in a certain technology and the structures that emerge in human action as users interact with the technology.

Structuration is the overall process by which social structures are produced and re-produced in social environments. Focusing on the role of advanced information technologies in the structuration process, DeSanctis and Poole (1994) discuss how technologies bring social structures that enable as well as restrict actions of users at a workplace. In terms of AST, such social structures are designated as structural features of a particular technology and the spirit of this feature set. Put together the structural features of a given technology and the spirit of this feature set constitute the structural potential of a certain technology. The structural features of a particular technology "are the specific types of rules and resources, or capabilities, offered by the system" (DeSanctis and Poole, 1994, p. 126). Features within a competence system include competence grading, competence and resource gap analyses, and search functions. According to AST, such features govern how competence data can be collected, categorized, and visualized. Structural features of a competence system therefore give meaning to the technology and enable, for instance, a chief knowledge officer in a consultancy firm to identify competence development needs of the staff. In AST, the spirit of a particular set of features is described as "the general intent with regard to values and goals underlying a given set of structural features (DeSanctis and Poole, 1994, p. 126). Technology spirit is thus associated with how a certain technology presents itself to a user or group of users. The technology spirit conveyed by a given

technology is related to its design rationale, the features it includes, the training material, the user interface, and the user support offered by the system.

Appropriation is an analytical concept for identifying actions that manifest deeper structuration processes. As suggested by AST, one way to capture such deeper structuration processes is to isolate "a group's application of a specific technology-based rule or resource within a specific context and at a specific point in time" (DeSanctis and Poole, 1994, p. 128). By analyzing appropriations, it is possible to disclose how, for instance, the competence gap analysis feature within a given competence system is brought into action. The design of a particular technology, however, does not automatically determine how a user or group of users appropriates it. In practice, appropriation moves vary because users actively select the way in which structures are used. According to AST, there are several dimensions of appropriation to consider when analyzing a user group's application of the structural potential of a given technology. First, users may use the structural features directly or making judgments about them. Second, users can appropriate the technology faithfully or unfaithfully. Third, users may appropriate the structural features for instrumental uses or objectives. Fourth, users can show different attitudes such as comfort, respect, and challenge while appropriating the technology.

5. Research approach

While the common objective of most research methods is to study organizational phenomena but not to change them, the rationale of action research is to create organizational change and simultaneously to study the process. Action research has been introduced as a post-positivist social scientific research method to support practical problem solving while expanding scientific knowledge (see e.g., Baskerville and Wood-Harper, 1996; Hult and Lenning, 1980; Mathiassen, 2000; Susman and Evered, 1978). Action research therefore aims to link theory and practice, thinking

and doing for the purpose of accomplishing practical as well as research objectives (Susman, 1983).[7]

5.1 Characteristics of action research

Developed particularly as a corrective to the deficiencies of positivist science, the action research method has a number of characteristics (Susman and Evered, 1978). First, action research is future oriented. Concerned with the practical problems of people, action research is about creating a future situation in line with their desires. Second, action research is collaborative. The needs and the competencies of both the client system and the researcher influence the direction of an action research project. Third, action research implies system development. Building an infrastructure supporting communication and problem solving procedures is important for understanding and ultimately improving processes in the problem situation. Fourth, action research generates theory grounded in action. Theory is developed on the basis of conducted theory-informed actions and their consequences for organizational members. Fifth, action research is agnostic. The action researcher recognizes that theories based on previously taken action need to be re-examined and sometimes re-formulated when applied in new research situations and that effects of selected actions are hard to grasp in beforehand. Sixth, action research is situational. Rather than based on documented knowledge of previously relationships between actions and outcomes, appropriate actions build on the consensus of particular actors' views of their present situation.

5.2 The action research cycle

Susman and Evered (1978) formulate action research as a cyclical process including five different phases (diagnosing, action planning, action taking, evaluating, and specifying learning).

[7] For illustrative examples of action research projects in Scandinavia, see Nygaard (1992), Nygaard and Bergo (1975), and Pourkomeylian (2002). For historical accounts of major traditions in Scandinavian research on systems development, see Bansler (1989) and Bjerknes and Bratteteig (1995).

Preceded by the establishment of a client system infrastructure or research environment, the five phases are then iterated in an ideal action research approach. Establishing a client-system infrastructure is about specifying actions, authority, regulations, and resource allocation so that each party's participation and expected contribution is clarified. On the basis of problems and underlying causes experienced by the practitioners, the diagnosing phase refers to the joint (researcher-practitioner) formulation of a working hypothesis that can function as input for planning the action. Action planning is about specifying the actions needed for improving the problems identified in the previous phase. Action taking is about implementing the actions specified during the action planning phase. Intended to be a collaborative effort between researchers and practitioners, the evaluating phase refers to the process of assessing the outcome of the action taken. Finally, specifying learning is about documenting and summing up the learning outcomes of the action research cycle as a whole.

5.3 Action research on the use of competence systems in competence management

This thesis builds on an action research study conducted within a 30-month (July 1999 – December 2001) research project called the "Competitive Knowledge-Intensive Firms Project". The project can be described as a collaborative undertaking that involved the Viktoria Institute, Gothenburg, Sweden and the nine organizations Astra Zeneca, EHPT (former Ericsson/Hewlett-Packard Telecom), Ericsson Mobile Data Design AB, Ericsson Microwave Systems AB, Frontec Konsulter AB, Guide Datakonsult AB, Volvo Car Corporation AB, Volvo Information Technology AB, and Volvo Truck Corporation AB.[8]

The action research study reported in this thesis is based on the sub-project on the use of competence systems in competence management. This sub-project included six organizations (EHPT, Frontec, Guide, Volvo Car Corporation, Volvo Information

[8] For a detailed description of how the project was designed to increase the relevance for both academics and industry participants, see Paper 6.

Technology, and Volvo Truck Corporation) and covered five competence systems ranging from off-the-shelf products (Prohunt Competence (Prohunt), SAP R/3 Human Resource Competence Module (SAP R/3), and Tieto Persona Human Resource (TP/HR)) to in-house developed systems (Guide's Kompetenstorget[9] and Frontec's Kompassen[10]).[11] The sub-project on the use of competence systems in competence management was conducted as two full action research cycles.[12]

5.4 The first action research cycle

The first action research cycle was carried out during the period July to October 1999. The diagnosing phase started from the fact that the six organizations included in the study wanted to learn how to use competence systems in their daily activities. In more detail, the organizations were interested in how competence systems can be designed so that they contain useful competence descriptions in knowledge work practice. In collaboration with the practitioners, competence representation and competence representation maintenance were identified as two practical problems to address in order to implement successful competence systems. During the action planning and action taking phases, the research team[13] together with the practitioners developed and implemented competence definitions and competence structures that were intended to overcome the diagnosed problems.

In order to evaluate the outcomes from the previous phases, a multiple-case study including a technology review and user site investigation was conducted. The evaluation of the implemented competence systems identified a number of adoption barriers related to the technical features of the systems. The adoption barriers inhibited successful integration of the competence systems

[9] Throughout the thesis the Competence marketplace refers to Kompetenstorget.
[10] Throughout the thesis the Compass refers to Kompassen.
[11] For a presentation of the six participating organizations and the five competence systems covered, see Paper 1.
[12] For a comprehensive description of how the two action research cycles were conducted, see Paper 6.
[13] During these phases Christopher Wallström and the author constituted the research team.

in the investigated organizations. Overall, the competence systems were used merely for personnel administration by human resource departments and the intended effects of using such systems were not achieved. Building on this observation, the main learning outcome was that successful competence systems adoption requires system features conveying a technology spirit more in harmony with the nature of organizational knowledge work practice (see Paper 1). Based on the learning outcome of the first action research cycle, the second action research cycle was concentrated on how to address the identified adoption barriers.

5.5 The second action research cycle

The second action research cycle was conducted during the period November 1999 to December 2001. The diagnosing phase was focused on the problems related to competence systems adoption experienced by two (Guide and Volvo Information Technology) of the six organizations included in the first action research cycle.[14] The diagnosing phase of the second action research cycle involved in-depth case studies of Guide and Volvo Information Technology.[15] The primary objective of these two case studies was to acquire a deeper understanding of how these organizations adopted their respective competence systems. First, an in-depth case study of how Guide adopted the Competence marketplace system was conducted. The research results indicated that Guide had problems with poor updating and static competence descriptions and the critical mass of users was not reached (see Paper 2 and Paper 3). Second, an in-depth case study of how Volvo Information

[14] There were basically two aspects that guided the selection of Guide and Volvo Information Technology. First, compared with the other organizations, these two were more mature in terms of using information technology to support competence management activities. This was an important factor since the ambition was to investigate ambitious organizational attempts to use competence systems. Second, the research team had good access to these organizations. Kalevi Pessi (general manager of the Viktoria Institute at the time of the study) was employed by Guide from 1994 to 1999 and during the period 1996 to 1998 he was Guide's chief knowledge officer. Dick Stenmark (who participated in the Viktoria Institute's industrial Ph.D. program at the time of the study) was a Senior Information Architect at Volvo Information Technology's Web Program Center.

[15] Besides the author, Christian Hardless, Dick Stenmark, and seven M.Sc. students were engaged in the research carried out at Guide and Volvo Information Technology.

Technology adopted the TP/HR system was carried out. The research results highlighted that Volvo Information Technology had problems with keeping the system's content updated and that there was a lack of commitment among organizational members to use the system (see Paper 4 and Paper 5). In sum, the two in-depth case studies showed how seemingly well-designed competence systems were marginalized in organizational day-to-day practice facing the obvious risk of becoming archives that passively store increasingly inaccurate formalized competence descriptions (see Paper 6).

Observing how the barriers to adopting the Competence marketplace and the TP/HR system were related to what seemed to be a problematic archiving technology spirit of the systems, two interventional studies were planned based on the lessons learned from the in-depth studies. The chief objective of the action taking phase was to develop and implement competence systems prototypes at Guide and Volvo Information Technology in order to better understand how to improve competence systems adoption in knowledge-based organizations. First, in collaboration with three M.Sc. students, the author developed, implemented, and evaluated the Competence visualizer system, i.e., the original version of the Competence marketplace system and an add-on module. The research results indicated that competence systems need features that handle flexible visualizations of both existing competencies and competence interests of organizational members (see Paper 3). Second, based on Dick Stenmark's research on search engines and recommender systems, the Volvo Information Portal (VIP) was developed, implemented, and evaluated as a complementing competence system to TP/HR. The research results highlighted the potential of using interest-activated technology as support for competence management (see Paper 5). In sum, the two interventional studies showed that using conceptualizations of people's interests as the basic design rationale for competence systems is a promising road ahead towards successful adoption of such systems in knowledge-based organizations (see Paper 6).

5.6 Data collection

During the two action research cycles described above, empirical data was collected through document reviews, focus groups, participant observation, semi-structured interviews, technology reviews, and workshop sessions.[16] Below, Table 1 outlines an overview of the action research cycles, research sites, competence systems, and data sources.

[16] The data was analyzed in accordance with the interpretive information systems approach (see e.g., Klein and Myers, 1999; Walsham, 1995). For detailed descriptions of how this approach was applied, see Paper 5 and Paper 6.

Action research cycle	Cycle one (July to October 31 1999)	Cycle two (November 1 1999 to December 31 2001)
Research sites	• EHPT • Guide • Frontec • Volvo Car Corporation • Volvo Information Technology • Volvo Truck Corporation	• Guide • Volvo Information Technology
Competence systems	• Compass • Competence marketplace • Prohunt • SAP R/3 • TP/HR	• Competence marketplace • TP/HR • Competence visualizer • VIP
Data sources	• Focus groups • Participant observation • 24 semi-structured interviews (3 at each site, except at Guide where 9 interviews (Gothenburg [3], Oslo [3], Stockholm [3]) were conducted • Technology review • Workshop sessions	In-depth studies: • Document review • Participant observation • 32 semi-structured interviews (Guide 22 [18 in Gothenburg and 4 in Stockholm] and Volvo Information Technology 10) Prototypes evaluations: • 6 focus group studies (Guide 4 [Gothenburg 2, Oslo 1, Stockholm 1] and Volvo Information Technology 2) • Participant observation • 34 semi-structured interviews (Guide 18 [Gothenburg 6, Oslo 6, Stockholm 6] and Volvo Information Technology 16)

Table 1: Overview of the action research cycles, research sites, competence systems, and data sources.

6. The six papers

This section summarizes the six individual papers of this thesis, while section 7 presents a summary of the main research results of

the six papers. The collection of papers follows directly after the introduction of this thesis.

6.1 First paper: "Using Competence Systems: Adoption barriers and Design Suggestions"

This paper examines barriers to adopting competence systems in knowledge work practice. On the basis of a technology review and a user site investigation, the paper relates the technical features of the investigated competence systems to the adoption barriers identified in six user organizations. The multiple-case study shows that the competence systems can be described as merely traditional personnel administration systems complemented by features that passively archive formalized descriptions of competencies. Building on this observation, the general objective of the paper is to provide design suggestions that facilitate successful integration of competence systems in organizations. The main conclusion of this paper is that competence systems need to have features conveying a technology spirit more in line with the knowledge work practice found in organizations. By researching competence systems and their features specifically, this paper contributes technology-specific knowledge within the area of knowledge management systems.

6.2 Second paper: "The Evolution of Knowledge Management Systems Needs to be Managed"

This paper reports the results from a field research study of such systems in a knowledge-intensive, fast-growing, and dynamic organization. The case illustrates that evolution, which refers to the process by which organizations and their information systems change over time, needs to be managed since it can result in knowledge management systems failures. The paper characterizes the mainstream knowledge management research literature in relation to managing the risk of knowledge management systems failures, and outline that management of knowledge management

systems' evolution is a dimension that has not been addressed so far. Building on these empirical and theoretical results, this paper discusses how the evolution of knowledge management systems could be managed and what implications the results have for future knowledge management research.

6.3 Third paper: "Competence visualizer: Generating Competence Patterns of Project Groups"

This paper describes and evaluates the design of Competence Visualizer, which is a competence system generating competence patterns of project groups. The system provides novel features that: (1) make it possible to survey competence status of teams in different sizes at a specific moment; (2) handle information about both existing competencies and competence interests; (3) manage snapshots of a particular point of time and development over a certain period regarding existing competencies and competence interests. The results from the system evaluation include fields of application, future design challenges, and organizational issues. A first conclusion is that competence systems need the potential to handle flexible visualizations of existing competencies as well competence interests of organizational members. A second conclusion is that organizational issues, such as incentives and management, are critical in order to attain data quality in a competence system.

6.4 Fourth paper: "Rethinking Competence Systems for Knowledge-Based Organizations"

This paper highlights that existing competence systems are based on a rationalistic view of competence. While these competence systems might work in job-based organizations, this paper argues that in more dynamic settings, such as in knowledge-based organizations, the interest-informed actions that capture the emergent competencies of tomorrow require different types of information technology support. The main objective of the paper is

to introduce interest-activated technology as a new design rationale for competence systems. This paper is based on an action case study of an implemented interest-activated intranet recommender system prototype at Volvo Information Technology AB in Gothenburg, Sweden. On the basis of how organizational members used this prototype to find information they were interested in, the research team was able to inquire into how personal interests, embodied in information seeking activities, could be a means for identifying competence. Building on the relationship between personal interest and competence, this paper discusses competence systems design and spell out explicit implications for managerial practice in knowledge-based organizations.

6.5 Fifth paper: "Designing Competence Systems: Towards Interest-Activated Technology"

Despite the considerable research interest shown in various types of knowledge management systems, not much academic work can be found on information technology support for managing competence. This paper addresses this shortage by presenting an 18-month action case study of the design, implementation, and evaluation of a traditional competence system at Volvo Information Technology AB in Gothenburg, Sweden. In addition, to upset prevailing assumptions and provoke reflection among the organizational members, an interest-activated recommender system prototype was implemented and introduced as a contrasting competence system. The research results increase the understanding of competence systems in two ways: First, the paper illustrates how inherent problematic aspects of mainstream competence systems can negatively affect the adoption and use of such systems. Second, the paper shows how interest-activated technology can be exploited and developed to support competence management. Building on these results, this paper's main contribution is five general design implications for future competence systems based on interest-activated technology.

6.6 Sixth paper: "Facilitating the Adoption of a New Competence Systems Agenda: Applying Adaptive Structuration Theory in Action Research"

This paper examines and demonstrates how competence systems can be designed to facilitate their adoption in organizations. The paper argues that successful competence application and development require a competence systems agenda more suited for knowledge work practice. The use of adaptive structuration theory in an action research study of adoption processes in six Swedish organizations indicates that existing competence systems are virtually counter-productive to their intended purposes. While competence systems are found to be espousive, reproductive, isolative, and rigid, the joint collaborations between the academic research team and the practitioners in the investigated organizations show that the practical competence problems existing in knowledge work practice require transparent, interest-driven, media-rich, and flexible systems. The action research study consisted of two action research cycles. As a result of researcher-practitioner intervention within the realm of existing systems, the first action research cycle identified a number of competence systems adoption barriers. On the basis of the learning outcome of this intervention, a second cycle was designed with the ultimate research goal of overcoming the identified adoption barriers by formulating new design principles for competence systems. Two organizations were selected as "organizational laboratories" in which two competence systems prototypes were tested and evaluated in actual knowledge work practice. The findings of this paper have implications for a variety of clients such as practitioners, action research initiators, research sponsors, and students. On a general level, the paper illustrates that action research can be a promising methodology for producing consumable research with the potential to have an impact on the future direction of our technology-induced society. To exploit this potential, however, the information systems community has to identify ways to design action research studies with the capacity to simultaneously contributing to knowledge and practice. This paper presents and clarifies one such way.

7. Research results

On the basis of a number of adoption barriers identified during the first action research cycle, the general lesson learned was that there seems to be a misfit between existing competence systems and organizational knowledge work practice. Designed as traditional personnel administration systems, the competence systems were virtually unusable for the investigated organizations (see Paper 1). Considering the fact-oriented, formalistic, systematic, and top-down nature of the competence systems included in the first action research cycle, most of them can be described as archiving technologies that passively store formalized competence descriptions. This thesis highlights that there are four fundamental problems of the archiving technology spirit of competence systems (see Paper 6):

- Competence systems seldom manage useful competence descriptions in the first place. Typically, competence systems merely contain formalized competence descriptions primarily constituted of competencies and roles in line with an organization's job descriptions and policy statements. Competence systems therefore handle little information about individuals' future plans, personal interests, and wanted assignments. This exclusive orientation on formalized competence descriptions resulted in that several of the investigated competence systems were unfaithfully appropriated. Organizational members manipulated their competence descriptions in order to get assignments in which they could develop certain competencies.

- Competence systems tend to counteract career changes of individuals. Built-up by predefined and hierarchically structured competence descriptions that function as mechanisms that retain and reinforce existing practice, existing competence systems discourage competence application and development outside the competence domain that organizational members already know (once a C++ programmer, always a C++ programmer).

- Competence systems often have a closed system structure that hinder organizational members to access and assess competence descriptions of others. While a closed system structure obstructs activities such as internal recruiting, it also reduces competence systems to merely top-down oriented management tools. In light of the fact that existing competence systems depend so heavily on committed grass-roots willing to enter their competence data regularly, this "user isolation" undermines the possibility for such systems to provide updated competence descriptions.

- Competence systems only support analyses of individuals' existing competencies on predefined and strict sizes of groups at given points of time. The low degree of flexibility makes the competence systems less adaptable to changing conditions. Existing competence systems therefore offer limited support for staff members in need of quick and flexible competence overviews as support for their decision-making. Considering managers important role for successful uptake and use of competence systems in organizations, this "group level imprecision" negatively affects the outcome of such adoption processes.

In order to address the fact that existing competence systems tend to have a static nature, a closed system structure, and lack a future-orientation conveying an archiving technology spirit, the main objective of the second action research cycle was to produce design principles towards a new competence systems agenda (see Paper 6). More specifically, the ambition was to design, implement, and evaluate competence systems conveying a technology spirit more in harmony with the nature of organizational knowledge work practice. The Competence visualizer (see Paper 3) and the VIP system (see Paper 5) represent a fundamental re-orientation of the rationale that underlies the current design of competence systems. Based on the evaluation of the prototype systems, the general lesson learned was that an activating technology spirit of competence systems would facilitate

their successful adoption in knowledge-based organizations. This thesis suggests four principles important for designing competence systems conveying an activating technology spirit (see Paper 6):

- Competence systems should have features that reveal organizational members' competence on the basis of their actions. While existing competence systems exclusively handle formalized competence descriptions concentrated on historical data, transparent competence systems are directed towards individuals' present and future competence interests. Rather than maintained by some administrator, action-based competence systems are built-up by the efforts of all organizational members collectively. While competence descriptions based on predefined top-down categorizations easily become outdated, an action-based bottom-up approach to competence mapping has the potential to indicate real-time status of individuals' competencies.

- Competence systems should have features that put organizational members' interests in the forefront and facilitate the creation of communities of interests. While existing competence systems typically restrict individuals on the grass-root level to merely see their own competence descriptions, interest-driven competence systems make descriptions of individuals' competencies and interests available to anyone in the organization. By facilitating informal networking among organizational members, interest-based competence systems with an open structure address the incentive problem that existing competence systems so often face.

- Competence systems should have features that handle a deeper level of personal information. Competence descriptions of existing competence systems are in most cases too shallow to provide the sufficient richness for competence application, competence sharing, and community building. Media rich competence systems increase the sense of familiarity by complementing information about name, organizational belonging, position, and telephone number with more personal

data such as a photograph, a link to a homepage, or information about previous, current, and wanted assignments.

- Competence systems should have features that enable adaptable aggregated visualizations of formalized competencies and competence interests of individuals at particular points of time and over particular time periods. By incorporating such features, competence systems offer the flexibility needed for supporting complex competence development and project manning decisions.

In sum, the lessons learned from the two action research cycles contribute to the understanding of how to design competence systems so that they achieve their intended effects in knowledge-based organizations. As a concrete result of this 30-month action research study based on the sub-project on the use of competence systems in competence management, Guide and Volvo Information Technology have applied and realized some of the design principles discussed above (see Paper 6). Building on the development, implementation, and evaluation of the Competence visualizer system, Guide has re-designed the Competence marketplace system. The primary goal of this re-design was basically to improve their internal competence management activities. However, Guide has also used the experiences from the Competence visualizer project in their customer projects on competence management. Recently, Volvo Information Technology has initiated a project that intends to improve the organization's competence management processes worldwide. Based on the experiences from the TP/HR project and the VIP system, Volvo Information Technology has integrated interest profiles of individuals into the organization's competence descriptions.

In this thesis, conceptualizations of individuals' interests are suggested as the basic rationale for designing competence systems suited for knowledge-based organizations. For interest-activated competence systems in effect to become useful for such organizations, however, requires more than fitting the systems to the needs of a new-style workforce. Appropriate managerial

mindsets and organizational efforts are critical in order to reach the full potential of interest-activated competence systems. First, the use of this type of competence systems must be paired with a corresponding management attitude. The job-based perspective on competence management needs to be abandoned in favor of an approach in which the interests and motivation of organizational members are considered as the primary drivers (see Paper 4). Second, most of today's organizations are undergoing rapid and radical change. Since the world changes, business changes, strategy changes, and context changes, competence systems have to be adapted to such changes in order to achieve their desired effects. Changes in other information systems in an organization also affect the uptake and use of competence systems. An important dimension of successful competence systems adoption is therefore that such systems need to be deliberately managed in relation to other information systems in an organization and to organizational change processes (see Paper 2).

8. Conclusions

While management literature has suggested that the job-based approach to competence management is insufficient for knowledge-based organizations, this thesis shows that current competence systems are still designed on the basis of such a paradigm. Since competence systems are based on the conceptualization of workers as "machines" without "needs" and "wants", little attention is given to the individuals' own interests in the work. Today's competence systems can be described as merely personnel administration systems conveying an archiving technology spirit that makes them virtually unusable in knowledge work practice. As a result, competence systems provide weak support for competence management in knowledge-based organizations.

This thesis argues that competence systems need to have features conveying an activating technology spirit more in line with the knowledge work practice found in many of today's organizations. By using conceptualizations of individuals' interests

as the basic rationale, competence systems suited for knowledge-based organizations can be designed. Since personal interests highlight the things that individuals have a passion for, competence system should support expression of interests so that they become visible and valued. As exploited in this thesis, the Competence visualizer and the VIP system are two competence systems prototypes primarily designed to cater for the interests of organizational members. The challenge for future information systems researchers is to come up with more such systems.

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First paper[17]

Using Competence Systems: Adoption Barriers and Design Suggestions

Abstract

This paper examines barriers to adopting competence systems in knowledge work practice. On the basis of a technology review and a user site investigation, the paper relates the technical features of the investigated competence systems to the adoption barriers identified in six user organizations. The multiple-case study shows that the competence systems can be described as merely traditional personnel administration systems complemented by features that passively archive formalized descriptions of competencies. Building on this observation, the general objective of the paper is to provide design suggestions that facilitate successful integration of competence systems in organizations. The main conclusion of this paper is that competence systems need to have features conveying a technology spirit more in line with the knowledge work practice found in organizations. By researching competence systems and their features specifically, this paper contributes technology-specific knowledge within the area of knowledge management systems.

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1. Introduction

The increasing use of knowledge management systems in organizations has inspired much research (see e.g., McDonald and Ackerman, 2000; Hahn and Subramani, 2000; Alavi and Leidner, 2001). Despite the growing body of knowledge, however, the few studies done on the use of such systems illustrate that seemingly well-designed systems nevertheless fail when they meet the practice of knowledge work (see e.g., Fahey and Prusak, 1998; Newell et al., 1999; Schultze and Boland, 2000; Storey and Barnett, 2000). In fact, there is still little knowledge about how to design knowledge management systems so that they are easily adopted in the daily activity of an organization.

The focus of this paper is on a particular sub-group of knowledge management systems referred to as competence systems. Such systems fit into the category of knowledge management support that Hahn and Subramani (2000) call "expertise profiles and databases" and can be broadly characterized as systems that describe and present measures of individuals' competence on dimensions such as programming skills and project management. The typical competence system intends to support the management of competence development and staff allocation and can, for instance, facilitate the manning of systems development projects by providing consultancy firms with competence overviews. Setting up development teams for customer projects is indeed a recurring task in the everyday management of consultancy firms, software developers as well as IT support organizations, ultimately aimed at timely and resourceful composition of existing competencies.

On the basis of a multiple-case study conducted in six different organizations (EHPT (former Ericsson/Hewlett-Packard Telecom), Frontec, Guide, Volvo Car Corporation (VCC), Volvo Information Technology (VIT), and Volvo Truck Corporation (VTC)), this paper examines barriers to adopting competence systems and relates these barriers to the technical features of the investigated systems. The general objective is to provide design suggestions that can overcome some of the adoption barriers impeding successful adoption of competence systems in knowledge work practice. There

are at least two reasons why this is important. First, there exists a misfit between the notion of knowledge embedded in mainstream knowledge management systems and the notion of knowledge enacted in the practice of knowledge work. Many researchers have noted this misfit (see e.g., Bannon and Kuutti, 1996; Ackerman and Halverson, 1998; Schultze, 1999; Swan et al., 1999), suggesting that we need to design systems more in line with how knowledge actually is created and distributed in real-life organizations. In order to do this, more specific knowledge about how to design knowledge management systems conveying such a notion of knowledge is needed. Second, as noted by Monteiro and Hanseth (1996) and Orlikowski and Iaccono (2001), IS research would benefit from being more specific about technology. In researching competence systems and their features specifically, this paper contributes to the production of more technology-specific knowledge within the area of knowledge management systems. Such knowledge is important for designing competence systems intended for the future social and organizational settings of knowledge work.

The structure of this paper is as follows. Section 2 presents related work, and section 3 outlines the research design and method. Section 4 presents the technology review. Section 5 outlines the user site investigation in order to present adoption barriers related to technical features of the investigated competence systems. Section 6 outlines design suggestions for future competence systems, while section 7 discusses the research findings. Section 8 concludes the paper.

2. Related work

The growing literature on knowledge management provides a number of alternative frameworks for understanding the design and use of knowledge management systems (see e.g., Ruggles, 1997; Wiig et al., 1997; O'Dell and Grayson, 1998; Hansen et al., 1999; Milton et al., 1999; Althoff et al., 2000; Alavi and Leidner, 2001). As an alternative framework to many other ones, we find

Hahn and Subramani's (2000) framework of knowledge management support both comprehensive and useful in the way it provides structure to a rather fragmented field. In view of this, we use this particular framework as a backdrop for presenting the related work to the design and use of competence systems.

Hahn and Subramani's (2000) framework addresses two important considerations in managing knowledge by focusing on both where the knowledge resides and the extent to which the knowledge is structured. More specifically, this framework classifies knowledge management support based on the locus of the knowledge (artifact or individual) and the a priori structuring of the contents (unstructured and structured). The first dimension determines if the knowledge management system relates a user to an artefact (e.g., a document) or a person. The second dimension ascertains the extent to which the knowledge management system imposes or requires a structure a priori. These dimensions constitute Hahn and Subramani's (2000) framework for knowledge management support, which is a matrix that comprises four cells.

Cell 1 (artifact – structured) includes knowledge management systems handling organizational knowledge that is or can be codified. Document repositories and data warehousing systems are examples of knowledge management systems that fall into this category (Hahn and Subramani, 2000). One typical contribution on this type of knowledge management system is from Ackerman (1994). In this paper, Ackerman argues that the knowledge and expertise in organizations, groups, and communities can be augmented through an organizational memory, i.e., some record of the organization's knowledge. More specifically, Ackerman investigates how computer systems can be used to augment or supplement existing learning and knowledge mechanisms within organizations, groups, and communities. This is realized through a field study of the organizational memory system Answer Garden, which aims at making organizational knowledge retrievable. Other interesting contributions to knowledge repositories and organizational memory are from Bannon and Kuutti (1996), Randall et al. (1996), Ackerman and Halverson (1998), Weiser and Morrison (1998), and Decker and Maurer (1999).

Cell 2 (individual – structured) covers knowledge management systems that manage knowledge by storing pointers to knowledgeable persons within the organization. Examples of such systems are databases of expertise profiles and personal skill databases, which content is constructed by employees filling out questionnaires to represent their level of expertise in certain predefined areas (Hahn and Subramani, 2000). One representative contribution to this type of knowledge management system is from Becerra-Fernandez (2000). People-finder systems can be described as knowledge repositories that handle knowledge by holding pointers to an organization's experts who have specific knowledge. Becerra-Fernandez discusses experiences from the development of the Expert Seeker and the role of technology in automating the maintenance of the experts' profiles. Additional contributions touching upon this category of knowledge management systems are from Karduck (1994), Davenport and Prusak (1998), and Abecker et al. (1999).

Cell 3 (artifact – unstructured) comprehends knowledge management systems that capture knowledge by handling artefacts, which do not have a priori structures imposed on them. Document repositories that are indexed on the words they contain is one example of such systems. Another example is knowledge management systems geared with document recommendation capabilities using collaborative filtering technology. According to Hahn and Subramani (2000), collaborative filtering that recommends documents is an alternative approach to locating documents relevant to a person's question or problem without structuring contents a priori. One of very few accessible accounts that discuss recommender systems in terms of knowledge management systems is Stenmark (2001). Focusing on the intranet as a knowledge management platform, Stenmark shows that web documents and recommender system technology can function as a facilitator in the knowledge managing process by leveraging tacit knowledge of organizational members.

Cell 4 (individual – unstructured) comprises knowledge management systems that impose no a priori structure on the knowledge but enable interpersonal contacts between users, e.g., electronic discussion forums where users can access others who

may be able to help. Typical examples of systems in this category are threaded discussions and e-mail distribution lists (Hahn and Subramani, 2000). In Ackerman and McDonald (1996), the development of the Answer Garden 2 system is reported. According to the authors, the objective was to develop a surrogate for hallway talk within distributed communities since this is often the way questions are asked and answered. Based on an analysis of an expert consultancy firm where e-mail is used for knowledge search, Robertson et al. (2000) argue that e-mail is a rich media for the communication of individuals' explicit knowledge base and tacit expertise. Additional experiences of this class of knowledge management systems can be found in McDonald and Ackerman (2000), Schultze and Boland (2000), and Smith and Farquhar (2000).

In this paper, the focus is on competence systems that describe and present measures of the competence of organizational members. As suggested in section 1, competence systems can be seen as a sub-group of the category of knowledge management systems included in cell 2. Competence systems have, however, certain characteristics that distinguish this type of system from traditional expertise profiles and personal skill databases. Rather than just being developed to support expertise identification and project configuration in the operative daily work, competence systems are designed to support organizations in their efforts to manage organizational members' competence in an efficient and structured way, i.e., to have the right competence, at the right place, and at the right time. More specifically, competence systems are supposed to support the handling of organizational competence in both a short- and long-term perspective. The latter strategic dimension requires features that complement those that exist in expertise profiles applications and personal skill databases. Examples are features for competence and resource gap analyses that are implemented to facilitate the management of competencies and roles. Since competence systems have received little research attention (for two exceptions, see Lindgren (2002); Lindgren and Stenmark (2002)), there is not much knowledge about the design and use of such systems. In order to contribute with knowledge about both the main features of competence systems and the

practical usage experiences of this type of system, this paper presents a technology review and a user site investigation based on a multiple-case study of the use of competence systems in six organizations.

3. Research design and method

This research was undertaken as a multiple-case study (Yin, 1994) covering six different organizations and their use of competence systems. The choice of research method reflects the observation that the development of consistent findings over multiple-case studies is likely to produce robust research results, while nevertheless maintaining a large extent of the richness characterizing intensive case study research. As Benbasat and Zmud (1999) note, practicing relevance in IS research requires the maintenance of a certain level of contextual description and this is particularly important in research that intends to produce design suggestions for both researchers and practitioners.

The multiple-case study consists of two main components: a technology review and a user site investigation. The two components complement each other for the purpose of providing useful suggestions for the design of future competence systems. While the technology review contributes with the technical distinctiveness needed, the user site investigation provides the context for understanding how competence systems function in practical knowledge work.

First, the technology review is designed to inform the user site investigation by providing a detailed overview of the technical nature of different competence systems. The review covers three standard software packages for competence management (Prohunt Competence (Prohunt), SAP R/3 Human Resource Competence Module (SAP R/3), and Tieto Persona Human Resource (TP/HR)) and two in-house developed competence systems (Frontec's Compass and Guide's Competence marketplace) used in one or more of the investigated organizations. Since there exists no published overview over existing competence systems, this type of

review is important for allowing researchers and practitioners to identify and analyze the nature of different competence systems. While this review would potentially benefit from covering even more competence systems (see Althoff et al. (2000) for a similar review of 21 knowledge management systems), the specific collection of systems was in part guided by our access to case organizations (see Table 1) and the prescribed (by the research design) co-existence of data about both the systems themselves and organizational usage of them. The data collection for the technology review consisted of sources such as the system manuals, using and testing the systems, observation of systems use, participation in educational sessions (Prohunt, SAP R/3, and TP/HR), and a workshop on system features involving participants from all organizations included in the user site investigation.

Case organization	Business type	Company data	Competence system	Number of interviews
EHPT	Software developer	1250 employees $198 million turnover (1998)	• Prohunt Competence (pilot)	3
Frontec	IT consultancy firm	1200 employees $109 million turnover (1998)	• Compass • Prohunt Competence (pilot)	3
Guide	IT consultancy firm	750 employees $66 million turnover (1998)	• Competence Marketplace System	9 (3 at each of the three sites Gothenburg, Stockholm, and Oslo)
Volvo Car Corporation (VCC)	Car manufacturer	27000 employees $12,8 billion turnover (1998)	• TP/HR (since 1999) • SAP R/3 (evaluation)	3
Volvo IT (VIT)	IT support organization	2500 employees $386 million turnover (1998)	• TP/HR (pilot)	3
Volvo Truck Corporation (VTC)	Truck manufacturer	23000 employees $7,8 billion turnover (1998)	• TP/HR (since 1999)	3

Table 1: Case organizations and their competence system use.

Second, the user site investigation covers six organizations of different nature (see Table 1). Two of the organizations are IT

consultancy organizations (Frontec and Guide), two are manufacturing organizations (VCC and VTC), and the remaining two consist of a software developer (EHPT) and an IT support organization (VIT) respectively. These organizations were selected because they all focus on competence management and routinely compose competence teams, while they nevertheless differ significantly in many respects, providing the study with a good variety of organizational contexts. The user site investigation was conducted over approximately a ten-week period during the summer of 1999 and was based on the perceptions of three informants at each site. In the Guide case, interviews were conducted at three sites (Gothenburg, Oslo, and Stockholm) resulting in nine interviews. In all, the investigation included 24 semi-structured interviews (see Table 1). Each interview lasted between 45 minutes and one hour and covered topics such as work practice, competence, competence development, and competence systems. The interviews were transcribed and analyzed according to the general principles of qualitative studies where recurrent themes were identified for further analysis. When a single or few informants are used, it is important to select people with much experience and knowledge. Our study therefore included people such as consultants, consultant managers, account managers, HR people, HR managers, project managers, and CEOs who had good insight about the competence management activities of the organizations because of their organizational role and/or by interest. In addition to the interviews, the user site investigation included data sources such as observation through active participation within the organizations' competence management projects and organization-specific competence plans.

As an important part of validating the results presented in this paper, we conducted two workshop sessions, which can be described as focus groups (Agar and MacDonald, 1995) where we presented and discussed our tentative research results.

4. Technology review

This section outlines a technology review that covers five different competence systems: the Compass (Frontec's in-house developed system), the Competence marketplace (Guide's in-house developed system), Prohunt, TP/HR, and SAP R/3. This review consists of three elements: a presentation of the intended use of competence systems as it can be inferred from systems documentation (subsection 4.1), a short description of the background data of each system (subsection 4.2), and an overview of the technical features of each system (subsection 4.3).

4.1 The intended use of competence systems

In reviewing the systems documentation, one can note that the competence systems included in our study are intended broadly to support competence management processes. In this context, competence management processes can be described as activities focusing on goal-directed administration, development and management of employees' competencies in relation to business goals. The overall objective of these processes is to develop and strengthen organizational members' competence for both present and future corporate needs. To sum up, competence management processes concentrate on:

- The development of structures and common languages for competence work.

- The planning, development, management, and assessment of the competence level of an organization and its employees.

- The measurement and analysis of present and future competence levels.

In a broad sense, competence management processes are often implemented on the basis of two different types of analyses: resource and competence gap analyses.

First, a resource gap analysis focuses on the relationship between resource/competence status and competence demand. In other words, the analysis identifies the discrepancy between the predicted demands and the current supply of particular competencies in an organization. This indicates to what extent the existing employees cover future competence demands of the organization.

Second, the competence gap analysis indicates to what degree the organizational members comply with the competence profiles for different roles on a more detailed level. Analyzing competence gaps is about identifying the competence gaps that exist in an organization at both the individual and the organizational level. With an activity plan as a starting point, key competencies as well as role profiles are defined in the form of competence descriptions. These competence descriptions are then applied in order to map the organizational members. This mapping activity aims at evaluating how well the employees correspond to the competence demands of existing roles in the organization.

4.2 The investigated competence systems

The Compass was developed through an in-house project at Frontec. It was originally designed to both enable internal diffusion of project documentation and facilitate the reuse of successful models and already existing knowledge. Basically, this competence system can be regarded as a searchable free-text database and, over time, it has been complemented with features that enable competence identification for configuring project teams.

The Competence marketplace system was originally developed at the Guide site in Oslo, Norway. This system provided features for both formation of teams of several individuals and statistic analyses on these teams. Guide's idea of the Competence marketplace system was to improve as well as map the competencies of the employees and to find expertise for their external projects.

Prohunt is a commercial product developed by Palmér System AB in Sweden. Prohunt is based on competencies, but the

focus of the system is on roles, e.g., one role can be database implementer. A role consists of several competencies at different levels. This competence system has been implemented as a pilot at EHPT and EHPT has analyzed the competencies of their employees through internal workshops. Frontec has also implemented and evaluated Prohunt in a pilot project.

TP/HR is a commercial product developed by Tieto Datema AB in Sweden. It is based on "competence windows" that are customizable to contain a special type of competencies. The special competencies can be, for instance, background education, courses, and certificates. Furthermore, it is possible to specify a local "window" if a competence is vital only to those employees at a certain location in the organization. VCC in Olofström started using this competence system a couple of years ago and was, at the time of this study, using it to support its change toward a process-oriented organization. Through a cross-company project within the Volvo Group both VIT and VTC started to use TP/HR for their competence management efforts. VTC has been analyzing its working processes and tasks for several years and has also conducted a large-scale pilot. VIT is still analyzing its work processes and has initiated and evaluated a pilot.

SAP R/3 is a module to the widely spread SAP R/3 product from the German company SAP. It is based on competencies and has many statistical features, which focus mainly on individual facts. VCC in Olofström has evaluated and rejected this competence system. The main reason for this rejection was that it was impossible to run the HR module separated from the main SAP R/3 application.

4.3 Technical features of the investigated competence systems

One obvious characteristic of all competence systems included in this technology review is that they describe and present measures of individuals' competence on dimensions such as programming skills and project management experience. Despite the seemingly common ground of these competence systems, however, a

thorough analysis reveals important differences between the systems in terms of the technical features included and how these sets of features present themselves to a user in everyday knowledge work practice.

Throughout this paper, we use DeSanctis and Poole's (1994) definition of structural features of technology for distinguishing the particular nature of technical features. They define structural features as "the specific types of rules and resources, or capabilities, offered by the system" (DeSanctis and Poole, 1994, p. 126). These features both enable and restrict the range of actions that can be performed by the user of a specific competence system. Table 2 lists an overview of the investigated competence systems and their technical features, as they were to be found in 1999. Because of space restrictions, the listed features represent only a subset of the total number of features of these competence systems. This selection has been made on the basis of their relative importance for competence management in organizational contexts.

4.3.1 Technical features

- Dedicated client. The competence system uses a special client to access the competence data.

- HTTP compatible. The competence data is accessible through a web-browser internally or externally.

- Subsystems. The competence system has more components than those described here, e.g., a recruiting system.

- Competencies. Outlines that the competence system handles competencies. A competence is a certain skill, e.g., in the Competence marketplace system a competence was, for example, project leader, C++ programmer, or an implementer.

- Roles. The competence system manages information about roles. Usually a role is the work task that a person has been assigned to.

- Search. Supports the identification of specific competencies or roles.

- Measurement. Provides competence status overviews.

- Competence gap. Identifies discrepancies between existing and desired competencies.

- Resource gap. Identifies discrepancies between existing and desired resources in terms of roles.

- Survey. Monitors changes in competence status over time.

- Competence tree. Supports a hierarchical competence structure. As an illustration, the Competence marketplace had a three level competence structure. The top level consisted of four different groups and each of these groups had sub-levels, which was constituted of the competencies, e.g., technology, tools, and systems – programming- and script languages – C/C++, Pascal, Java, etc.

- Competence grading. Outlines the skill level for a particular competence dimension.

- Free-text. Allows the input of comments and additional information into the competence system.

- Individual plan. Supports the individual to express a desired skill level and/or new areas of interest.
- Competence ⇒ course. Relates the individual plan to a course planning system.

- Multilingual. Supports multiple languages.

- CV-page. Supports CV-composition on the basis of the competence system's database.

Features of the competence systems \ Competence systems and organizations	Compass (Frontec)	Competence market-place (Guide)	Prohunt (EHPT, Frontec)	SAP R/3 (VCC)	TP/HR (VCC, VIT, VTC)
Dedicated client	○	○	●	●	●
HTTP compatible	●	●	●	○	○
Subsystems	○	○	●	●	●
Competencies	●	●	●	●	●
Roles	○	○	●	●	○
Search	●	●	●	●	●
Measurement	○	●	●	●	●
Competence gap	○	●	●	●	●
Resource gap	○	○	●	●	○
Survey	○	○	●	●	○
Competence tree	○	●	●	●	●
Competence grading	●	●	●	●	●
Free-text	●	●	○	○	●
Individual plan	○	●	○	●	●
Competence ⇒ course	○	○	○	●	●
Multilingual	●	●	○	●	●
CV-page	●	●	●	○	●

● feature present ○ feature not present

Table 2: Technical features of the investigated competence systems.

5. User site investigation: Identified adoption barriers

This section describes the empirical findings of a user site investigation covering six organizations (EHPT, Frontec, Guide, VCC, VIT, and VTC). The intention is to identify barriers to adopting competence systems in the knowledge work practice of these organizations. As noted in the literature on IS adoption (see e.g., Tyre and Orlikowski, 1994; Ciborra, 1996; Majchrzak et al., 2000), organizational uptake of information technology can be very complex despite seemingly sophisticated technologies and promising organizational change intentions. Empirical studies show that issues such as reward systems (Orlikowski, 1996), organizational defensive routines (Henfridsson and Söderholm,

2000), and power structures (Markus, 1983) can work as impediments to successful IS adoption. While much of the existing literature covers barriers residing primarily in the social context, our interest is here with how competence systems themselves can inhibit adoption. Having said this, it should be noted that this remark does not imply that we see the distinction between technology and social context as an unproblematic one.

In what follows, we describe and interpret eight barriers to adopting competence systems in the investigated organizations. These barriers represent dominating themes that emerged from our qualitative analysis of the collected data material. While there existed differences between organizations as well as competence systems, which we indicate in the text, the themes apply more or less to all organizations and systems.

First, two of the five competence systems included in the study (Competence marketplace and TP/HR) represented competence in both free-text and structured forms. While the free-text feature was intended to cater for the qualitative aspects of competence, these two parallel representation forms created an apparent problem in using the systems. An HR manager at VIT expressed this when discussing the TP/HR system:

> "Our offices make use of the competence concepts in inconsistent ways. They do not mean the same thing when writing free-text, as they do when they fill in formalized declarations of competencies. […] Moreover, the fact that there is no relation between these two ways of representing competence makes the situation problematic. […] While we are talking at cross-purposes, we will invest a great deal of time in trying to update different types of unrelated competence descriptions. Since they are separated, a search in, for instance, the free-text profile does not generate competence information from the tree structure. Surely, this will affect the employees' commitment for updating and using the system."

The statement illustrates a manager's frustration about the co-existence of two fundamentally different approaches to competence representation. The investigated competence systems supported one of the two or both, but not an integrated view of both approaches. As a result of this divide, a search for a German-speaking staff member in the specified competence declaration, for

instance, would not track the employee who had declared “I have worked in Germany for five years” in the free-text part of the system. This disintegrated competence representation was a barrier to the successful adoption of the competence systems in practical day-to-day activity. In short, the disintegration meant that employees in the organizations had to update parallel competence descriptions although a search in one of those descriptions did not return information from the other. This situation largely affected their commitment to conducting timely and correct updates negatively.

Second, a recurring task in the investigated organizations is the manning of development projects. Broadly speaking, it is important to compose project teams with an appropriate balance in terms of both competence and experience. This composition depends in part on accurate information about staff availability, which none of the investigated systems supported. This was a problem highlighted by almost all respondents engaged in project management activities. As an illustration, one account manager at Guide in Stockholm expressed the following:

> “To my mind, the fact that there are no features that handle availability might be the most significant problem with the Competence marketplace system. You can almost anticipate in advance that the identified person is unavailable. To be sure, you have to check another list to find out whether or not this person is available. We have an Excel sheet, the so-called “free list”, which indicates who is available and not.”

Indeed, the account manager in question, like colleagues at Guide in Oslo, VCC, and VTC, experienced a shortage of necessary information for undertaking informed project-manning decisions, unless he had not used additional information sources as complements to the competence system. The staff availability blindness of the systems was clearly a barrier to adopting them in the everyday work of account managers.

Third, the same account manager continued:

> “I have often searched for a particular programming language competence and the system has presented a few names. As I have contacted these people, however, they often answer that they were not into this kind of programming anymore. They

> were competent enough, but they were not interested in applying the type of competence that I requested."

This statement illustrates a recurring problem related to an inherent inability of the investigated competence systems to cater for both the competence and desired work tasks of an employee. Almost exclusively, a manning decision depended on the competence registered rather than individual competence development goals. As an unintended result, and highlighted by respondents of almost all organizations, employees tended to "hide" existing but personally uninteresting competencies to avoid unwanted assignments. The reproduction bias (once a C++ programmer, always a C++ programmer) of the competence systems produced biased maps of existing competencies and worked as an efficient but unproductive barrier to successful adoption of them.

Fourth, there are many situations in which individuals need to get in touch with persons with a particular expertise, but cannot do so because the competence system would not let them. VCC's HR manager expressed the following:

> "The TP/HR system is hierarchically structured and closed. As an individual you see nobody but yourself. If I search for a certain competence, the system should support me in identifying the appropriate person. Such features are missing in the system. Instead, I have to talk to someone who is familiar with the employees' competencies. In any case, I can not use the TP/HR system for doing it myself."

This statement highlights how the system restricted access to the competence descriptions of others. This user isolation was clearly a barrier to adopting competence systems in VCC, VIT, and VTC. In this context, some of the respondents remarked that the closed structure was primarily a means to avoiding internal recruiting.

Fifth, one important element in consultancy and project work is the exchange experiences and ideas with your peers. This exchange often works as a source of inspiration and motivation. Quite a few of the respondents, however, felt that the competence system they used missed features that would enable this exchange. A project manager at Guide in Gothenburg put it as follows:

> "Maybe it should be possible to connect this group of people with similar interests profiles in some way. For instance, mark here [in the competence system] that I am a member of this network. Then I have more search paths and this would make it easier to find knowledgeable colleagues. At present, there is no interactive forum for exchange of opinions and sharing of competencies. It is important to make it easier to initiate a dialogue."

Indeed, as suggested in this statement, the knowledge sharing disability of the competence systems worked as a barrier to adopting them in everyday project work.

Sixth, one HR manager at VCC expressed the following about TP/HR:

> "The major disadvantage of the system is that it is not possible to make competence analyses of teams and groups of different sizes. The system supports analyses on the individual level in an excellent way. But we must be able to use the system in order to form a project team and analyze the total competence level. So, the system needs features facilitating evaluation of groups in varying sizes. Moreover, the system should also be more flexible with regard to analyses of competence status at a certain point in time and competence status changes over time."

The HR manager's concern about the group level can be understood in the light of the fact that almost all development projects involve more than one individual. The more the people involved, the more complex is the manning process. The group level imprecision worked as a barrier to adopting competence systems in the investigated organizations.

Seventh, as outlined in subsection 4.1, one important element in competence management processes is to develop the competence level of individual employees. A critical success factor of this type of competence development work is to ensure that individual interests and desires are catered for. In discussing the Competence marketplace system, the CEO of Guide's office in Stockholm observed:

> "There [in the competence system] you should also have directions, aspirations as well as ambitions related to employees' competencies. If not, you will only base competence

> decisions on the competencies that people have had or have today. This means, basically, the competencies that they have documented in the existing competence descriptions. A complementary and important approach is to try to identify the interests, aims, and directions of the employees. [...] If the competence system had this type of features it would surely become a more integrated part of our competence development activities."

This observation indicates that competence development is related to future interests as much as past experiences. While documentation of past experience is supported in the existing competence systems, none of the investigated systems support competence descriptions complemented by individual interests in a useful way. The free-text feature provides, of course, the possibility to express interests, but as observed by staff members at VIT, this feature is not integrated with statistical analyses for aggregation of such information in order to visualize interests and ambitions. This competence direction inattention worked as a barrier to adopting existing competence systems in the investigated organizations.

Finally, the use of competence systems can often be part of a more systematic attempt to relate competence activities to strategic business planning. This attempted relation makes it reasonable to assess the potential support that competence systems provide strategic planning activities. The CEO of Guide's Stockholm office noted:

> "Information about market research and market analyses that indicates what the market demands would be useful to have [in the competence system]. We have to be sensitive to the world around us in order to handle our competencies more professionally. What is the market direction and what are our abilities to pursue that direction ourselves? Important issues are: our track record and competence status in those areas. Because the system's features do not handle this type of information it is of limited use for top management and strategic planners within the organization."

Considering this statement, and similar observations noted at EHPT and Guide Oslo, one might suggest that the environmental exclusion of the investigated competence systems worked as a barrier to their adoption by the top management.

6. Design suggestions

The general objective of this section is to provide design suggestions intended to facilitate successful integration of competence systems in organizations. A set of general design suggestions is outlined below for future competence systems.

It is a well-known argument that implementations of groupware systems fail when the users required to do the job do not benefit from their work (Grudin, 1994). Competence systems are based on the rationale that competence information about the employees is collected in order to facilitate different types of management analyses, e.g., resource and competence gap analyses. It is therefore important that the employees benefit from entering the competence information that the management is supposed to base their analyses on. The fact that competencies as well as activity continually change requires that the process of entering competence information is smooth and that the incentives are in place (cf., Holtshouse, 1998; Hahn and Subramani, 2000). Our study shows that competence systems need to be re-designed to facilitate the flow of competence information.

First, one obvious aspect is that there is no relation between free-text expressions and competence structures in existing competence systems. Since these two in an integrated view are supposed to represent a rich picture of an employee's competence, there should be a linkage between these two types of descriptions. If the employees are expected to fill in and update both free-text and formalized representations of competence, a search in one of these descriptions must also return available information from the other one. Otherwise, there are reasons to believe that the employees' motivation for cultivating their competence descriptions will be declining.

Second, the reproduction bias of competence systems produce biased maps of existing competencies. To address this adoption barrier, competence systems should be designed to primarily address or solve other problems or perform a different task on the user's behalf and update the competence descriptions as a spin-off. Recommender systems have been used to locate and leverage expertise within organizations (McDonald and Ackerman, 2000) and to find and communicate unarticulated knowledge (Stenmark, 2001). Thus, recommender systems supporting information seeking could be an action-oriented approach to competence mapping that is worth researching.

Third, it is important that competence systems can be used not just for competence representation. Several competence systems included in our study provide limited support to users in non-managerial positions. Even though it is possible to search for competence, users will merely find managers having employees with the requested competence. Some of the competence systems have completely closed structures, which mean that managers are authorized to see every subordinate's competence descriptions, while employees who hold other positions in the hierarchy posses the authority to see only their own descriptions. These aspects have negative effect on the usage of the competence systems since knowledge work activities such as networking and collaboration are hampered. Features making it possible to search for competencies across departmental borders and on different organizational levels, and addressing the adoption barrier user isolation, are therefore an important design dimension of future competence systems. Here the action-oriented view of competence is also worth investigating since previous research indicates that descriptions based on actual practice are more trustworthy than espoused theory representations of work (Stenmark, 2001). Thus, there are reasons to believe that action-generated role and competence descriptions would facilitate expertise identification and the emergence of communities of practice among organizational members, as also organizations' work with the setting up of development teams for customer projects.

Fourth, while the previous design suggestions were concentrated on critical mass aspects, the last one addresses a

more strategic level. Our study of competence systems shows that the systems are enriched with features supporting a vide range of managerial analyses. However, these features are limited for basically two reasons. Analyses on employees' competencies can be conducted only for predefined periods of time and on fixed sizes of teams. Moreover, analyses merely deal with the existing competencies of organizational members, while interests and aspirations about future competence are ignored. The adoption barriers group level imprecision and competence direction inattention highlight that the underlying rationale of the features contrasts with the active character of knowledge work practice. Therefore, the features have to be redesigned and changed, and future competence systems should incorporate features that increase the systems' flexibility in relation to management analyses. More specifically, there is a need for features that handle information about both existing competencies and competence interests in the organization and their status at a particular point of time and development over a definite period.

In action research including Guide and VIT, the above-presented design suggestions have been, to some extent, elaborated further, developed, implemented, and evaluated in order to investigate how improved features can overcome some of the adoption barriers identified in this research. Guide's Competence marketplace system and VIT's TP/HR system have constituted the basis for these experiments. The results from the experiments can be found in Lindgren (2002) and Lindgren and Stenmark (2002).

7. Discussion

In this section, we use DeSanctis and Poole's (1994) distinction between the structural features of a given technology and the spirit of this feature set for understanding the relationship between the competence systems' features and the identified adoption barriers. As described in subsection 4.3, structural features such as search functions, competence and resource gap analyses, and competence grading give meaning to the technology and enable the user to

actually perform his job in a given work situation. As an example, these features support account managers in the process of manning a development project. They enable the manager to assess what competence a certain staff member can be expected to have and, on the basis of several such assessments, compose a well-balanced project. The spirit of a particular feature set (technology spirit, for short) is associated with how the system presents itself to the people who use it. The consultants who were expected to fill in correct competence descriptions, for instance, realized soon that they needed to bypass the technology by exaggerating their competence in the areas they were interested in, while down-playing their competence in the areas they did not want to get stuck in. The competence system surely presented itself with a reproduction bias in these situations conveying a spirit that was not aligned with the reality that the consultants experienced.

Looking back at the competence systems and organizations included in this study, we can see that the eight adoption barriers identified (disintegrated competence representations, staff availability blindness, reproduction bias, user isolation, knowledge sharing disability, group level imprecision, competence direction inattention, and environmental exclusion) can be associated with the technology spirit conveyed by the investigated systems. Rather than conveying virtues such as openness, continuous learning, and future-orientation, the competence systems conveyed isolation, reproduction, and stagnation. The competence systems can be described as merely traditional personnel administration systems complemented by features that passively archive formalized descriptions of competencies. Contrary to the intended use of competence systems (as suggested in the systems documentation), a faithful adoption of these systems would be counter-productive to the competence development plans of the individual. This finding suggests that it is important to design competence systems that convey a technology spirit more in line with the knowledge work practice found in organizations.

More specifically, we have outlined four design suggestions for future competence systems:

- Features that handle the linkage between free-text and formalized descriptions of competence are needed. A search in one of these representations must also return available information from the other one.

- Features that address or solve other problems or perform a different task on the user's behalf and update the competence descriptions as a spin-off are important.

- Features making it possible to search for competencies across departmental borders and on different organizational levels are needed.

- Features that manage information about both existing competencies and competence interests, and their status at a particular point of time and development over a certain period are important.

Developing and implementing these types of features would, we believe, facilitate successful integration of competence systems in organizational knowledge work practice.

Finally, our study shows that the identified adoption barriers have negative consequences for the organizations. In the case organizations, competence management processes are fundamentally related to the use of competence systems. With the identified adoption barriers as a point of departure, it is reasonable to question the outcome of such competence management processes. If the competence systems are supposed to constitute the basis in the organizations' competence management processes, there is a need for further research in order to develop features that better match the nature of knowledge work practice. This argument contrasts with the research results that criticize the knowledge management research's altogether one-sided technology orientation and meagre focus on organizational and cultural dimensions (Swan et al., 1999). Towards the production of more technology-specific knowledge about competence systems, our research results could be seen as a first contribution.

8. Conclusion

With a multiple-case study including six different organizations (EHPT, Frontec, Guide, VCC, VIT, and VTC) as basis, we have examined barriers to adopting competence systems and related these barriers to the technical features of the investigated systems. Our study shows that the identified adoption barriers have a negative impact on the competence systems' role in the organizations' competence management activities and many of these barriers can be associated with the technology spirit conveyed by the systems. The competence systems can be described as merely traditional personnel administration systems complemented by features that passively archive formalized descriptions of competencies. Instead of communicating virtues such as openness, continuous learning, and future-orientation, the competence systems conveyed isolation, reproduction, and stagnation. Based on these findings, the main conclusion of this paper is that competence systems need to convey a technology spirit more in line with the knowledge work practice found in organizations.

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Second paper[18]

The Evolution of Knowledge Management Systems Needs to be Managed

Abstract

Today many organizations rely on the knowledge and competence of individual organizational members. Consequently, information systems to support knowledge management (KM) are considered to be vital tools in order to achieve competitive advantage. In this paper, we report the results from a field research study of such systems in a knowledge-intensive, fast-growing, and dynamic organization. The case illustrates that evolution, which refers to the process by which organizations and their information systems change over time, needs to be managed since it can result in KM systems failures. We characterize the mainstream KM research literature in relation to managing the risk of KM systems failures and outline that management of KM systems' evolution is a dimension that has not been addressed so far. Building on these empirical and theoretical results, we discuss how the evolution of KM systems could be managed and what implications our results have for future KM research.

1. Introduction

To improve business performance and competitive advantage organizations make large investments in information systems to

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support KM (see e.g., Wiig, 1997; Milton et al., 1999). However, there is a risk that the investments do not lead to the expected benefits. Recent contributions to KM research show that KM systems often fail (Fahey and Prusak, 1998; Newell et al., 1999; Lindgren and Henfridsson, 2002; Storey and Barnett, 2000) and it is apparent that KM systems suffer from development and implementation difficulties that previously have been discussed in the broader literature on information systems failures (e.g., Lyytinen and Hirschheim, 1987; Lyytinen and Robey, 1999). Given the risk that KM systems fail to deliver the expected benefits, an important task for the KM research is to contribute with knowledge that will support researchers and practioners in their efforts to successfully develop and implement KM systems.

In the broader literature on information systems failures, evolution, although often discussed in different terms such as adaptation and drift, has been identified as an important dimension that can result in failures (see e.g., Orlikowski, 1992, 1996; Ciborra, 1996, 2000; Henfridsson, 1999). In this paper, evolution refers to the process by which organizations and their information systems change over time. Since the world changes, business changes, strategy changes, and context changes, the information systems need to adapt to such changes in order to deliver benefits (Parker, 1996). Further, changes in information systems also affect other systems and the organization. Therefore, changes are often interrelated and affect their surroundings in sometimes unpredictable ways. The change process is continuous, multi-dimensional, and difficult to manage. An implication of this perspective is that information systems cannot be viewed as stand-alone systems but as interrelated systems that need continuous management rather than one-time planning (e.g., Hanseth and Monteiro, 1997; Magoulas and Pessi, 1998).

In this particular study, we are interested in what support KM research has provided so far for the management of KM systems' evolution and what additional support KM research needs to provide. We first characterize the mainstream KM research literature in relation to managing the risk of KM systems failures and point out that evolution is one dimension that has not been addressed so far. We then illustrate, by presenting findings from a

field research study, that evolution is an important dimension that can lead to unnecessary complexity and ultimately KM systems failures. In the final part of the paper, we discuss how the evolution of KM systems could be managed and what implications our results have for future KM research.

2. KM research

In this section, we characterize the contemporary mainstream KM research literature in relation to managing the risk of KM systems failures and outline that evolution is a dimension that has not been addressed so far. The literature that we have studied is found mainly in the three overlapping research areas Computer Supported Cooperative Work (CSCW), Information Systems (IS), and Organization Theory (OT). Most of the contributions that explicitly focus on KM have been published since 1995. Conferences that we have concentrated on are the Conference on Computer Supported Cooperative Work (CSCW), the European Conference on Computer Supported Cooperative Work (ECSCW), the Hawaii International Conference on System Sciences (HICSS), the International Conference on Information Systems (ICIS), and the European Conference on Information Systems (ECIS). Journals that we have studied are Journal of Knowledge Management, Organization Science, and special issues on KM in Harvard Business Review, Journal of Management Studies, Strategic Management Journal, and Strategic Management Review. Moreover, we have less comprehensively studied and used other conferences and journals. Below, we characterize the mainstream KM research within CSCW, IS, and OT.

Contributions within the research area CSCW inform the design of KM systems. The focus is on computer systems and functions supporting groups and the emphasis is on developing and evaluating new types of functions and uses for KM systems. This is supported by empirical and theoretical studies that inform design of new KM systems. Typical contributions propose a KM system and evaluate it (e.g., Terveen et al., 1993; Ackerman, 1994;

Karduck, 1994; Ackerman and McDonald, 1996; Kovalainen et al., 1998), inform design through empirical studies of work-practice (e.g., Ackerman and Halverson, 1998; McDonald and Ackerman, 1998; Fagrell et al., 1999), and inform design through theoretical discussions (e.g., Bannon and Kuutti, 1996; Randall et al., 1996). Overall, in relation to managing the risk of KM systems failures, KM research within the CSCW area offers researchers and practioners support and guidelines for how to design and implement a KM system to fit work-practice in a specific use context.

Contributions within the research area IS inform the design of organizational KM initiatives and KM systems. Through both empirical and theoretical studies, the emphasis is on finding a match between a certain type of KM system and an organization. Typical contributions propose strategies for organizational use of a KM system (e.g., Davenport and Prusak, 1998; Pan and Scarbrough, 1998; Hansen et al., 1999; Zack, 1999; Swan et al., 2000), improvements of functions for KM systems from an organizational perspective (e.g., Abecker et al., 1999; Hauck and Chen, 1999; Hahn and Subramani, 2000; Lindgren and Henfridsson, 2002), and investigations of the nature of knowledge and KM in order to create an understanding of the phenomena to support (e.g., Schultze, 1999; Tuomi, 1999; Hedesstrom and Whitley, 2000; Alavi and Leidner, 2001). Overall, in relation to managing the risk of KM systems failures, KM research within the IS area offers researchers and practioners support and guidelines for how to design and implement a KM system to fit organizational characteristics and strategies.

Contributions within the area OT inform the design of organizational KM initiatives. The emphasis is on organizing and IT is treated peripherally. With both empirical and theoretical studies as a basis, typical contributions discuss proposals for organizational designs (e.g., Nonaka, 1994; Brown, 1998; Nonaka and Konno, 1998), the nature of organizations and work (e.g., Brown and Duguid, 1991; Grant, 1996; Spender, 1996; Tsoukas, 1996; Brown and Duguid, 1998; Scarbrough, 1998), and the nature of knowledge (e.g., Blackler, 1995; Cook and Brown, 1999). Overall, in relation to managing the risk of KM systems failures,

KM research within the OT area offers researchers and practioners support and guidelines for how to design and implement a KM-oriented organization. KM systems are not discussed in detail, but instead seen as unproblematic supportive technology for the organizational designs.

Summing up, the mainstream KM research can be described as having a perspective that focuses on the development and implementation of one KM system in a relatively stable organization during a limited time-period. This perspective does not encompass the evolution of KM systems, i.e., the process by which organizations and their information systems change over time. Knowledge from a perspective of a single systems development project does not offer support and guidelines for managing the evolution of KM systems. In the remainder of this paper, we illustrate, by presenting findings from a field research study, that evolution is an important dimension, which can result in unnecessary complexity and ultimately KM systems failures. With these theoretical and empirical findings as a point of departure, we argue that more KM research focusing on this problematic phenomenon is needed.

3. The Guide case: Research site and methodology

The research site was the Swedish IT consultant organization Guide, which could be characterized as a knowledge-intensive, fast-growing, and dynamic organization. At the time of this study, Guide had approximately 800 employees at ten offices located in three countries. Since its start in 1988, Guide's business concept has been to offer top expertise. In order to realize this ambition, Guide annually invested 15 percent of its turnover in competence development and could be described as an ambitious organization with regard to KM.

From a practical standpoint, we had good access to the organization. One of the authors was employed by Guide 1994 to 1999 and during the period 1996 to 1998 he was the chief knowledge officer (CKO). This means that on the one hand he has

unique insights and knowledge regarding the case, yet on the other hand he can be considered biased towards the case. The problems with bias are likely to have been counter-balanced by the fact that the fieldwork at Guide has been conducted by the rest of the authors who have not been affiliated with the organization. Moreover, other studies at Guide have contributed to the understanding of the case (see Lindgren and Henfridsson, 2002).

The fieldwork was carried out during March to May 2000 and employed ethnographic techniques (see e.g., Van Maanen, 1988). We conducted 25 semi-structured interviews, each lasting approximately one hour, with sales managers, project managers, system architects, management consultants, personnel managers, competence area managers, and business area managers. 15 of the interviews were with people from Guide's office in Gothenburg who had knowledge of local issues as well as local development and use of KM systems. Most of these people, however, also had assignments on a top-management level and therefore had knowledge of the organization as a whole. Moreover, we interviewed 5 people from Guide's office in Stockholm and 5 people from Guide's office in Oslo (Norway). The reason for this was to gain knowledge regarding the locally developed KM systems at these offices, i.e., the Competence-marketplace and the Developers-guild. The interviews focused on issues regarding what has and has not worked with KM systems at Guide during the period 1995 to early 2000. Large parts of the interviews were conversations where the respondents were given the freedom to express the issues that were most relevant from their perspective. However, in order to test the stability of these expressions, we tempted the respondents to counter-argue. Furthermore, all interviews were recorded and later transcribed. Besides the interviews, we collected empirical data through studying documents such as system manuals, strategy plans, competence plans, and annual reports. We have maintained a critical perspective towards the empirical data and iteratively analyzed the case in order to get past first-impressions and surface explanations of the situation. Our analysis can be described as grounded theory-inspired since we have not applied an explicit theoretical framework as a basis. Instead, we have pragmatically constructed a theory based on our interpretation of the empirical

data, albeit influenced by our own experiences and implicit theories. Overall, our research approach can be broadly classified as an interpretive case study (Walsham, 1995) and the results presented in this paper are one possible interpretation of the Guide case.

4. Results

In this section, we present the results from our field research study at Guide. The results are structured using categories generated from the analysis of the empirical data. First, we describe the overall organizational development of Guide during the period 1988 to 2000. Second, we present an overview of the KM systems that are relevant for this study. Third, we describe the complex situation early 2000 at Guide's office in Gothenburg with regard to the KM systems use. Fourth, we suggest that ad hoc management of the KM systems' evolution is a contributing factor to the unnecessarily complex situation. The first and second sections serve as a background to the third and fourth, which are of a more problematizing character.

4.1 The organizational development of Guide

Guide was founded in 1988 when two IT consultant firms merged and a number of consultants at one of the firms decided to leave the organization and start a new company. The objective was to offer top expertise and therefore developing knowledge as well as managing it were recognized as key issues.

In 1989, consultant profiles containing brief descriptions of individuals' competencies were introduced in order attract customers. Further, consultants with an average experience of 15 years were recruited to offer a mentoring base for less experienced employees. Recruiting experienced consultants from other organizations was, however, relatively easy due to the competence focus that Guide had. Furthermore, the ambition at this time was

to have a growth rate equal to the growth of the industry branch, yet not to become too big. The organization was geographically concentrated to Gothenburg and Stockholm where the major customers were located and the business focus was systems development.

In times of recession, in 1993, Guide suffered its worst result ever. This was met by intensified investments in competence development. A test-laboratory was built in order to show their high competence for customers and this laboratory gained much positive attention.

In 1994, Guide implemented routines to enable customers to value specific consultants' competencies and performance in assignments.

In 1996, competence development ratings were implemented as a measurement of the consultants' perceived competence development in assignments. This enabled management based on other parameters than traditional economical ratios. The same year the business strategy changed from selling individual consultants to selling teams, concepts, and complete solutions in order to increase profit margins. Further, the organization was ISO-certified and this demanded routines for managing knowledge and competence. A KM strategy was formulated and an IT strategy was developed. Moreover, two new subsidiaries, IT management and Integration, were created, which resulted in the business becoming more diversified. Previously, the offices in Stockholm and Gothenburg were organizationally separated, i.e., they had their own customers, consultants, and assignments. With the two new subsidiaries this was changed since the different offices were part of the same organization. Also in 1996, some smaller corporations were acquired and the new employees were integrated into the existing organization.

The year after, in 1997, the extent of corporate takeovers increased. Guide acquired the corporation Communicator and established offices in Uppsala, Malmö, and Oslo.

In 1999, Guide established an office in Copenhagen (Denmark).

In February 2000, the Internet consultant corporation Framfab acquired Guide.

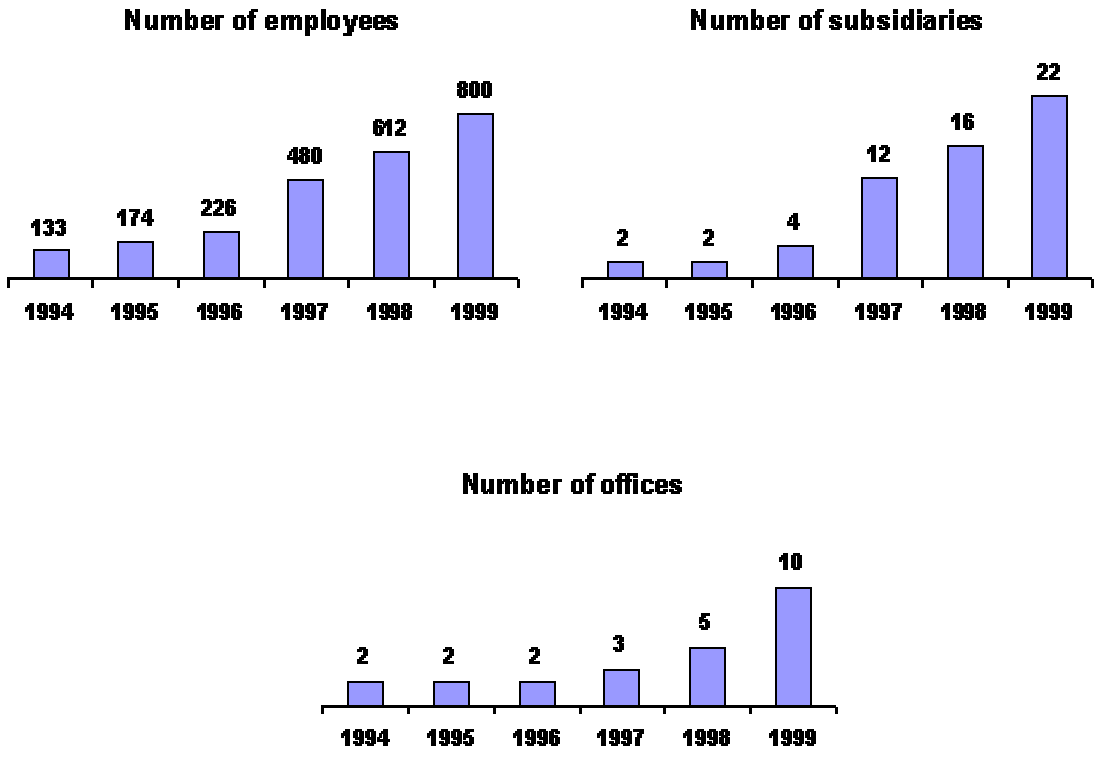

Figure 1: The growth of Guide during the period 1994 to 1999.

4.2 KM systems at Guide

As part of the ISO-certification process, Competence descriptions were developed and implemented in 1996. The Competence descriptions were word documents containing detailed descriptions of the consultants' competencies, which were mainly used for

manning assignments. However, they were also used to show the customers the competencies that were available for a prospect. The Competence descriptions could be edited and used by everyone, i.e., both management and consultants. Until 1996, the business strategy focused on selling individual consultants and the operational focus within Guide was to find the appropriate consultant for an assignment. Eventually, as the organization grew, keeping track of individuals competencies and matching those with appropriate assignments required more sophisticated system support. As a result, the Available-consultants system was developed and implemented in the beginning of 1996. The system was a spreadsheet document, stored on a server, containing competence profiles, availability status, competence areas, and prospects. Only management could access this system. The First intranet was launched in 1996. This intranet version contained HTML based competence descriptions, which were automatically generated from the above-described word documents, prospects, project information, competence areas, etc.

In 1998, the Second intranet was implemented as a replacement for the First intranet. This version of the intranet contained information regarding consultant profiles, but less attention was given to projects and competence areas. Instead, the focus was on personal information about the consultants. The same year, the Job-assignment system was developed and implemented at Guide's office in Gothenburg. This system was based on Lotus Notes and partly replaced the Available-consultants system. The Job-assignment system contained competence information and prospects and was used to match incoming prospects with the consultants' competencies and wishes. Only management could access the system.

In 1999, the Competence-marketplace system was developed at Guide in Oslo and since August 1999 the system was up and running at Guide's offices in Gothenburg, Oslo, and Stockholm. The system was a database containing competence areas and competence levels of the consultants' competencies. Guide's idea regarding the Competence-marketplace system was to have a KM system for mapping the consultants' competencies, categorization and visualization of the competencies within the organization,

forming teams of consultants, and finding expertise for their projects. Further, the consultants were responsible for the input of their competence data. At the time of the implementation of the Competence-marketplace system, the Developers-guild system was developed at Guide's office in Stockholm. The system was made available for the whole organization in late 1999. The Developers-guild system was a community website functioning as a meeting space for system developers. The idea was to have an alternative forum for co-operation, knowledge sharing, and information retrieval. The Developers-guild system included online articles, discussion lists, collaborative writing tools, and news.

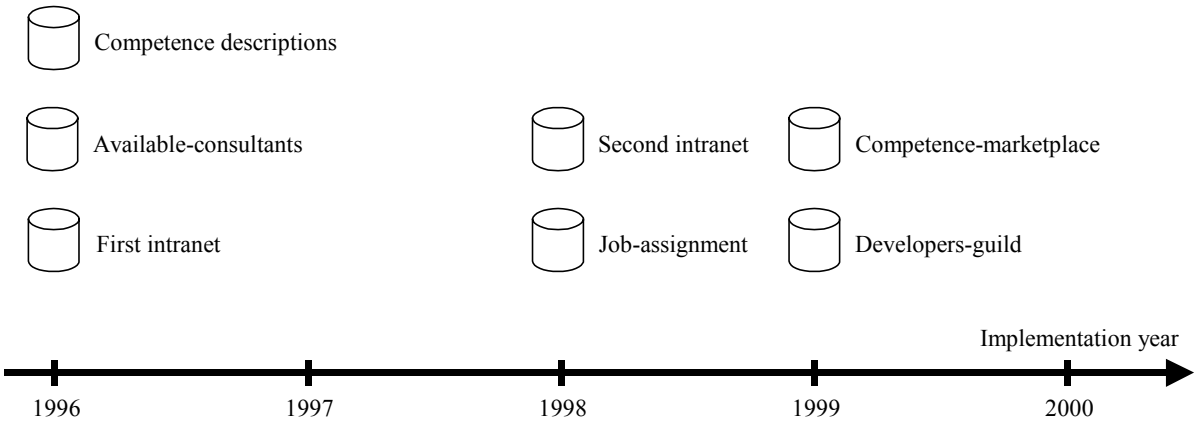

Figure 2: KM systems at Guide's office in Gothenburg.

4.3 Complexity and the risk of KM systems failures

With regard to the KM systems use at Guide's office in Gothenburg, the situation early in 2000 was characterized by unnecessary complexity. This means that in addition to the complexity that naturally exists in this type of organization, there were dimensions of complexity that to a large extent could have been avoided. As we show in the following subsections, there were, for example, several systems with conflicting relationships and the data quality in the KM systems was low. Overall, the KM systems were not embraced by the organization and thus not extensively used. The desired effects of the KM systems, such as support for finding expertise, team formation, and competence analyses, were not achieved. The problems and barriers for achieving the desired effects were

substantial and commitment for the systems among organizational members was deteriorating. Therefore, the risk of KM systems failures was considerable. Below, technical and organizational dimensions regarding the complex situation are presented. These dimensions are illustrated by quotations from the interviews.

4.3.1 Competing systems

Competing systems is about the influence KM systems within the organization have on each other. At the time of this study, co-ordination for reducing conflicts between KM systems was missing. Different KM systems had to be updated with similar data and, therefore, the consultants had to update several systems. A sales manager and one of the project managers for the implementation of the Competence-marketplace system in Gothenburg discussed this:

> "In 1998, the Job-assignment system was developed in Lotus Notes. The problem with the Competence-marketplace system was that the consultants were compelled to update the Notes system as well. If you had merged these systems, it would have worked better… as it is now, the data is not replicated between the systems."

> "The problem has been that there is no connection between the Competence-marketplace system and the Competence descriptions. There are no defined routines regarding how to… for example update. The original idea was that the Competence-marketplace system would generate competence descriptions… but this is not the case."

Consequently, at Guide's office in Gothenburg there were several similar KM systems containing the same type of data. Their reciprocal relationships had neither been elucidated nor defined, which in turn resulted in low compatibility.

4.3.2 Related systems

Related systems is about how other systems within the organization have "invisible" relations to the KM systems. At the time of this study, value adding co-ordination was missing and, for

instance, compulsory systems such as financial systems had data that was relevant for the KM systems. One management consultant and a competence area manager explained:

> "In our more compulsory systems there are time reports… these you have to hand in… otherwise you will not get your salary. The time reports contain information regarding what assignments you have worked in and every assignment has a description concerning what competencies it consists of. It should be quite simple to scan these documents and in this way update systems like the Competence-marketplace."

> "The Competence-marketplace system should contain information about what assignments different consultants have accomplished. Actually, we have invoices and basic data in our operative systems that could be useful to have in the Competence-marketplace system. I do not think that it is integrated with other types of systems within the organization."

Accordingly, there were other systems within Guide's activity that to a great extent were related to the KM systems. However, useful data from these more compulsory systems were not utilized. In consequence, the consultants were expected to supply and update data that already existed in other systems within the organization.

4.3.3 Heterogenous usegroups

Heterogenous usegroups concerns the relations between the KM systems and different usegroups within the organization. At the time of this study, there was uncertainty regarding which groups of users were served by the KM systems. Furthermore, it was not consolidated as to who was producer and consumer of the KM systems' information. Concerning the Competence-marketplace system, a personnel manager and a project manager discussed this:

> "The greatest winners concerning this are the personnel managers. Maybe it should be their responsibility to secure that the system is updated. The consultants are interested in having the right assignments and if the Competence-marketplace system was the way for this… then the incentives are in place, but this is really not the situation. I think this is due to

> misapprehensions regarding what the system is supposed to do."

> "The Competence-marketplace system has a built-in conflict. From my point of view, it is developed with the sales organization's demands as a starting point... the sellers argue that they need to be able to search for information about competence within the organization. But, you must remember that someone is needed in order to provide that information."

The Competence-marketplace system served primarily the personnel managers and the sales part of the organization. The consultants that were supposed to supply the information about their competencies did not get much in return. Thus, it seems that an organizational awareness regarding which groups of users were producers and consumers of the Competence-marketplace system's information was missing.

4.4 Ad hoc management of KM systems' evolution

In the previous sub-section, we presented the complex situation at Guide's office in Gothenburg with regard to the KM systems use. Here follows an analysis of the period 1995 to 1999, which suggests that ad hoc management of the KM systems' evolution was a contributing factor to the unnecessarily complex situation. In order to illustrate the evolution of KM systems, we have chosen to discuss different types of changes. These changes, which we have categorized as functional and organizational changes, have been generated from the analysis of the empirical data. Functional changes deal with new KM systems in the organization, new versions of a KM system, and new features in a KM system. Organizational changes are about new business models in the organization, new subsidiaries in the organization, and new competencies in the organization. To illustrate each type of change, we use quotations from the interviews. The reason for this presentation is to show that evolution of KM systems is an important dimension that needs to be managed.

4.4.1 Functional changes

Functional changes deal with new KM systems in the organization, new versions of a KM system, and new features in a KM system. Below, we describe and illustrate each type of change.

New KM systems in the organization

This change considers situations where several different KM systems are implemented in the organization over time. This is illustrated by a management consultant at Guide:

> "We changed the intranet… and then we unfortunately lost speed. At the same time the Competence-marketplace system came in by leaps and bounds, and took over… this regarding the information about individuals' competencies. The marketing of the Developers-guild system at the time of its introduction was insignificant… so, there are merely a few who take part… some even do not know that it exists. In the midst of it all, the Competence-marketplace system appeared and it can be described more as the essential thing… the core… it is like the heart in our knowledge bank."

This quotation highlights the fact that the second intranet, the Competence-marketplace system, and the Developers-guild were developed in different quarters within the organization and that there was a lack of co-ordination between the different initiatives. The development and implementation of the KM systems can be characterized as locally driven and their relations were managed in an ad hoc manner.

New versions of a KM system

This change concerns the case where new versions of existing KM systems are developed and implemented in the organization. A sales manager at Guide in Gothenburg discussed this in relation to the development of the different versions of the intranet:

> "Competence descriptions as well as the competence areas were put up as sites on the intranet [version 1]. These sights were supposed to indicate work tasks, what we were actually doing, projects, and anybody was permitted to go there and have a look. This was the first attempt in order to display something for the consultants and it really set off the competence development. Then the intranet [version 2] became more of an

> information channel consisting of general information. Our ambition was this huge competence mass, but it did not turn out that way. This implementation became more of a news channel, rather than a knowledge system."

The quotation highlights the fact that the development of the intranet has been problematic. The first version of the intranet was adapted to Guide's activity and the management of knowledge and competence was supported. When the second version of the intranet was developed, however, the experiences gained from the first intranet version were missed. This resulted in the new intranet not having the qualities, which made the former version useful for the organization.

New features in a KM system

This change concerns where new features are developed and added to existing KM systems within the organization. Concerning this issue a sales manager at Guide's office in Gothenburg phrased the following:

> "The development of the intranet [version 2] was conducted top-down. Since there was no organization that managed the implementation of the system, sub-intranets emerged. These local initiatives evolved in order to meet needs belonging to particular parts of the organization… driven by personnel, and around these sub-intranets, forums developed. These have, of course, effected the use of other systems within the organization."

This quotation illustrates that the functions in the second version of the intranet did not satisfy local needs. Therefore, local initiatives were initiated in an ad hoc manner to adapt the system for their respective demands.

4.4.2 Organizational changes

Organizational changes concern new business models, new subsidiaries, and new competencies in the organization. Below, we describe and illustrate each type of change.

New business models in the organization

This change is about when new business models in the organization are developed over time. One business area manager in Gothenburg discussed this in relation to the Competence-marketplace system:

> "The business model resulted in certain questions such as, for example, are there any persons who are suitable for this project. This is reflected in the Competence-marketplace system. However, reality as well as business models change, but this is not mirrored in the systems. Our business has changed... from selling individual consultants to selling complete solutions."

The quotation highlights the fact that Guide developed a new business model (i.e., selling teams and complete solutions instead of individuals and man-hours), which in turn was not implemented in the Competence-marketplace system (e.g., features for team analyses such as aggregation of team members' competencies). Consequently, the Competence-marketplace system did not support the new way of working within the organization.

New subsidiaries in the organization

This change deals with the arrival of new subsidiaries in the organization, which adds new business areas as well as perspectives to the existing activity. A sales manager at Guide in Gothenburg discussed this increased heterogeneity:

> "At the same time as we acquired companies with new lines of business, we tried to implement the system. Guide had 22 subsidiaries... all of them with their own perspectives. Who has the right to change the Competence-marketplace system's structure... who owns the information so to speak... from this viewpoint it would have failed irrespective of our efforts."

The quotation highlights the fact that the implementation of the Competence-marketplace system was difficult since different parts of Guide's decentralized organization had varying demands. It was unclear as to who had the responsibility for the information and the authority to change the structure of the system.

New competencies in the organization

This change concerns the addition of new employees to the organization, which leads to new competencies and greater diversity within the organization. A management consultant at Guide's office in Gothenburg articulated this:

> "Oslo has contributed with the original competence structure, but... then we have done nothing, and it has been the new consultants' task to take care of the structure if they are not satisfied. That is the way it has been... it is not properly handled."

This quotation illustrates that the original competence structure in the Competence-marketplace system was developed at Guide in Oslo and when the system was implemented at Guide's office in Gothenburg the original competence structure was applied. Moreover, when new consultants with new competencies had been recruited to the activity in Gothenburg, the updating of the competence structure was managed in an ad hoc manner. Accordingly, there have been competencies within the organization that were not represented in the Competence-marketplace system.

5. Discussion

This section contains a summary of the Guide case, a discussion about how the evolution of KM systems could be managed, and, finally, what implications our results have for future KM research.

5.1 Summary of the Guide case

In this paper, we have presented empirical findings from a field research study at Guide, which demonstrate that ad hoc management of KM systems' evolution has resulted in an unnecessarily complex situation (see Figure 3).

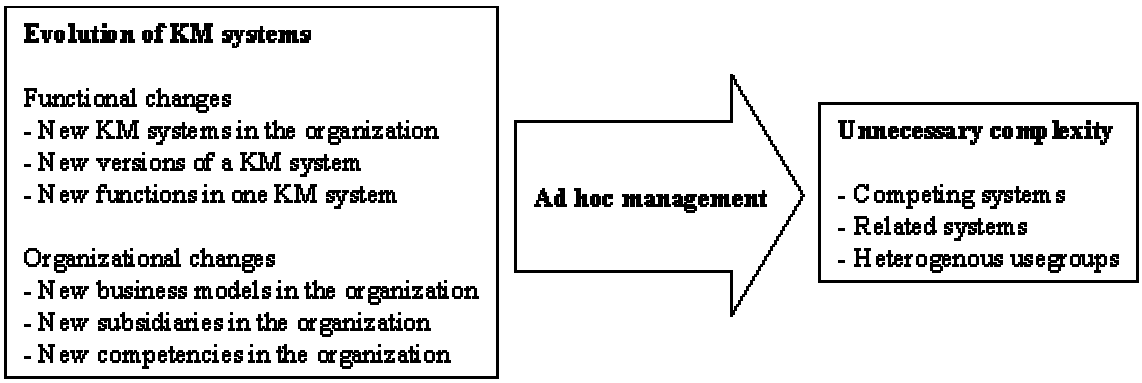

Figure 3: Summary of the Guide case.

As outlined in this paper, Guide has implemented several KM systems at various points of time. Many of those systems have not realized their potential and can be considered as failures. Other systems, successfully used in the present situation, risk failing in the long run due to continued evolution and increased complexity. We have shown that the main reason for this problematic situation is ad hoc management of the KM systems' evolution. The various changes within Guide's activity were managed in an improvised, impromptu, contingent, and undefined manner. Managing the evolution of KM systems was not a clear and recognized area of responsibility. Decisions were made based on a short-term, narrow, and local perspective. Relationships between different systems were not investigated and dealt with, long-term co-ordination of various efforts was missing, and changes in the organization that had consequences for systems design and implementation were not considered. Seemingly, the organization did not learn anything from their negative experiences regarding the development, implementation, and use of KM systems and similar mistakes were repeated over time.

Our interpretation of the Guide case shows that the KM system's evolution has to be deliberately managed in order to avoid the type of unnecessary complexity described in this paper. Ad hoc management of the evolution of KM systems may work in a short-term perspective, but to avoid unnecessary complexity and failures in the long run the management process must be a dedicated area of responsibility. In the Guide case, we believe that a conscious and holistic management approach would have reduced the unnecessary complexity and improved the conditions for successful implementations of KM systems. In the next subsection

(5.2), we discuss the nature of such a perspective on managing the evolution of KM systems.

Although outside the scope of our analysis, an interesting development since we conducted our field research study is that the Internet consultant corporation Framfab has bought Guide. This has resulted in that the number of systems, organizations, competencies, business models, etc., has increased and Guide is now in an even more complex situation than we have reported. The KM systems' evolution at Guide has continued and the need for management is even more apparent in the present situation.

Our experiences from other KM projects, collaborations, and networking events in the Gothenburg vicinity have further convinced us of the validity of our results. This additional evidence, which is of a less systematic and more anecdotal nature, indicates the existence of problems similar to those presented in this paper in other organizations. Therefore, there are reasons to believe that the situation at Guide is also common in other knowledge-intensive, fast-growing, and dynamic organizations. It is easy to imagine the turbulence in such organizations and the problems with KM systems that eventually will emerge if evolution is not managed. Moreover, in less dynamic organizations the problems related to the evolution of KM systems are likely to occur, although being less frequent and immediate.

5.2 Managing the evolution of KM systems

From the Guide case we can see that the evolution of KM systems needs to be managed. In this subsection, we explain our perspective of managing KM systems' evolution. More specifically, we discuss both what should be managed and how. However, the objective is not to present a tangible solution proposal but rather to develop an understanding of management as a phenomenon. As a basis for our reasoning, we use Magoulas and Pessi's (1998) study of strategic IT management in dynamic organizations. Magoulas and Pessi present a picture of the meaning of IT management and they discuss how information systems' evolution can be managed.

While the task for systems development is to develop the best possible systems with regard to allocated resources, IT management is about getting the most out of the whole, i.e., to attain synergy. By elucidating what systems exist, the relations between these systems, and the degree of co-ordination, conditions for understanding as well as good decisions are created. Consequently, management is about taking a standpoint regarding different strategic questions about systems and activity in order to improve the information system environment. One decision could be, for instance, a decentralized strategy for systems responsibility, while at the same time require co-ordination between different local systems. Management does not necessarily mean a rigid process characterized by strong governing, i.e., a top-down strategy. Equally often, management is about designing a space of possible action in which system developers have the freedom to act. In such an information system environment, systems come and go and are allowed to drift over time, i.e., a bottom-up strategy. Which strategy to chose depends on the specific situation. While a top-down approach is appropriate in certain cases, a more decentralized, bottom-up strategy is preferable in other situations (for an extensive discussion about these different strategies, see Ciborra, 1996, 1997, 2000; Ciborra and Hanseth, 1998; Orlikowski, 1996).

Below, we will discuss questions that are important in relation to managing the evolution of KM systems. Within Guide, these questions were not asked and thus handled in an ad-hoc manner. More specifically, the systems and their relations were neither elucidated nor defined. Expressed differently, the focus was on the development of specific systems, while the implementation of systems in the organization's overall system enviroment received little attention. As we have shown in subsection 4.3, Guide's approach negatively affected the adoption and use of the KM systems within the organization. The questions that we will discuss are categorized as substantial and procedural questions (see Magoulas and Pessi, 1998). The reason why we have chosen these two categories is partly that they cover the functional and organizational changes that we have identified in the Guide case and partly because they contain a considerable part of the

questions that IT management within an organization has to deal with.

5.2.1 Substantial questions

Substantial questions focus on the actual goal or the result (the reality) one aims to realize or accomplish. This could be designated as a model based IT management, where the model describes some kind of ideal situation that represents the final result. Substantial questions are further devided in two subcategories: (1) Systems, relations between systems, and systems co-ordination; and (2) Overall relationships between business activity and systems.

Systems, relations between systems, and systems co-ordination

More specifically, these questions deal with: First, a general system view is about getting a comprehensive picture of the existing systems within the organization. With such a view as a basis, it is possible to evaluate a specific system's relation the whole system enviroment. As our study has indicated, Guide had no overall picture of their systems and how these were interrelated. Second, degree of dependence concerns how dependent the different systems should be on each other. Within Guide's activity, there were invisible relationships between different systems and since there was no co-ordination some systems became stand-alone. Third, co-ordination quality is a question about how to generate more value from the systems within the organization. Since the consultants within Guide had to enter information into several systems at different places their motivation for using them diminished. Fourth, information quality is about having information that is up to date as well as relevant for the members of the organization. In Guide's KM systems the information quality was low. One reason for this was that the information was not fetched from other sources already existing within the organization. Thus, the updating of information became a burdensome issue, which negatively affected the KM systems' content.

Overall relationships between business activity and systems

In more detail, these questions concern: First, relationships between individuals' perceptions of reality and system structures

deal with the relation between co-workers' ability and KM systems' structure. The Competence-marketplace system's structure was developed at Guide's office in Oslo. However, without any further examination regarding its appropriateness, the same structure was implemented at Guide's office in Gothenburg. As this research has indicated, the consultants in Gothenburg did not adopt the structure properly since they had competencies that could not be found. The lesson learned here is that Guide should have asked themselves whether or not it was possible to implement a general system structure throughout the organization. Second, customization is a question about how the systems can be modified to fit different parts of the organization. Since the Competence-marketplace system was implemented as a standard system, maybe Guide's office in Gothenburg should have had the possibility to change the system's structure. Nevertheless, the important question is if it was reasonable that Guide tried to implement the Competence-marketplace system as a system that was supposed to embrace the whole organization. Third, dependences between the activity's development and the systems' structures deal with issues such as flexibility and adaptability. As we have illustrated in this research, Guide bought smaller corporations that were integrated into the existing organization. Guide should have asked themselves whether or not these organizational changes had to be implemented in the systems. If so, it would have required more flexibility in, for instance, the Competence-marketplace system. The key issue here is about making a decision about the dependence between the own activity and the systems and how organizational changes should be handled.

5.2.2 Procedural questions

Procedural questions concentrate on the actual change process and deal with questions about how to make decisions and how to find guiding principles for managing this process. This could be designated as a process based IT management. Procedural questions are further divided in three subcategories: (1) The use of IT within the activity; (2) How to make activity development,

systems development, and competence development coherent; and (3) The pace of the development with regard to system inheritance, learning, and the evolution of the KM systems.

The use of IT within the activity

More specifically, these questions deal with: First, strategic decisions regarding how the systems are supposed to contribute to the activity. Even though there was an overall strategy for the organizational use of the Competence-marketplace system, Guide had no plans for how this particular system would support different usegroups within the organization. Second, fundamental decisions regarding who decides about the change direction, which people should participate, which goups are the targets for this change, which people would benefit from this change initiative, allocation of recourses, rights and obligations, and systems co-ordination. Within Guide the implementation of the Competence-marketplace system was unclear. It was not decided who the system owner was and what responsibilities that were required in order to support the adoption and use of the system.

How to make activity development, systems development, and competence development coherent

In more detail, these questions concern: First, the connections or relations between the activity's development, systems development, and competence development, is a question about degrees of freedom with regard to design and implementation of local systems within the organization and possibilities to adjust existing systems. When it was identified that the competence structure of the Competence-marketplace system did not match the activity at Guide's office in Gothenburg, there was no system owner that could decide whether or not it was feasible to conduct system adjustments to local needs. Second, the handling of problems and conflicts that originate from experiences of unsuitable principles, unwanted effects, a constantly growing quantity of systems, unwell suited or non-existent systems relations, rigid connections between systems, or confused systems integration. The unclear relationships between KM systems such as the Competence descriptions, the Available-consultants, and the Competence-marketplace have caused conflicts within Guide. Unfortunately

these conflicts have not been handled properly. Within Guide nobody has had the responsibility to evaluate systems quality, define systems responsibilities, examine development questions, and determine systems administration.

The pace of the development with regard to system inheritance, learning, and the evolution of the KM systems

More specifically, these questions deal with: First, time required for introducing new system concepts. Second, time needed for phase-outs of old systems. Third, time required for education of employees. Fourth, time needed for changes of the activity. Within Guide, the second version of the intranet was implemented before the first intranet version was phased-out. The overlap with the first intranet version could be seen as necessary during the transition period, but since this overlap was managed in an ad hoc manner it eventually negatively affected the use of both of these systems. Instead, Guide should have asked themselves what parts of the first intranet version that should be transferred to the second intranet version. Further, Guide's introduction of the Developers-guild system shows how important it is to have a well thought-out plan for a system's future use. Since there were local forums related to the intranet that served similar purposes as the Developers-guild system, the latter did not get as much attention as Guide had expected at the time of its implementation. The Developers-guild system's degree of diffusion was limited and the system has fallen short of Guide's expectations.

5.2.3 Summing up

We stress that management is a complex and difficult process that lacks easy solutions. Although managing KM systems' evolution is about taking a standpoint, we are not saying that a top-down approach is the most feasible. For us, management is rather a situated continuous process in which changes in both systems and activity are taken into consideration. Expressed differently, managing KM systems' evolution is about finding a balance between, what we termed above as, substantial and procedural questions. Instead of managing from a narrow single system perspective, what is needed is a well thought-out management

process with the aim of generating more systems value from a comprehensive point of view.

5.3 Implications for KM research

The arguments in this paper are strengthened by a few non-mainstream contributions in the KM research literature, which report partially similar observations and arguments as this study (see Wijnhoven, 1999; Hellström et al., 2000). Wijnhoven has drawn on the strategic planning literature and three case studies to discuss the development and implementation of KM systems (he uses the term organizational memories), viewed over several projects and years. He claims that different situations require different strategies for the development and implementation of KM systems. The study acknowledges, to some extent, the existence of several KM systems and relations between them and the organizational dynamics over time. Issues discussed are infrastructure complexity, roles regarding development, implementation, and use of KM systems, existence or absence of plans and policies, linkages between KM systems, business plans, and practices, and long-term objectives and structures. Hellström et al. have conducted a study of KM initiatives at the large Swedish telecom corporation Ericsson. The results show how KM initiatives at Ericsson have been decentralized and local and that Ericsson at the time had several conflicting KM initiatives that had been developed and implemented in parallel. The study highlights the existence of several KM systems and relations between them. Also, to some extent, the organizational dynamics over time are highlighted, but this is less visible in the paper. The need for co-ordinating different KM initiatives without restricting them is briefly discussed.

The main implication of our paper for KM research, is that more studies are needed that focus on the evolution of KM systems. Empirical studies of KM systems, which take into account the organizational dynamics over time and the relations between many systems in the organization, can produce results that help researchers and practitioners understand the evolution of KM

systems and improve the associated management. Moreover, KM researchers need to investigate whether knowledge in the broader literature regarding the evolution of organizations and their information systems can be drawn upon for the management of KM systems' evolution. For example, the following two studies, which are not included within our definition of contemporary KM research, focus on technologies that are often discussed in relation to KM. Damsgaard and Scheepers (1999) highlight the problematic evolution of intranets and propose a stage model for intranet implementation and management. Orlikowski and Hofman (1997) propose an improvisational model for managing technological change and illustrate the model in practice by presenting a case study of groupware technology implementation. A broad research field of particular interest is IT management (see e.g., Magoulas and Pessi, 1998), which has focused on managing the evolution of information systems. Hopefully, KM researchers can draw on knowledge in that field or researchers within that field can address KM systems more explicitly.

6. Conclusions

With our field research study of KM systems and a literature study of KM research as a basis, we draw three main conclusions:

- Evolution, which refers to the process in which organizations and their information systems change over time, is an important dimension of KM system implementation and use.

- Managing the evolution of KM systems on an ad hoc basis and treating them as stand-alone systems can lead to unnecessary complexity and KM systems failures. The evolution of KM systems needs to be managed by deliberately managing both the systems within the organization and the organizational change process from a long-term perspective.

- The KM research has paid little attention to the evolution of KM systems. Limited support and guidelines for managing KM systems' evolution are available in the mainstream KM research literature. Consequently, this is an important issue to add to the KM research agenda. The predominantly design oriented KM research needs to be extended by more implementation and management oriented studies.

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Third paper[19]

Competence Visualizer: Generating Competence Patterns of Project Groups

Abstract

This paper describes and evaluates the design of Competence Visualizer, which is a competence system generating competence patterns of project groups. The system provides novel features that: (1) make it possible to survey competence status of teams in different sizes at a specific moment; (2) handle information about both existing competencies and competence interests; and (3) manage snapshots of a particular point of time and development over a certain period regarding existing competencies and competence interests. The results from the system evaluation include fields of application, future design challenges, and organizational issues. A first conclusion is that competence systems need the potential to handle flexible visualizations of existing competencies as well as competence interests of organizational members. A second conclusion is that organizational issues, such as incentives and management, are critical in order to attain data quality in a competence system.

1. Introduction

Over the past several years there have been extensive research on knowledge management (KM) systems within the CSCW and IS

[19] Lindgren, R. Competence Visualizer: Generating Competence Patterns of Project Groups. Under consideration by *Journal of Knowledge Management*. A previous version appeared in the *Proceedings of HICSS 2002*, Big Island, Hawaii, USA.

fields (see e.g., Ackerman, 1994; McDonald and Ackerman, 1998; Alavi and Leidner, 2001; Stenmark, 2001). Although the nature of knowledge has been advocated as socially constructed by many researchers (see e.g., Brown and Duguid, 1991; Tsoukas, 1996), the "repository view" of knowledge has had an impressive impact on the design of KM systems (Swan et al., 1999). The idea of knowledge as a commodity possible to store in passive databases has, however, been criticized from different quarters (see e.g., Bannon and Kuutti, 1996; Swan et al., 2000). This critique is based on the perspective that knowledge cannot be managed separate from the people in whose heads it resides. Instead, direct communication to transfer knowledge has been recommended, i.e., putting people in touch not with databases but with other people. In line with this design rationale, CSCW and IS researchers have designed, implemented, and evaluated different types of information technology (IT) for organizational knowledge and expertise (see e.g., McDonald and Ackerman, 2000; Schultze and Boland, 2000).

This paper focuses on a specific sub-group of KM systems referred to as competence systems. One of the first contributions on competence systems is presented in Lindgren and Henfridsson (2002). The competence systems included in their multiple-case study were especially designed and implemented in order to support organizations in managing their competencies in an efficient and structured way, i.e., to have the right competence in the right place at the right time. More specifically, the investigated competence systems were intended to support the management of competence development and staff allocation by, for example, providing consultancy firms with competence overviews. In outlining a technology review and a user site investigation, Lindgren and Henfridsson (2002) relates technical features of the competence systems with adoption barriers identified in six user organizations. Group level imprecision and competence direction inattention are two general barriers to adopting competence systems in organizations. The former is about the lack of features that facilitate competence analyses of teams in different sizes. The latter deals with the absence of features that support the identification of employees' interests and directions regarding

competence development. This paper focuses on the two adoption barriers mentioned above by presenting an action research study of the Swedish IT consultant Guide's Competence Marketplace (CM) system. This paper describes:

- Empirical findings illustrating missing features related to the adoption barriers group level imprecision and competence direction inattention.

- Design implications for an add-on module to CM that handles status and development of existing competencies and competence interests.

- A designed add-on module for visualizing status and development of existing competencies and competence interests.

- An evaluation of the Competence Visualizer (CV) system, i.e., the original version of CM and the add-on module.

On the basis of the evaluation of the CV system, the following research dimensions are addressed:

- Fields of application that could be supported by the CV system.

- Improvements of the CV system's design related to the identified fields of application.

- Organizational issues critical in order to attain data quality in the CV system.

This paper's main objective is to describe and evaluate the design of the CV system, which addresses the adoption barriers group level imprecision and competence direction inattention reported in Lindgren and Henfridsson (2002). The motivation for doing this is to improve the general design of competence systems and thereby contribute to the existing body of CSCW and IS research within the area of KM systems.

2. Related work

The concepts of knowledge, expertise, and competence are closely related and the boundaries between them are fuzzy. Although both expertise and competence can be described as enacted and strictly work-related knowledge, there is a distinction between the two. Expertise, on the one hand, is usually understood as an individual aspect or skill needed for doing a specific job (Allee, 1997) Competence, on the other hand, is more often discussed on an organizational level as a way to increase the problem solving capacity of an organization (Hamel and Prahalad, 1994). While there have been a large number of studies focusing on KM systems for organizational knowledge and expertise, IT support for competence management has been studied less frequently.

KM and organizational memory (OM) are two related themes within the CSCW field (for extensive discussions on these themes see e.g., Bannon and Kuutti, 1996; Ackerman and Halverson, 1998). KM and OM researchers have reported important studies on KM systems and well-known contributions are TeamBuilder (Karduck, 1994), Answer Garden (Ackerman, 1994), and Answer Garden 2 (Ackerman and McDonald, 1996). These KM systems' purposes are to support organizational members to capture and retrieve knowledge, find and interact with experts, and thereby collaborate and co-operate more effectively. The experiences from the Answer Garden systems are elaborated further in McDonald and Ackerman (1998) and McDonald and Ackerman (2000). Related to the Answer Garden system (Ackerman, 1994) is the ColDECS system. This KM system supports domain experts in negotiating about knowledge and through that constructing a knowledge base (Duecker et al., 1999). Additional knowledge repository systems are Designer Assistant that serves as a "living design memory" for a large software development organization (Terveen et al., 1993), Project Memory that supports project work by integrating all kinds of knowledge in a central repository (Weiser and Morrison, 1998), and Oxymoron that aims to link people with knowledge and with other people (De Haan et al., 1999).

IS researchers have classified KM systems in typologies such as generate, codify, and transfer (Ruggles, 1997), conceptualize,

reflect, act, and review (Wiig et al., 1997), create, identify, collect, organize, share, adapt, and apply (O'Dell and Grayson, 1998), and codify and personalize (Hansen et al., 1999). These typologies include different types of IT such as groupware applications, hypertext systems, and intranets. These technologies have been more carefully investigated in recent studies. Examples are intranets for knowledge sharing (Scott, 1998), database technologies as tools for handling organizational knowledge (Maier and Lehner, 2000), groupware technologies to facilitate knowledge creation (Robertson et al., 2000), and recommender systems for leveraging tacit knowledge (Stenmark, 2001).

As presented above, the CSCW and IS research regarding KM systems has been concentrated to organizational knowledge and expertise. Comparatively, little research attention has been given to IT support for competence management. One exception is Lindgren and Henfridsson's (2002) multiple-case study of competence systems in practical use. On the basis of eight adoption barriers related to technical features of the investigated competence systems, they conclude that such systems need to have features conveying a technology spirit more in line with the knowledge work practice found in organizations. To facilitate successful integration of competence systems in organizational knowledge work practice, Lindgren and Henfridsson (2002) outline a set of design implications. While this particular paper addresses the need for features handling flexible analyses of existing competencies and competence interests of organizational members, Lindgren et al. (forthcoming) and Lindgren and Stenmark (2002) investigate and discuss recommender systems supporting information seeking as an action-oriented approach to competence mapping.

3. The Guide case: Research site and method

At the time of this research, Guide Konsult AB was a Swedish IT consultant organization focusing on the three main business areas: Guide IT consulting; Guide Infrastructure and Communication;

Guide Management. Guide had approximately 750 employees at six offices located in three countries. Since the start in 1988, Guide's business concept has been to develop expertise in the business areas mentioned above. In order to realize this ambition, Guide annually invested 15 percent of the turnover in competence development activities. One such activity was development of the consultants' competencies in assignments, which was based on the assumption that the more the consultants improve the better they perform. With this idea as a point of departure, Guide's objective was to, simultaneously, secure separate consultants competence development as well as customer satisfaction.

This research can be broadly classified as an action research study (see Susman and Evered, 1978; Argyris et al., 1985; Baskerville and Wood-Harper, 1996). In line with Susman's (1983) action research cycle, this research has been conducted as a comprehensive cycle including use assessment, informed design, technical implementation, and system evaluation. The fieldwork was carried out over a period of twelve months (July 1st 1999 to June 30th 2000). Thirty-six semi-structured interviews, each lasting approximately one hour, have been conducted at Guide's offices in Gothenburg, Oslo, and Stockholm. These interviews were divided equally between the preliminary study of the original version of CM and the evaluation study of the CV system, i.e., the original version of CM and the add-on module. The interviews were conducted with people in the following organizational roles: Consultants; consultant managers; sellers; sales managers; HR people; HR managers; project leaders; CEOs. At the time of this action research study, the interviews at Guide's offices in Gothenburg, Oslo, and Stockholm were representative of the three business areas mentioned above. All of the interviews were transcribed and analyzed. The analysis of the empirical material aims to "make sense of massive amounts of data, reduce the volume of information, identify significant patterns, and construct a framework for communicating the essence of what the data reveal" (Patton, 1990, p. 371-372). Besides the interviews, written documentation in form of CM manuals, results from focus group sessions (Agar and MacDonald, 1995), and observation through

active participation within Guide's competence management projects are the most important sources of data.

4. The Competence marketplace system

The competence system CM was developed at Guide in Oslo, Norway. The CM system was a database containing competence areas and competence levels of the consultants' competencies. Guide's idea regarding CM was to have a competence system for: Mapping the consultants' competencies; categorization and visualization of the competencies within the organization; forming project teams of consultants; finding competence for their external projects. Since late August 1999, CM was up and running at Guide's offices in Gothenburg, Oslo, and Stockholm. Below, platform, organizational aspects as well as technical features of CM are presented. The data were collected through analyses of CM manuals, interviews, and observations of pilot users during the preliminary study of the original version of CM.

4.1 Platform and organizational aspects

The following is a presentation of the fundamental concepts of CM's design and how this competence system was implemented within Guide's organization.

The database was a SQL (Structured Query Language) server and the information was presented through ASP (Active Server Pages) on an IIS (Internet Information Server) server. ASP generated the HTML (Hypertext Markup Language) pages, which were viewable in a web browser. CM was HTTP (Hypertext Transfer Protocol) compatible and was accessible internally on the Guide intranet. Further, CM was developed with the consultants' competencies as a basis. There were no predefined roles in CM such as project manager, sales manager, or HR manager. The top level consisted of four different groups and each of these had sub levels, which were constituted of the competencies, e.g.,

Technology, Tools and Systems – Programming Languages – C/ C++, Pascal, and Java (see Figure 1). CM's competence tree consisted of four levels of competence grading (see Figure 1): Beginner, a person who has some theoretical background in the competence area and has an interest of the area in question; some knowledge, a person who has experience from at least one project and also has some theoretical background in the subject; experienced, a person who has participated in several projects within a certain competence area and is able to teach others in the subject; expert, a person who has a great deal of experience in the competence area and has the ability to teach others on a higher level. Furthermore, CM was implemented through a top-down strategy, which means that the management defined which competencies that should constitute the CM's competence structure. The consultants were, however, responsible for the input of their competence data. Finally, in accordance with Guide's flat organizational structure, everyone could see everybody in CM, e.g., employees in managerial positions were able to see their subordinates' competence descriptions and vice versa.

4.2 Technical features

Here technical features of the CM system will be presented, i.e., how the competence system could be used.

In CM it was possible to search for a specific competence in the following ways: Search for a person, by using this search it was possible to receive information about how to get in touch with a certain consultant; search in free text, search for a defined phrase in the consultants' CVs; simple search, search for a consultant who has accomplished assignments in a certain branch of industry, has competence within at least one of the four competence areas in CM, or has been involved in projects with a particular customer or in a certain type of project; advanced search, search in the three major areas branch of industry, language, and skills. Within each area it was possible to search for a certain competence or a specific mix of competencies. It was also possible to search for a particular competence on a certain

competence level (see Figure 1). Finally, in each of these alternatives it was possible to choose in which subsidiary within Guide to search.

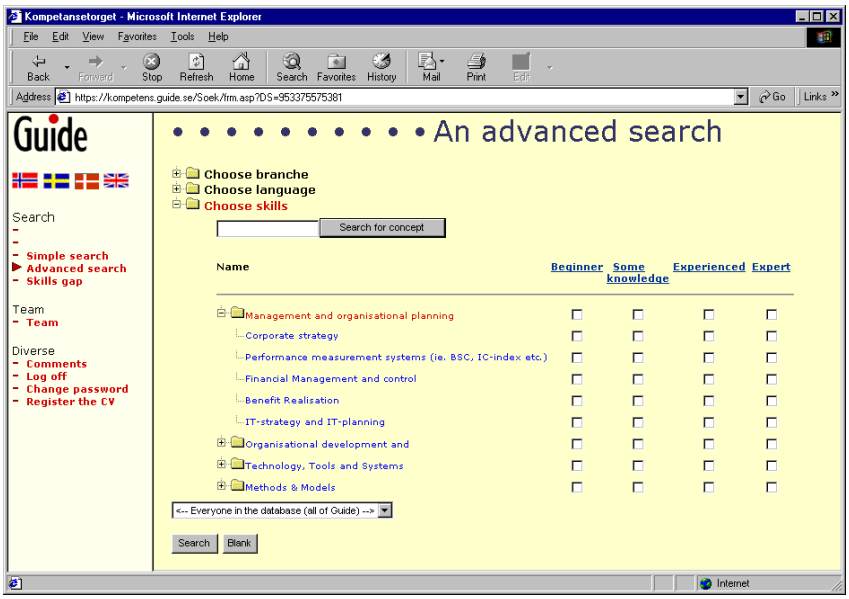

Figure 1: CM's competence tree and competence grading in advanced search.

An additional type of search was used for investigating the number of consultants that hold a certain competence. Through this search it was possible to monitor competence gaps, i.e., the difference between existing and wanted competencies. Further, subsidiaries within Guide's organization were predefined in CM and searchable. An alternative was to group the consultants in "lists" that made it feasible to find consultants irrespective of to which subsidiary they belong. However, it was not possible to use lists when searching for competencies.

Above, platform, organizational aspects, and technical features of CM were outlined. The next section presents the background regarding the design of the CV system.

5. Towards the Competence visualizer system

Below, the following is presented: Empirical findings showing missing features in the original version of CM related to the

adoption barriers group level imprecision and competence direction inattention; design implications regarding an add-on module to CM. In order to illustrate missing features in CM, quotations from the empirical findings are used. These findings are derived from the preliminary study of the original version of CM. The preliminary study was conducted after an eight-week test period and included 18 interviews, two focus groups sessions, and observations of organizational members while using CM.

5.1 Missing features

Regarding the present features in the CM system, one project leader at Guide in Oslo said:

> "It is not sufficient to know the employees' competencies. You must be able to manage those competencies in a strategic way, but it [the competence system] does not contain a complete package. Our intention is to categorize the activity with regard to strategic goals and critical competencies. At present, however, we can merely visualize competencies on an individual level by using the CM system. But, we want to manage competence on a, for instance, departmental level. When analyzing different groups of employees, we need it [the competence system] as a management tool for the activity."

This quotation shows that the original version of CM merely supports the management of separate consultants' competencies. In accordance with the project leader, several interviewees pointed out the need for features in CM that handle competence analyses of teams in different sizes. Further, as discussed by many respondents the present version of CM does not manage aggregated competence values of consultants' competencies. The sales manager at Guide in Stockholm articulated this:

> "We would like to use the system in this way […]: First of all, these are the business areas we will concentrate on. Then you come to the conclusion that within this business area these particular competencies are demanded and so on. Then we should use the competence system in order to make an inventory of the consultants. Identify the total status of our competencies in comparison with our business areas and vice

> versa. With such information as a starting point, we are able to handle future recruiting and competence development in a more professional way."

As highlighted by the sales manager, CM does not support valuation of different competencies' status. Moreover, a consultant manager at Guide in Gothenburg requested features in CM that handle information about the development of the competencies' status over time:

> "It is possible to do gap analyses by using the system. However, these gap analyses only deal with present competencies. What is needed are features [in the CM system] that can display a historical description of the organizations' competence status."

Besides the management of the existing competencies within the organization, several interviewees demanded features in CM that support the identification of consultants' competence interests. The CEO for Guide in Stockholm phrased the following:

> "There [in the CM system] you should also have directions, aspirations as well as ambitions related to employees' competencies. If not, you will only base competence decisions on the competencies that people have had or have today. This means, basically, the competencies that they have documented in the existing competence descriptions. A complementary and important approach is to try to identify the interests and directions of the employees. […] If the competence system had this type of features, it would surely become a more integrated part of our competence development activities."

This CEO's point was that CM's features at present merely deal with the consultants' existing competencies. As discussed by several respondents, this means that the consultants were not able to express their interests and aspirations regarding the development of competencies. As a result, consultants manipulate their competence descriptions in order to get assignments in which they could develop a particular competence.

5.2 Design implications

With the missing features in the original version of CM as a point of departure, the following design implications are essential for the design of an add-on module to CM:

- Features that make it possible to survey competence status of consultant teams in different sizes at a specific moment.

- Features that handle information regarding consultants' existing competencies and competence interests.

- Features that manage snapshots of a particular point of time and development over a certain period regarding existing competencies as well as competence interests.

The remainder of this paper deals with the CV system, i.e., the original version of CM and the add-on module for visualizing status and development regarding existing competencies and competence interests.

6. The Competence visualizer system

The CV system consisted of the original version of CM and the developed add-on module. This section presents the add-on module to CM and the CV system's user interface and output.

6.1 Add-on module

This add-on module was, like the original version of CM, based on ASP scripts, an IIS server, and a SQL server. Furthermore, the add-on module was built on the system structure and data of the original version of CM. However, since CM does not handle data concerning competence interests, data for this purpose have been simulated. The simulated competence interests were based on the

same competence tree and competence grading as the original version of CM.

On a regular basis, the server created copies of Guide's competence tables that contain information about competence areas and competence levels of all consultants within the organization. With these copies and the simulated data for competence interests as a starting point, the add-on module was able to generate competence patterns of existing competencies as well as competence interests of project groups, i.e., teams of consultants or the whole organization. These competence patterns could be constituted of either CM's competence grading or an aggregated competence value. A competence value was calculated on a weighting of CM's competence grading. The weighting of the competence grading was developed in co-operation with Guide's management and are as follows: Beginner was valued 0,25; some knowledge was valued 0,5; experienced was valued 1,0; expert was valued 1,25. This weighting was based on the assumption that an experienced Guide consultant is able to work independently and handle project assignments without the need for assistance. A consultant with some knowledge has basic competencies within the area in question but needs support in order to complete assignments.

6.2 User interface

Regarding existing competencies as well as competence interests, the user has the possibility to choose between two different chart types: (1) snapshot of competence status at a particular point of time; (2) development over a certain period. Further, the user can choose between the following scopes: (1) the whole organization; (2) a subsidiary; (3) a user created list. Finally, the user has the possibility to choose between the four competence areas represented in the competence tree. The user interface of the developed CV system is presented in Figure 2.

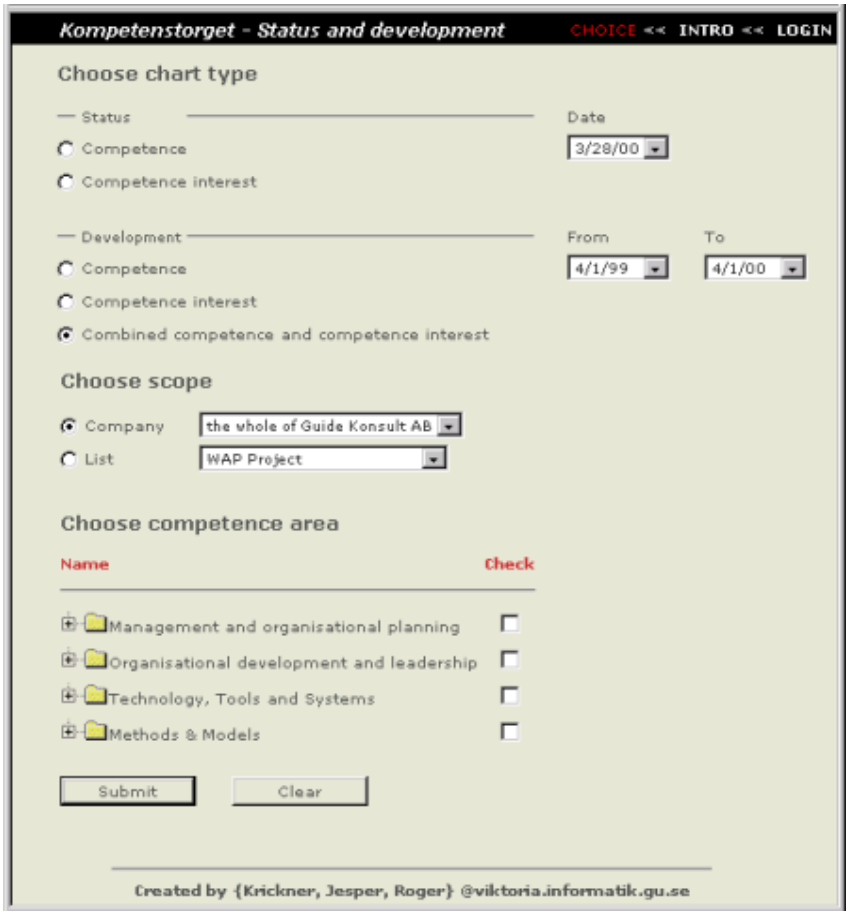

Figure 2: The CV system's user interface.

6.3 Output

The output was displayed in either a chart of horizontal bars representing a snapshot of the competence status at a certain point of time (see Figure 3) or a linear chart concerning development (see Figure 4). The competence patterns could be based on existing competencies as well as competence interests.

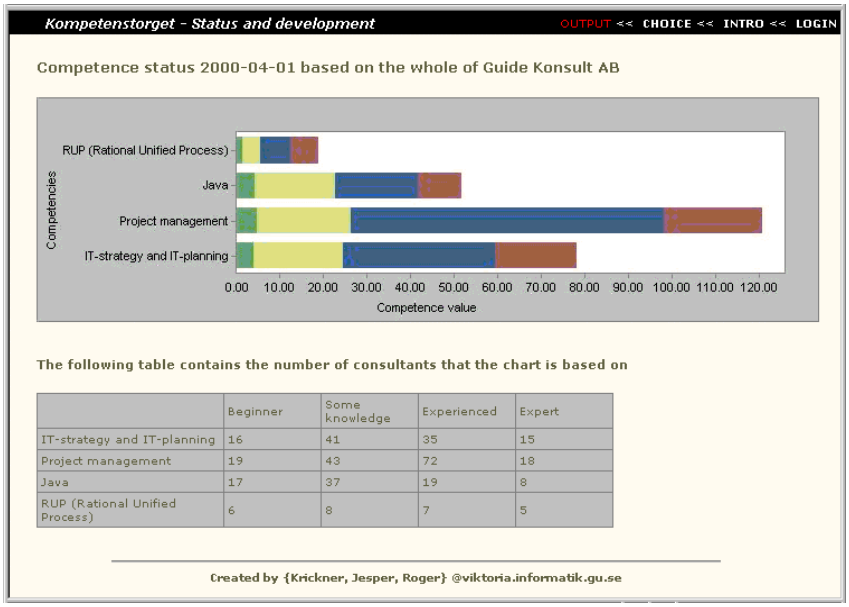

Figure 3: Snapshot of competence status at a certain point of time.

Each horizontal bar could be constituted of up to four parts, each representing a different competence level: Beginner; some knowledge; experienced; expert. If there were no consultants on a particular competence level, for example, experts, only three horizontal bars were presented and so on. Below the chart, a table was displayed containing the number of consultants that the horizontal bars were based on.

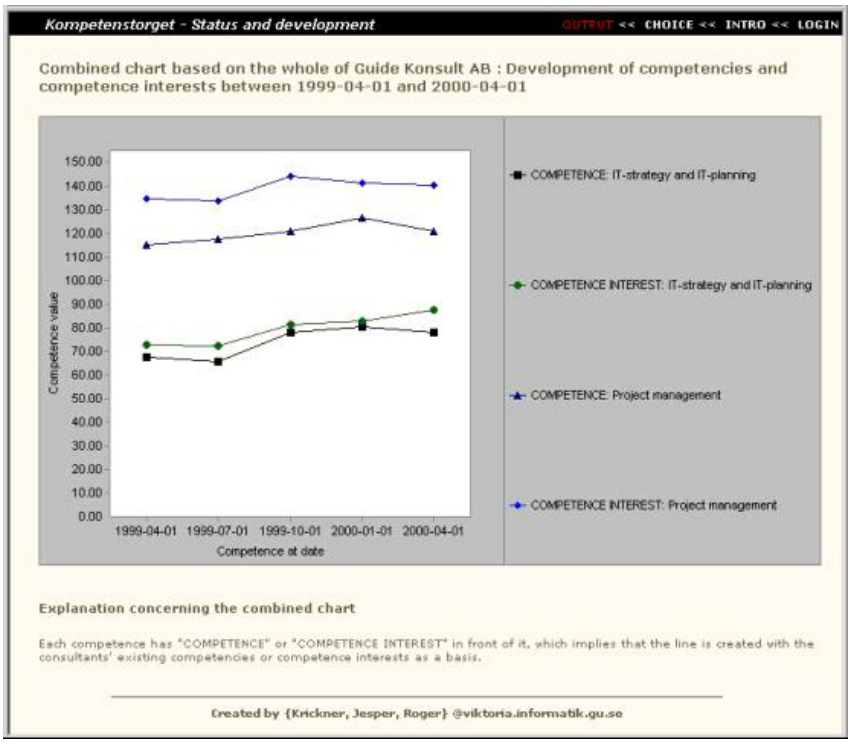

Figure 4: Combined chart based on the whole of Guide Konsult AB.

The combined linear chart was based on existing competencies and competence interests. The lines represented the existing competencies or competence interests in a specific competence area. Each dot on the lines displayed the aggregated competence value at a specific moment.

In the middle of April 2000, the CV system was introduced to Guide's organization. System presentations were conducted at Guide's offices in Gothenburg, Oslo, and Stockholm. During these presentations, the organizational members tested the CV system and evaluated its usage possibilities. The next section presents the results of the evaluation of the CV system.

7. Evaluation results

This section contains the following: Fields of application that could be supported by the CV system; design implications for the CV system related to the identified fields of application; organizational issues critical for the data quality in the CV system. In order to illustrate these results, quotations from the empirical findings are used. These are derived from the evaluation study of the CV system. The CV system was evaluated through interviews, focus groups, and participant observation.

7.1 Fields of application

Regarding the CV system's possible fields of application, several interviewees discussed estimating capacity. A consultant manager at Guide in Gothenburg said:

> "A large project that we will make a tender for […]. Is it possible for us to deliver? Do we have the required competencies within the organization? We could see [in the CV system] that we are not able to do so."

With the information about competence status as a point of departure, the organization is, according to the consultant manager, able to survey if the consultants have the competencies demanded for a specific assignment. Besides supporting the examination of the present situation, the CV system was discussed as a support for competence planning by many respondents. One consultant manager at Guide in Gothenburg expressed:

> "This [the CV system] is for managing the competencies. I mean to be able to stipulate the targets so to speak. Today, we are a hundred people and within six month we shall be 150. We will have to make these efforts, projects, and programs in order to carry out those competence objectives."

Based on a snapshot of the present competence status, the organization is capable of defining objectives for competencies that are expected to be required in the future. Then it is possible for the organization to determine the actions needed to attain these competence goals. Such an organizational activity is competence development. The CEO for Guide in Oslo articulated this when discussing the CV system:

> "It [the CV system] is useful when talking with the employees about the situation. It is easier to understand these charts that show the present situation as well a future dimension. Moreover, it is easier to understand what we mean when we discuss employees' opportunities in relation to the organization's activities."

According to this CEO, the graphical competence patterns are practical for the organization during competence development discussions with the consultants. In relation to competence development, several interviewees discussed the CV system in terms of a tool for managing expertise. The CEO for Guide in Stockholm said:

> "Competence interests [in the CV system] show in which direction we are going. In some ways the driving force within the organization. We can use our experts in the identified competence areas since their extra-competence is essential for the development of these areas."

On the basis of the competence interests, the organization is able to identify competence areas that the consultants find interesting. In order to develop these areas, experts with the required competence could act as mentors and share their experiences with less knowledgeable consultants within the organization. Furthermore, the respondents meant that the CV system could support the identification of future competence areas in which the organization lacks competencies. A consultant manager at Guide in Gothenburg phrased this about market analyses:

> "The possibility to search [in the CV system] for fields of interests is attractive. These fields of interests reflect what is in the wind within this line of business."

This respondent's point was that the competence interests information could be considered as a market indicator supporting the organization in analyzing the surrounding world with its demands and opportunities. In addition to the support for development and creation of the organization's competencies, numerous respondents saw the CV system's potential to facilitate competence evaluation. A project leader at Guide in Oslo explained:

> "It is interesting to use this system in order to see if our recent investments within a particular competence area have paid off. If a major investment this year has been correct [...]. Maybe we should have recruited instead."

Besides internal analyses of the outcome of particular competence efforts, the CV system's output could be useful for competence marketing externally. Several interviewees highlighted this particular issue and a sales manager in Gothenburg said:

> "A customer would probably choose our organization first if we used it [the CV system] as an instrument for visualizing the competence maps of our organization."

As pointed out by the respondents, the competence information generated by the CV system is, however, not only functional for the organization when presenting competence maps for potential customers. A project leader at Guide in Gothenburg articulated this about valuing competence:

> "We sell competence so to speak and that is the most important thing. This kind of tool for presenting that competence is the thing for the future. The stock market estimates the value of us with the brain power we have, what we know, and how we develop as a basis."

The historical information about the development of the consultants' competence status is, according to this project leader, momentous for the organization in order to preserve existing stockholders as well as attracting new.

7.2 Design implications

Regarding how the CV system could be improved in relation to the identified fields of application, one consultant manager at Guide in Stockholm said:

> "Some search mechanisms have to be improved. Availability is one such parameter that must be searchable. It is important that we are able to see which resources that are at one's disposal. It does not matter if they are competent, if they are not available."

In the present version of the CV system, features that manage information about the availability of the consultants are missing. As discussed by several interviewees, a competent consultant is an available consultant. Therefore, it is essential that the competence system contains information telling whether or not the consultants are available. In line with the above, one HR manager at Guide in Oslo discussed the need for features in the CV system that deal with availability as well as personal information about the consultants:

> "First of all, features for displaying availability have to be implemented. Information that makes it possible to identify the consultants behind the charts is also needed."

An additional improvement related to the CV system's output was expressed by a project leader at Guide in Gothenburg:

> "The usefulness of the chart that presents an aggregated value of competence interests is limited since I do not know if these

> consultants are competent in that area or not. Maybe they are merely interested."

In the present version of the CV system, the aggregated competence value of a specific competence interest is based on every consultant within a particular scope. However, the consultants with a special competence interest are, as this project leader pointed out, not necessarily competent within that area. In order to separate competence interests and existing competencies in a clear way, the project leader suggested that the scope should be limited, i.e., competent and interested consultants, competent and not interested consultants, and not competent but interested consultants. Moreover, many respondents argued that the development chart should display the different competence levels and not just the aggregated competence value. The CEO for Guide in Oslo commented:

> "It would be great to see the development over time with regard to the different competence levels, the number of beginners in proportion to the number of experts and so on, and how the relation between these levels are changing as times goes on."

Features that handle this type of information support analyses of the development of competence levels over time. Besides features for managing competence level information, a consultant manager at Guide in Stockholm requested information about the relation between a certain competence and the total number of consultants:

> "First, the development chart should include the four competence levels. Second, analyses of the organization's competence mix are important since certain projects demand a particular mix of competencies. But, depending on the content as well as the size of the project the configuration can change. However, if you look at specific competencies it might seem great, but if we only have one percentage of project leaders we are not able to take it."

Finally, in the present version of the CV system features that manage information about the organization's strategic business goals, prospects, and suspects are missing. The sales manager in Stockholm articulated this:

> "Information about the organization's competence goals, the number of inquiries we receive, and our present assignments should be obtainable in the system. Then you could compare this kind of information with the current market situation."

Features that support the handling of this kind of information in the CV system form, according to several interviewees, an important resource for the organization's management in their strategic work with the consultants' competencies.

7.3 Organizational issues

Regarding organizational issues critical to attain data quality in the CV system, the CEO for Guide in Oslo expressed the following:

> "The consultants must have something in return. I mean get something back when they update their competence descriptions. So, there have to be incentives. Such an incentive could be that the organization manages the consultants not only with traditional parameters such as contribution margin as point of departure. Also pay attention to alternative means of control like, for example, the consultants competence interests."

As discussed by several interviewees, there have to be incentives for the consultants to update their competence descriptions. Such an incentive is, according to this CEO, that the organization mans their assignments with the consultants' competence interests in consideration. Besides identifying the appropriate incentives, it is, according to many respondents, essential for the organization to establish routines for updating the consultants' competence descriptions. A consultant manager at Guide in Gothenburg phrased this:

> "Changes regarding competencies can be due to courses as well as finished assignments or projects. In any case, changes in the consultants' competence descriptions have to be entered in to the system on a regular basis."

In addition to routines, several interviewees discussed responsibilities in relation to the CV system's content. An HR manager at Guide in Oslo commented on this issue:

> "First of all, within our organization we have to reach an agreement regarding the meaning of our competence definitions. Then the input of data must be secured and the tree structure that consists of the organization's competencies have to be constantly examined. Someone has to have the responsibility for these aspects."

All in all, as pointed out by numerous interviewees, the commitment of the organization's management is a determining factor. The CEO for Guide in Stockholm expressed it as follows:

> "Management has to introduce the system and the ideas concerning its use […]. Only then can the system turn out to be a hot topic within our organization and that is required if the system is supposed to become a part of a consultant's tool-box."

If management does not motivate the use of the CV system it will be problematic to create an active interest within the organization, which is required in order to attain data quality in the CV system.

8. Discussion

In this paper, the design of the CV system has been described and evaluated. The reported results from the system evaluation include fields of application, future design challenges, and organizational issues.

Regarding the CV system's possible usage areas there were many respondents that primarily discussed the system as a tool for competence planning. With snapshots of different competencies' status as a starting point, the organization is able to formulate goals concerning organizational members' future competence. Then the organization can plan the necessary activities in order to develop the wanted competencies. Furthermore, there were several consultant managers as well as HR managers that pointed out that the information about existing competencies and competence interests within the organization constitute a basis for the empowerment of individual consultants through, for instance, career planning. Moreover, as highlighted by one CEO, competence interests indicate driving forces within the organization. In order to

utilize the consultants' intrinsic motivation, this CEO argued that experts should function as mentors that help less knowledgeable consultants get the practical training necessary for developing the particular competence. This makes it possible for the organization to continuously cultivate, develop, and try out new combinations of competencies (cf., Ilinitich et al., 1996), which in turn is one way to avoid competence traps (Levitt and March, 1988). Thus, the CV system has the potential to support the organization in finding a balance between what is often termed "exploration" and "exploitation" (March, 1991). Summing up, the information about the combination of existing competencies and competence interests constitute a foundation for the organization when formulating competence strategies for the future.

The respondents expressed similar ideas of how the CV system could be improved. One such was to implement features in the CV system that handle information about availability (cf., Lindgren and Henfridsson, 2002). According to several project leaders, it is essential that the system manage information about whether or not the consultants are available since from the organization's point of view a competent consultant is an available consultant. This improvement of the CV system's features would, according to the project leaders, facilitate the organization's work with manning assignments as well as estimating competence capacity. An additional design improvement, discussed by many interviewees, was the need for scope limitations, i.e., a separation of existing competencies and competence interests. With such an improvement, it would be possible to identify which group of consultants that constitutes the basis for an aggregated competence value regarding competence interests. For some interviewees, however, separating existing competencies and competence interests was a design improvement of marginal importance. Finding consultants with merely a special competence interest was not a problem since people's interests and motivation, they argue, in some situations is worth more than existing competence.

Furthermore, several respondents wished for the relation between a certain competence and the total number of consultants to be displayed in the graphical charts. The organization might, for

example, have a goal of 25 percent of the consultants having competence in project management. The fact that the combined chart does not display any relation between the competence value and the number of consultants could result in that even though the total value of the competence project management has increased, for instance due to recruiting, the percentage of consultants with competence in project management has decreased in relation to the number of consultants in a group or the whole organization. As discussed by several interviewees, this improvement would support organizational activities such as estimating capacity and competence marketing.

In a competence system such as the CV, the competence flow is an important issue (cf., (Hahn and Subramani, 2000)). The competence descriptions in Guide's CM system were supposed to be updated in connection to the annual personal development discussions. This is too seldom and an alternative approach, discussed by the respondents, is to update the competence descriptions as soon as an assignment or course is finished. Thus, a critical problem is one of motivating the consultants to contribute on a regular basis and there were many interviewees who highlighted the producer/consumer dilemma (Grudin, 1994). The consultants are responsible for the data input and this implies that without their motivation for using the CV system, data quality will not be attained. In order to keep the data up to date, there have to be incentives for the consultants to update their competence descriptions (cf., (Davenport and Prusak, 1998)). Such an incentive, discussed by Guide's CEO in Oslo, is that the organization mans their assignments with the consultants' competence interests in consideration. If the consultants realize that, the updating of the competence descriptions would be less burdensome. However, as pointed out by many interviewees, it is not enough to motivate the consultants to enter their competence data. There is also a need for organizational functions that have the responsibility to create acceptance as well as consensus concerning the chosen competence definitions, to secure that the data input are correct, and keep the structure of the competence tree dynamic and relevant. Finally, it is the management's responsibility to motivate and encourage the use of the CV system.

Otherwise, the system will hardly be adopted and used by the organization and this was an issue that almost all respondents commented.

9. Conclusions

Within the CSCW and IS fields KM systems for handling organizational knowledge and expertise have been the subject of sizeable research interest (see e.g., (McDonald and Ackerman, 2000); (Schultze and Boland, 2000)). However, IT support for managing competence has been debated less extensively. This, in combination with the weak support for competence management provided by current competence systems (see Lindgren and Henfridsson, 2002), was the main motivation for this research.

In this paper, the design of the CV system has been described and evaluated. This competence system provides novel features that: (1) make it possible to survey competence status of teams in different sizes at a specific moment; (2) handle information about both existing competencies and competence interests; and (3) manage snapshots of a particular point of time and development over a certain period regarding existing competencies and competence interests.

The results from the system evaluation include fields of application, future design challenges, and organizational issues. A first conclusion is that competence systems need the potential to handle flexible visualizations of existing competencies and competence interests of organizational members. A second conclusion is that organizational issues, such as incentives and management, are critical in order to attain data quality in a competence system.

Finally, by attempting to develop features that address general barriers to adopt competence systems in organizations, this research adds to the existing body of CSCW and IS research within the area of KM systems.

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Forth paper[20]

Rethinking Competence Systems for Knowledge-Based Organizations

Abstract

Existing competence systems are based on a rationalistic view of competence. While these competence systems might work in job-based organizations, we argue that in more dynamic settings, such as in knowledge-based organizations, the interest-informed actions that capture the emergent competencies of tomorrow require different types of information technology support. The main objective of this paper is to introduce interest-activated technology as a new design rationale for competence systems. This paper is based on an action case study of an implemented interest-activated intranet recommender system prototype at Volvo Information Technology AB in Gothenburg, Sweden. On the basis of how organizational members used this prototype to find information they were interested in, our research team was able to inquire into how personal interest, embodied in information seeking activities, could be a means for identifying competence. Building on the relationship between personal interest and competence, we discuss competence systems design and spell out explicit implications for managerial practice in knowledge-based organizations.

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1. Introduction

The industrial revolution transformed work in the western society. This revolution occasioned a significant shift in what people did for a living and how work itself was performed. During the industrial era workers were brought together in large shops and factories. Owners divided tasks into constituent activities that were assigned to individuals who performed them repeatedly (Barley and Orr, 1997). Workers did the physical work and were treated as a collective of muscles that were supposed to execute the owners' decisions. This way of organizing was based on the rationale that actors who hold higher positions in the hierarchy possess the authority to manage and direct the actions of those in subordinate positions (Nelsen, 1997; Zabusky, 1997). Work was structured according to the principles of scientific management, or what management literature defines as 'Taylorism', and each job was specified in a formalized explicit description including tasks and required competence. On the basis of the principles of scientific management, Taylor (1911) argued that workers' competencies should be made apprehensible by classifying and reducing them to rules, laws, and formulas (see e.g., Sandberg, 1994). "Time and motion studies" was Taylor's managerial tool to identify and describe the competence of the most efficient workers.

Today's human resource management approaches are not based on time and motion studies but nevertheless products of the same rationale. Job-based approaches to managing competence, i.e., the idea of individuals holding jobs (see e.g., Gael, 1988; Armstrong, 1991), can be traced back to the era of Taylor and several systematic attempts to identify what constitutes fundamental aspects of competence in relation to particular work within organizations have been made (see e.g., Ghoparde and Atchison, 1980; Fombrun et al., 1984). Job descriptions are used in most organizations as a basis for training, selection, career development, and pay determination (Lawler, 1994). According to Lawler and Ledford (1992), however, it is now time for organizations to concentrate on individuals and their competencies. Organizing and managing people based on the concept of an individual holding a job is no longer the best way.

Instead of thinking job in terms of a relatively fixed position occupied by a person, it seems to be more suitable to see the person as a knowledge resource working for an organization (cf., Lawler, 1994). The competence of knowledge workers or "symbolic analytic workers" are varied, e.g., problem identification, problem solving, and brokerage (see Reich, 1991; Starbuck, 1992; Alvesson, 1993). Since knowledge workers perform their work based on accumulated experiences and a tacit understanding of how to accomplish their tasks, they are likely to resist routines. In this sense, the level of autonomy separates them from administrative workers (see Davenport et al., 1996). Autonomy and self-motivation can be regarded as driving forces for the knowledge worker and it has been argued that a knowledge worker's interest regarding the task in question affects the end result of the work (see e.g., Nonaka, 1994; von Krogh and Roos, 1996). Moreover, research in a corporate setting has shown that professional interests, rather than espoused theory is what motivates people (Stenmark, 2000).

Management literature have suggested that the job paradigm, where competence is outlined as primarily directed towards formalized knowledge and skills, is insufficient for describing knowledge work practice (cf., Sandberg, 1994). Nonetheless, competence systems are still based on an oversimplified rationalistic perspective on competence rooted in early 20th century scientific management thinking. Needless to say, the adoption of such systems in organizational knowledge work practice has become problematic (Lindgren and Henfridsson, 2002). Competence systems are typically used for personnel administration by human resource departments. In this paper, we argue that there is a misfit between existing competence systems handling formalized competence descriptions related to well-defined tasks and the dynamic nature of knowledge work. Knowledge-based organizations distinguished by changing conditions, unforeseen requirements, continuous learning, and a constant need for innovation require competence systems based on a richer interpretation of competence. Such an interpretation should include the form of competence-in-action that is primarily driven by individuals' own interests in the work. This in turn requires competence systems that are emergent, dynamic, which

depict real-time status and are based on interest-driven actions of organizational members. The main objective of this paper is to introduce interest-activated technology as a new design rationale for competence systems. The paper is based on an action case study of an implemented interest-activated intranet recommender system prototype at Volvo Information Technology AB (Volvo IT) in Gothenburg, Sweden. By studying how people used this prototype to find information in which they were interested, we were able to inquire into how personal interests, embodied in information seeking activities, could be a means for identifying the competence of organizational members. Building on how people perceived the relationship between personal interest and competence, this paper presents implications for competence systems design and more specifically for managerial practice in knowledge-based organizations.

The remainder of this paper is organized as follows. The next section outlines the related research. Section three discusses the concept of competence. Thereafter, we relate competence to job-based and knowledge-based organizations in section four. Section five presents our research approach, while section six outlines the empirical results. Section seven contains a discussion of personal interest versus competence, and here we describe some concrete effects this research has had on Volvo IT's competence management strategy. Section eight presents the lessons learned and spells out the implications our competence systems design has on management practice. Our conclusions in section nine finish the paper.

2. Related research

There have been many studies focusing on how to use information technology to manage knowledge and expertise, e.g., intranets for knowledge sharing (Scott, 1998), database technologies for handling organizational knowledge (Maier and Lehner, 2000), groupware technologies to facilitate knowledge creation (Robertson et al., 2000), and recommender systems for leveraging tacit

knowledge (Stenmark, 2001) and identifying expertise (McDonald and Ackerman, 2000). Furthermore, empirical studies have been carried out in order to elicit implications for knowledge management systems design, e.g., analysis of work conducted in a telephone hotline group (Ackerman and Halverson, 1998) and expertise location in a software development company (McDonald and Ackerman, 1998).

This paper concentrates on a particular type of knowledge management systems designated as competence systems. There is little research on such systems to be found in the literature. Davenport and Prusak's (1998) study of competence mapping at Microsoft is one of very few accessible accounts. While their report on the SPUD project presents details about the process of identifying competence types and levels, defining competencies needed for particular jobs, and rating of individuals' performance based on the competencies, less attention was given to the implemented competence system. Lindgren and Henfridsson (2002) are, however, more specific about the technology when they report the results from their multiple-case study of competence systems in practical use. The main characteristic that the competence systems they study have in common is that the systems store measurements of organizational members' competencies in hierarchical tree structures. The competence systems use a grading scale to indicate the level of skill for a certain competence. With stored competence data as a point of departure, the competence systems facilitate search for specific competencies and analyze gaps between existing and wanted competencies. The investigated competence systems were specifically designed and implemented to support the organizations in managing their competence in a structured and efficient way, i.e., to insure the right competence in the right place at the right time. According to Lindgren and Henfridsson (2002), this objective has not been reached. On the basis of eight identified adoption barriers, the authors describe the competence systems as traditional administrative systems complemented with features that passively archive formalized descriptions of competencies. In order to facilitate successful integration of competence systems in organizations, the authors suggest general design changes for

future competence systems. First, they suggest that competence systems need features for flexible analyses of both existing competencies and competence interests of organizational members. How such features can be developed and implemented is described in Lindgren (2002). A second suggestion is that recommender systems supporting information seeking activities of organizational members could be an action-oriented approach to competence mapping. In addressing Lindgren and Henridsson's second suggestion, here we introduce interest-activated technology as a new design rationale for competence systems. Since design-specific knowledge about how to exploit and develop such technology for competence management is addressed elsewhere (see Lindgren and Stenmark, 2002), we concentrate on managerial implications in this paper.

3. Competence

The concepts of knowledge, expertise, and competence are closely related and historically these have been discussed in terms of distinctive or firm specific resources (Hitt and Ireland, 1985), invisible assets (Itami and Roehl, 1987), skills (Aaker, 1989), core competencies (Prahalad and Hamel, 1990), organizational memory (Walsh and Ungson, 1991), intangible resources (Hall, 1992), core capabilities (Amit and Shoemaker, 1993), and collective knowledge (Spender, 1996). In this paper, both expertise and competence are seen as enacted and strictly work-related knowledge (cf., Allee, 1997). The difference, however, is that expertise is understood as an individual aspect, while competence is discussed on an organizational level. Throughout this paper, we adhere to this notion.

Established in early 20th century scientific management (Taylor, 1911), competence is a concept that was frequently used in human resource management approaches during the 70's and 80's (see e.g., McClelland, 1973; Boyatzis, 1982). Competence is comprehended as the relation between humans and work tasks, i.e., the concern is not about knowledge and skills in itself but

what knowledge and skills are required to perform a specific job or task in an efficient way (McClelland, 1973). Early management thinkers addressing competence criticized the ad hoc and unstructured way in which competence was managed. As part of his scientific management approach, Taylor (1911) introduced time and motion studies as one way of making the employees' competence visible and measurable. In this tradition, competence consists of a set of properties needed to perform a specific task: "A competency is an underlying characteristic of an individual that is causally related to [...] superior performance in a job or situation" (Spencer and Spencer, 1993, p. 9). A plethora of espoused theories and human resource management approaches used by practitioners is based on different sets of such characteristics including attributes like knowledge, skill, ability, experience, attitude, willingness, and personality (see e.g., Veres III et al., 1990). According to Sandberg (1994), however, the rationalistic perspective on competence suffers from three basic limitations: First, descriptions of competence are fragmentary and atomistic. Second, competence is categorized beforehand in an ad hoc way with weak connections to both empirical data and theory. Third, competence descriptions are based on the assumption that there exists an external relationship between the worker's attributes and the work activities. In sum, regardless of the number of categories, competence descriptions are static, indirect, and general representations of human competence. Competence descriptions do not demonstrate whether workers actually apply the competence in accomplishing work, i.e., the competence descriptions are not rooted in work practice. At best, competence descriptions indicate prerequisites for being able to accomplish a certain job or task. In line with this argument, Lawler and Ledford (1992) point out that the most serious problem with job-based competence descriptions lies in their focus on jobs, rather than on individuals. The rationale is to find individuals who can be shaped to fit job descriptions. Furthermore, formalized competence descriptions all too often reflect how the organization has operated in the past. Such descriptions, the authors argue, are not capable of anticipating future needs of the organization. Formalized competence descriptions also fail to acknowledge the individuals'

ability to contribute in ways out of line with their present job and how it is described. Finally, flexibility in competencies and career changes are discouraged since application and development of competence have to be managed within the boundaries of job descriptions.

In order to address the problems with job-centered descriptions of formalized competence, alternative approaches have been developed that focus directly on the competence used by individuals in accomplishing work. Building on researchers such as Silverman, Weick, Schön, and Dreyfus and Dreyfus, Sandberg (1994) outlines an interpretative approach to human competence at work. In an attempt to move away from the job-based model for managing competence, Lawler and Ledford (1992) introduce a skill-based approach to human resource management. Despite the emergence of approaches addressing the limitations of the rationalistic perspective on competence, however, competence systems still rely heavily on such a perspective (Lindgren and Henfridsson, submitted). In order to understand why the adoption of competence systems has become problematic, competence must be understood in relation to the organizational practice in which the systems are implemented.

4. From job-based to knowledge-based organizations

Generally speaking, two ideal forms of organizations have been used to divide and co-ordinate labor in western society: The goal-oriented rationalistic form suitable for a stable and predictable environment and the organic form appropriate for changing conditions and unforeseen requirements for action. Based on this dichotomy, which relates to the extensive literature describing typologies of organizational forms, we shall separate the job-based from the knowledge-based organization (cf., Lawler, 1994). It is to be noted, however, that job-based and knowledge-based organizations do not necessarily have to be mutually exclusive. Normally, both forms can be found in different areas, departments, or layers within the same organization (cf., Nonaka, 1994).

The job-based approach to organizing has been addressed by different schools and has been expressed in terms that can be traced to scientific management (Taylor, 1911), bureaucracy (Weber, 1947), mechanistic systems (Burns and Stalker, 1961), and goal-directed rationalistic organizations (Pfeffer, 1982), and it has a perspective on organizations as closed and stable systems (Thompson, 1967). The overall picture of the job-based organization is one of order, predictability, and hierarchy. An organization has well-established recurrent activities characterized by repetitive tasks and known problems and is driven by an ambition to optimize performance and eliminate redundancy (Blackler, 1995). A job-based organization can be described as a well-coordinated machine with a fixed repertoire of routines. The hierarchy of responsibilities, duties, and accountabilities that is part of the bureaucratic approach leads to a command and control structure, which has as its foundation the principles of scientific management with each job specified in an explicit description and tasks clearly differentiated across jobs. The rationale is that the best way to optimize organizational performance is to fill jobs with appropriately skilled individuals and motivate them to perform effectively through pay and other extrinsic rewards (Lawler, 1994). The organization-individual relationship could be characterized as "I pay you to do, not to think". The job-based organization is knowledge-routinized and knowledge is encoded in rules, roles, and procedures that are invested in positions, rather than people (Whalley and Barley, 1997). The development of knowledge over time was systematic and sequential, i.e., previous knowledge was the base for advanced knowledge. Competence is either defined as the knowledge or experience of technologies or as the rules and procedures required to perform the repetitive tasks. Making competence visible and retrievable and thereby available to the organization as a whole is thought of as a way to enhance performance as well as a way to avoid having to reinvent the wheel. Since future tasks and problems are presumed to be known, competence is defined and categorized in beforehand.

Over the past several years, however, the conception of work has changed from a focus on narrow and specific tasks carried out by individuals, constrained by rules and procedures, to be viewed

as a collective effort conducted by teams with diverse skills working with considerable discretion judged on results and outcomes. Peter Drucker (1988, 1993) coined the phrase “knowledge work” in order to describe the increased importance of knowledge in the emerging postindustrial society. Recent literature on organization theory has discussed knowledge work in relation to knowledge-based organizations and knowledge-intensive workers (see e.g., Starbuck, 1992; Alvesson, 1993; Blackler, 1995; Boland and Tenkasi, 1995; Schultze, 1999). According to Starbuck’s (1992) definition, knowledge work is knowledge-intensive and requires a formal education, i.e., abstract, technical, and theoretical knowledge. Furthermore, knowledge work can be characterized by variety, rather than routine and is problematic to describe in manuals, job descriptions, and charts (see e.g., Brown and Duguid, 1991; Nelsen, 1997). Knowledge work defies routinization and requires the use of creativity in order to produce idiosyncratic and esoteric knowledge (Blackler, 1995). Accordingly, knowledge work is disorderly in comparison with administrative or operational business processes in which tangible inputs are acted on and converted to outputs in some predictable and structured way. The inputs and outputs of knowledge work, i.e., ideas, inspirations, are usually less tangible and discrete and in knowledge work there is no predetermined task sequences that, if correctly executed, guarantee the desired outcome (Davenport et al., 1996). Finally, as pointed out by Davenport et al., (1996), activities dealing with acquiring, creating, packing, and applying knowledge lie at the heart of any knowledge work, which in turn can be identified inside the core competence of more and more modern organizations across the service, industrial, and governmental sectors (Prahalad and Hamel, 1990). Although it is easiest to appreciate the significance of knowledge work in organizations involved in leading edge technology development, the rapid pace of and change in today’s market means, basically, that all organizations will increasingly rely on their ability to create new knowledge.

The knowledge-based organization, in contrast to the job-based, is based on a rationality that has much in common with descriptions such as organic organizations (Burns and Stalker, 1961) and emergent, almost-random organizations (Pfeffer, 1982).

From this perspective, organizations are seen as open and dynamic systems (Burns and Stalker, 1961). The major issue for knowledge-based organizations is to find creative ways for representing and integrating knowledge across their lateral units (see e.g., Weick and Roberts, 1993; Nonaka, 1994) and in such organizations dynamic processes and project groups will characterize work. This is a form of work that builds upon co-operation across boundaries, self-governing project groups, quick communication, and tight networks (Castells, 1996). It is simply a question of co-operation between people having different knowledge and experiences for the purpose of solving common problems (Nonaka, 1994; Brown and Duguid, 1998; Nonaka and Konno, 1998). This particular perspective on organizations, is based on the idea that knowledge exists in a variety of forms, e.g., tacit and explicit (Nonaka, 1994), in a variety of locations, e.g., in the individuals, the brains, the dialogue, the group, and the organization (Blackler, 1995), and is continuously shaping and being shaped by the social practices of communities (Brown and Duguid, 1991; Boland and Tenkasi, 1995). Therefore, knowledge-based organizations can be seen as consisting of multiple communities with specialized expertise, i.e., "communities-of-knowing" (Boland and Tenkasi, 1995), "communities-of-practice"(Lave and Wenger, 1990; Orr, 1990; Brown and Duguid, 1991), and "communities-of-practitioners" (Blackler, 1995) and it is through the dynamic interactions between such communities that new configurations of knowledge emerge (Boland and Tenkasi, 1995). Expressed differently, knowledge is emergent (Weick and Robert, 1993), is not possessed by a single individual, and is never complete at any point (Tsoukas, 1996). Thus, in order to sustain their capability to perform, knowledge-based organizations must continuously maintain and develop their knowledge and utilize the existing knowledge that otherwise degenerates (Nonaka, 1994). Accordingly, in knowledge-based organizations both rule-bound action and novelty are present in order to find a balance between regularity and creativity or between "exploitation" and "exploration" (March, 1991; Tsoukas, 1996).

To solve tasks, knowledge-based organizations, according to Starbuck (1992), rely on knowledge workers who, by definition,

have a high degree of formal education. The organization-individual relation could be described as “I pay you to think and not just to do”. Knowledge workers draw upon individual or collective knowledge (Spender, 1996; Brown and Duguid, 1998; Cook and Brown, 1999) and creating new knowledge is vital for these workers in order to prevent themselves to be caught in competence traps (Levitt and March, 1988). However, the new knowledge need not be in the same area as the old knowledge. In the knowledge-based organization, competitive advantage on the organizational and the individual level are bounded to here and now. To learn C++, Visual Basic, or Java programming, it is not necessary to know how to program in BASIC, and, analogously, a BASIC programmer need not develop into a C++ programmer. Making lateral competence jumps instead of simply extrapolating the previous direction stresses the importance also of unlearning in the knowledge-based organization. Competence has to be associated with processes of change and should be seen as dynamic, emergent, and situated in constantly evolving practice. Competence is therefore hard to define precisely and in beforehand. Making knowledge workers more efficient by rationalizations is not an issue. Instead, people’s commitment and motivation become crucial assets alongside technology’s role of enabling new possibilities and connections. Individual autonomy is a basis for self-organizing and increases the likelihood that individuals will motivate themselves to continuous learning in terms of creating novel knowledge and developing new competencies (Nonaka, 1994).

As stated previously in this paper, existing competence systems are designed based on a rationalistic perspective on competence (cf., Lindgren and Henfridsson, 2002). Such competence systems might work in a job-based organization, but do not support a knowledge-based organization. Consequently, there is a lack of contributions that deal with competence systems suited for organizational knowledge work practice. Competence systems for knowledge-based organizations, we argue, must be based on a richer understanding of competence including interest-driven working practice.

5. Research approach

Ordinary office activities performed by the organizational members leave behind tangible traces that can be exploited to deduct the nature of these activities. Tasks carried out on an intranet can, for example, be captured in form of web server log files, published documents, or submitted search engine queries. By exploiting a user's everyday actions in an unobtrusively manner, the intranet activities a user is already engaged in during an ordinary workday can be aggregated and turned into an organizational benefit revealing otherwise invisible patterns (Stenmark, 2002).

On a corporate intranet, where all material is work-related, it has been suggested that information retrieval systems could be used to reveal part of our tacit knowledge by making salient our search patterns (Stenmark, 2001). Elaborating on these ideas, we suggest that pursuing a professional interest in a corporate setting eventually leads to competence within that area and that it seems plausible that interests can be a means for identifying competencies applied in practice. The idea of a relationship between interest and competence contrasts with the rationalistic view on competence as something well-defined and stable and opens for new ideas about how to design competence systems better suited for the dynamic nature of knowledge work. To be able to study the relationship between interest and competence, we implemented an interest-activated recommender system prototype at Volvo IT's intranet.

5.1 The site

Volvo Information Technology AB is the competence center for IT services within the Volvo Group. At the time of our research in the spring of year 2000, Volvo IT had approximately 2,400 employees worldwide and some 900 of these worked at the headquarter in Gothenburg, Sweden.

In an attempt to take a firmer grip on its competence management, Volvo IT had in late 1999 initiated a pilot installation of Tieto Persona/Human Resource (TP/HR), which is a traditional

competence system, designed to support mapping, categorization, and visualization of an organization's competencies. TP/HR is based upon a pre-established competence structure where competencies are defined as functional skills (practical work tasks) and technical skills (methods or techniques used to perform the tasks). Each skill is graded on a five level scale ranging from no competence to expert competence. The system's main features are functions for measurement of employees' competencies status and competence gap analyses. The gap analyses are used to indicate discrepancies between existing competence and competence needed in the future. The analyses show both how well the employees' competencies match the given competence demands for a given work task and how critical competencies related to specific work tasks are distributed within a certain group. Volvo IT planned to use these analyses as a support for organizational activities such as resource and availability planning, internal and external recruiting, goal and personal development discussions, forming teams of employees, finding competence when manning assignments, and mission steering. Consequently, the TP/HR system was assumed to support Volvo IT in managing their competence in a short as well as long perspective.

Though being an IT company, the legacy from the manufacturing industry was evident and the size of the company made it more hierarchically organized and somewhat more bureaucratic than smaller IT consultancy firms. For many decades Volvo IT had benefited from its centralized mainframe operation, which had received several international awards for high efficiency and cost-effectiveness. As is often the case in industry settings, high degree of standardization was typically the norm to strive for. However, in contrast to the highly controlled mainframe environment, the intranet, consisting of over 700 web servers and approximately 750,000 web pages, was rather decentralized and characterized by a bottom-up approach. While the official information was maintained by appointed information providers via coherent structures and by using design guidelines, the major part of the intranet structure, although containing much valuable information, seemed ad hoc and haphazard.

5.2 The recommender system prototype

Finding the right information was commonly conceived as a major problem at Volvo IT and to address this, a recommender system (RS) (Resnick and Varian, 1997) was implemented and evaluated in 1998 (see Stenmark, 2001). The primary objective of the recommender system prototype, which was based on AgentWaretm (Autonomy, 2001), was to provide the organizational members with relevant and targeted information retrieved from the corporate intranet. The system regularly spidered the intranet, and retrieved and synthesized every web document into a 0.5K digital representation. Using this representation, the system allowed the users to create information agents, which search the created index for documents matching the users' interests. An interest was defined in a free text natural language sentence, i.e., a richer representation of an interest than merely a keyword-based query from which the system created a 0.5K digital representation. The search results from each agent were displayed in a simple list. When the user had read the results and identified one or more of the returned documents as relevant, the user could mark the document(s) that best represented his or her interest and click the retrain button. The digital signature of the agent was then merged with the signature(s) of the selected document(s) and the result became a new signature that replaced the previous one. This mechanism made it easy to update the agent profile to reflect one's actual interest.

Building on the experiences reported in Stenmark (2001), we designed and implemented a second recommender system prototype: The Volvo Information Portal (VIP). VIP was released on Volvo's intranet in January 2000 and the 50 or so individuals who had participated in or otherwise shown an interest in our previous prototype were notified of its existence. No formal training was offered but an introduction email was submitted to all interested parties and the prototype had built-in help files. Although the prototype was not explicitly announced or promoted to the larger audience, being an intranet application it was generally available to all Volvo employees. When we conducted our research during the period April to June 2000, approximately 20 users had active agents.

In addition to the standard RS function of providing the employees with targeted and relevant information, we added a Find competence feature. This feature enabled the VIP users to enter a natural-language text describing a specific interest, e.g., “database administration on an Oracle system”. VIP would then list all users with matching agents, i.e., all users who had agents actively searching for information related to the specified interest. Obviously, the VIP prototype did not locate people with formalized competence but people with an interest. To label this feature Find Competence was a deliberate provocation intended to cause the organizational members to reflect upon the relation between interest and competence.

5.3 Method

When the researcher has the intention not only to observe, interpret, and understand but also to intervene in and change the practice under study, the approach can be described as a mix between action research and case studies, i.e., an action case study (Braa and Vidgen, 1999). Although small-scale intervention is part of our approach, the initial focus was to gain in-context understanding of prevailing attitudes and mental references. The change-oriented part lies in our desire to make the organizational members aware of and appreciative of a broader understanding of competence and to inform the design of competence systems capable of embracing this new conception. The empirical data consists of 16 semi-structured interviews with organizational members having used the VIP prototype. The interviews, each lasting approximately one hour, were conducted in May and June 2000 after a 10-week test period. The interviewees occupied different positions within the organization ranging from non-technicians such as HR staff members and business analyst to technology watchers and systems developers, as shown in Table 1. All interviews were recorded and transcribed.

Occupational role	#
Systems developer	4
Technician	2

Project manager	2
Department Manager	2
Human Relation staff	2
Business analyst	1
Information staff	1
Technology watcher	1
Product manager	1
Sum:	**16**

Table 1: The number of interviewees and their occupational roles.

The data was then approached in an open-minded manner meaning that we let the data itself suggest concepts and categories, rather than importing these from a pre-selected theory. In this aspect, our approach is similar to the open coding technique used in grounded theory (Strauss and Corbin, 1990) although we do not subscribe to the entire framework. The data was thus categorized, conceptualized, and interpreted and the concepts derived were analyzed and evaluated in an iterative fashion where the initial categories were revised and refined until they sufficiently explained all data. Accordingly, the empirical results can be said to have emerged from an iterative and interpretative analysis of the collected data (Walsham, 1995). In the next section, we present the empirical results in order to highlight how the interviewees perceived the relationship between interest and competence.

6. Empirical results

Regarding the prototype's Find competence feature, it was evident that many users were uncertain of what this feature actually returned. The interviewees' understandings varied between "formal competence descriptions", "tasks that the employees are designated or hired to do", or merely "representations of people's interest". One software developer, familiar with both conventional information retrieval tools and the TP/HR system, expressed his uncertainty in the following way:

> "First, I interpreted [the Find competence feature] as if you came to some kind of competence database. There is one competence database that I subscribe to where you search for

> competencies. So it does not seem intuitive that this is called Find competence, but maybe it is right. I guess it is something you have to get used to if you want to use it. But it does not seem intuitive."

According to this software developer, competence is typically something that is formalized and refers to specific roles and work tasks within the organization. This was a rather typical attitude amongst the organizational members who thought of competence in terms of named entities and discrete levels. A department manager, when answering the question whether he thought the Find Competence feature in VIP could be of any use, gave an example of this position:

> "Yes, definitely, if it took off and people started to use it. If we, for example, have a shortage in some situation… like, with Java, or if we are to start a new project and we need a particular sort of competence and we don't know where to find it. We're a big company, so there might be a Java programmer sitting idle somewhere… But some sort of grading scale for competencies would be needed."

Furthermore, some respondents saw the Find competence feature as a way to become aware of areas where the organization did not have any competence. The absence of interests, one of the interviewed system programmers argued, reveals missing competencies within the organization:

> "It gives a hint of that there is no one else but me who is interested in these areas. Yes, it would be able to show shortcomings, missing competence for instance, and that there is a shortage in a certain area. You could find areas that were neglected or where you were weak."

The idea of using the prototype as an instrument to identify missing competence areas is based on the assumption that interest is linked to competence. This way of reasoning about competence analyses was also expressed by a technology watcher who highlighted the possibility of using the prototype for competence management:

> "A personal agent speaks about an element that people want. Then maybe you realize, through analyzing personal agents,

> that you can discover that there is a competence gap in comparison with what the organization would like to have. Then you can create new areas that enable people to see that there are more possibilities to discover."

The above quotation expresses a view on interest as a means for managing the organization's competence. This respondent also meant that interest is so important for competence that they should be taken into account when configuring new projects. There were, however, interviewees who stressed the importance of interests even more. One member of the HR staff commented:

> "When you take initiatives beyond your assigned tasks, there is a commitment to and an interest in participating in changing things. Commitment really is worth more and says more [than formal competence], because I do not have to do it. No one is forcing me to do it and I am not measured by it. You can perform miracles in 10 minutes if you have enough motivation. Therefore, it would have been exciting to find those with an interest and not those who are assigned to do it because they are not always the most suitable."

According to this respondent, people's interests do not necessarily indicate their formal competencies. This is not a problem, however, since it is essential for the organization to identify the driving forces among the employees. People's interests hint at their ambitions as well as motivation and in some situations such qualities are more valuable than formal competencies. Therefore, representations of interests can be of great value. When elaborating on how the prototype could be used, one technology watcher said:

> "The most powerful thing I see is a possibility to visualize. If one can use VIP in a proper way then there is a possibility to visualize [interests] in order to get a quick feeling for where people have been, where they are heading, and what they want. Looking ahead is the difficult part."

By visualizing the status of interests over time on an aggregated level, it is possible for the organization to trace the historical development of the employees' interests. Such an approach could facilitate the discovery of emerging new initiatives and hence have a strategic impact.

7. The relationship between interest and competence

In this section, the different personal views of the relationship between interest and competence, illustrated in the previous section, will be condensed into three themes: Competence as formalized description; interest as competence; and interest beyond competence. These themes will be discussed in relation to the job-based and the knowledge-based organizations as well as to existing competence systems.

A considerable part of the interviewees discussed the prototype in relation to TP/HR, which is a competence system that embodies and expresses the rationalistic view of competence. The respondents implicitly perceived competence as primarily constituted of attributes such as knowledge, skills, and ability that can be represented in formalized descriptions (cf., Veres III et al., 1990; Spencer and Spencer, 1993). In line with the rationale of the job-based approach to organizing, the TP/HR system is based on formal descriptions of competencies in form of skills related to certain tasks and can therefore be described as a traditional tool for managing competence. Most if not all of today's existing competence systems are designed with this rationalistic perspective on competence as a basis (see Lindgren and Henfridsson, 2002). The representations of competencies provided by TP/HR are needed in order to match tasks with qualified persons or to get an experts view of a special problem (cf., Blackler, 1995). Further, the competence resides somewhere in the organization and the TP/HR system's role is to support the identification of that particular competence in a rationalistic and effective way. This logic builds on the assumption that tasks are recurrent and competencies are largely stable over time and therefore reusable. Interests, in regard to competence, were ignored by both the TP/HR system and by this category of respondents.

There were interviewees who recognized interests as essential because they say something about work-practices. This represents a view in which people's actions speak about what they do and that interests in similar areas mean working with comparable problems, which in turn indicates related competence. Interests thus give important information about individuals' and

hence also organizations' competencies and were seen by some respondents as equally important as the rationalistic way of understanding competence. Consequently, in this perspective formalized descriptions and competence applied in practice are both important and complement each other. The respondents, for instance, discussed the possibility to have the VIP prototype update the content of the TP/HR system. Though the perspective of the relationship between interest and competence expressed by these respondents also has its roots in the job-based approach to organizing, the importance of interest as an addition to the formalized view of competence was acknowledged. Embryos of competence systems supporting this perspective on competence can be seen in the form of features for free text expressions of personal interests. However, free text descriptions do not support statistic analyses of the expressions and there is no possibility to aggregate such information in order to visualize interest and ambitions (Lindgren and Henfridsson, submitted).

The most radical perspective found amongst the respondents suggested that interest is more important than formal competence. This way of understanding the interest-competence relationship stresses the need for continuous competence development as a result of the ever-changing environment. It is the intrinsic motivation that comes from personal interests that sets the limits for the organization's future and it is therefore crucial for people to be motivated and "hungry", as one interviewee expressed it. To actively nurture and develop these interests thus becomes more important than to archive records of past achievements. Although the respondents do not explicitly refer to the two organizational forms, it became obvious to them that knowledge work practice requires other ways of organizing as well as a new understanding of competence. The view of interest as something that goes beyond competence belongs to the knowledge-based organization, where tomorrow's tasks are more difficult to foresee and people's interests, their motivation, and their commitment become the main assets (Nonaka, 1994; Stenmark, 2000). Hence, in the knowledge-based organization business rely more on identifying individuals with the ability to learn as they go along than on finding employees matching predefined and formalized

competence descriptions. IT support for detecting emerging interest with the potentials of becoming new competence areas is difficult to realize since much of the input required is only tacitly expressed. However, this does not mean that such support is entirely out of reach, as we have illustrated in this paper.

Condensed into three categories, the different personal views of the relationship between interest and competence are illustrated in Table 2.

Category	Example of attitude
Competence as a formal merit.	Competence is formalized, categorized, and graded.
Interest as a complementing aspect.	Lack of interest indicates missing competence.
Interests transcend competence.	Interest and commitment is more important than formal competence.

Table 2: Three categories of the interest-competence relationship.

The above categories present how the interviewed people at Volvo IT perceived the relationship between personal interest and competence. Although three perspectives were derived, the first category represents the dominating perspective within the organization. The second and third categories could be seen as products of this research's action orientation. In line with the rationale of action research (see e.g., Susman and Evered, 1978; Argyris et al., 1985; Baskerville and Wood-Harper, 1996; Braa and Vidgen, 1999), the intention was partly to make the organizational members aware of and appreciative of a broader understanding of competence and partly to inform the design of competence systems capable of embracing this new conception. A tangible result of our research is that Volvo IT has applied some of the ideas presented in this paper. Currently, Volvo IT in Gothenburg conducts a project that aims at improving the organization's competence management worldwide. Based on the lessons learned from TP/HR and the VIP system, Volvo IT has decided that personal interest profiles should be included in the organization's competence descriptions.

8. Discussion

Since organizational members have varying perceptions of the relationship between interest and competence, it seems important that competence systems of the future are able to accommodate a mix of these entities. Therefore, interests satisfying the need for up-to-date indications of competence should be paired with integrated access to formal competencies and descriptions of previous achievements. The dynamic characteristics of a recommender system enable it to handle unstructured information and emerging topics without having to manually adjust labels and categories. However, this inability to distinguish between different levels of interests also makes it impossible to know whether an organizational member has developed the interest yesterday and thus is a novice or has had it for years and thus has gained a lot of experience (cf., McDonald and Ackerman, 1998). By allowing formal descriptions and dynamic interests to complement each other, the users would have enough information to eliminate possible misunderstandings and enhance the perception of an individual's background.

Furthermore, information about interests should not be entered manually since such an approach would suffer from the same problems that plague traditional competence systems. Instead, interests must be derived unobtrusively from the users actions, while pursuing other tasks (Stenmark, 2001). Therefore, the competence systems of tomorrow must be able to aggregate interest-derived information more automatically and over time. A compiled and aggregated picture of the number of information agents searching a certain area and how frequently they are updated would show how different groups of individuals use their competence in practice. Such features would provide management with a quick and flexible overview of the organization's competence status. By aggregating interests, we thus elevate ourselves from the individual to the organizational level. As we can see, the novel perspective on competence advocated in this paper has implications for competence systems design and such have also been suggested (see Lindgren and Stenmark, 2002).

New and different IT artifacts per se are, however, seldom sufficient to improve work. Only when matched by appropriate organizational changes and managerial attitudes can the full potentials be unleashed. For the enriched interpretation of competence that also includes personal interest in effect to become useful, it must be paired with a corresponding change of management mindset. To give an example, consider two fictive IT companies, Alpha and Bravo. Alpha's management is characterized by a traditional view on competence and the company is equipped with a competence systems based on formalized competence descriptions, whereas Bravo has a management team who appreciate the intrinsic motivation of the employees and consequently has invested in an interest-driven competence system. Top management at the two companies decides to investigate whether WAP is a technology the companies should start to explore.

At Alpha, Jane, head of the software development department, gets the assignment and she assembles a team of three of her employees and tells them to do a two-week evaluation of WAP technology from a business perspective. Jane picks the team members based on availability and does not consult the competence systems since she knows she would not find anything should she search for WAP. Meanwhile at Bravo, the assignment goes to John, who is managing their software development department. John realizes that there are probably a number of employees around the company who have already looked into WAP technology out of sheer interest. Using the interest-driven competency system, he quickly identifies eight different candidates. Seven of these belong to department other than SW development. One is from marketing, another is with accounting, and some are from operations. Having consulted their managers respectively, John selects three employees who get to do a two-week evaluation. Note that we are not suggesting that interest should be used instead of formal competence. The team selected at Bravo is equally competent as the Alpha team in doing evaluation work. The difference between the two teams is, however, that the Bravo team has a head start since its members have much more pre-knowledge from personal experiences and an intrinsic motivation. Being

sincerely interested, they have probably already played around with the technology, set up their own WAP servers, used or possibly also developed WAP services, bought and used WAP-phones, and read all there is to read in popular press. Out first managerial implication is therefore to actively take advantage of the interests of the organizational members.

Much if not all of the WAP knowledge gained by the Bravo team were probably acquired outside business hours on their spare time. It has been noted that employees driven by intrinsic motivation, and who thus have extra-ordinary dedication and commitment, are willing to do far more than the company could possibly ask of them if only they were allowed to work with things in which they were really interested (Stenmark, 2000). Although the boundaries between business hours and spare time are blurring, organizations should not base their future competitiveness on their employees' willingness to do unpaid work. Instead, more slack should be allowed for the organizational members to explore and exploit their interests during office hours. Knowledge-based organizations cannot be managed with the rationalistic "measure and control" attitude that has characterized the 20th century industry environment. Instead, it has been argued that innovation must be managed through a "coach and facilitate" approach. Such a management style should acknowledge the need for redundancy, autonomy, intrinsic motivation, and give recognition to creative initiatives (cf., Nonaka, 1994; Scarbrough, 1999). When deadlines and budgets are cut so tight that the employees barely manage to do what is expected, their opportunities to pursuit personal interests are limited. The sort of competence systems we advocate in this paper can only capture activities occurring at work. To be able to take advantage of such traces of work, our second managerial implication is that at least a minimum amount of redundancy must be allowed.

In hierarchical bureaucracies, it takes time for new trends and emerging interests at grass-root level to reach the top executives, be converted to official corporate strategy and implemented in traditional job descriptions and competence systems. By the time the process is completed and the new directives are communicated back to the employees, the interest

and the business opportunity may be long gone. By empowering the employees to act autonomously and follow their interests, new, unplanned, and rapidly emerging openings may be encountered (cf., Drucker, 1999). It has been shown that when people are driven by intrinsic motivation, such as personal interests, they are more creative than when aiming for goal imposed on them by outside actors even though this means that they need to act outside of their job descriptions. Although such actions involve risk-taking and hence occasional failure, they should not only be considered acceptable but also necessary. Our third managerial implication is to allow employees to pursuit interests outside their job descriptions.

Following emerging interests, communicating laterally, and crossing organizational borders may upset prevailing practices and established routines and can seem threatening to managers who see it as their duty to guard their own territory and their own resources. In job-based organizations, employees therefore cannot be encouraged to contribute to the success of external projects without returning tangible benefits also to their own organizational unit. Knowledge is power and knowledge sharing is typically conceived as a zero-sum game where if there is a winner there must be a loser. Recognizing that work increasingly is performed not by isolated workers but by cross-organizational project groups and that sustainable knowledge creation and business innovation depends on mixing input from a variety of competencies, the knowledge-based organization should not engage in this sort of in-house competition and territorial warfare. For interest-activated competence systems to be successfully exploited, our fourth and final managerial implication is to encourage collaboration and co-operation.

9. Conclusions

In this paper, we have argued in favor of interest-activated technology for managing competence in knowledge-based organizations. We have provided an example of interest-driven

technology in form of a recommender system and shown how it can be used as a competence management tool. We have further elaborated on the notion of knowledge-based organization and contrasted it to the job-based organization. Our main conclusion is that the shift towards knowledge-based organizations that is currently taking place calls for a rethinking of competence systems and that such a new approach has consequences for management. The four managerial implications identified and discussed in the paper are:

- Actively utilize the interests of the employees.
- Allocate slack time for employees to do skunk work.
- Empower the employees to pursuit interest outside their job descriptions.
- Encourage employees to collaborate and actively share knowledge.

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Fifth paper[21]

Designing Competence Systems: Towards Interest-Activated Technology

Abstract

Despite the considerable research interest shown in various types of knowledge management systems, little academic work can be found on information technology (IT) support for managing competence. This paper addresses this shortage by presenting an 18-month action case study of the design, implementation, and evaluation of a traditional competence system at Volvo Information Technology AB in Gothenburg, Sweden. In addition, to upset prevailing assumptions and provoke reflection among the organizational members, we implemented and introduced an interest-activated recommender system prototype as a contrasting competence system. Our results increase our understanding of competence systems in two ways: First, we illustrate how inherent problematic aspects of mainstream competence systems can negatively affect the adoption and use of such systems. Second, we show how interest-activated technology can be exploited and developed to support competence management. Building on these results, this paper's main contribution is five general design implications for future competence systems based on interest-activated technology.

[21] Lindgren, R. and Stenmark, D. (2002). Designing Competence Systems: Towards Interest-Activated Technology. Accepted for publication in *Scandinavian Journal of Information Systems*, 14.

1. Introduction

Although a great deal has been written about the design, implementation, and evaluation of knowledge management (KM) systems (e.g., Ackerman, 1994; Ackerman and McDonald, 1996; Hahn and Subramani, 2000; McDonald and Ackerman, 2000; Schultze and Boland, 2000; Alavi and Leidner, 2001), most of the contributions have either dealt with knowledge in a broad sense or with expertise, i.e., individually held work-related knowledge.

This paper concentrates on IT support for managing competence, i.e., organizationally managed work-related knowledge. Relatively little attention has been paid to this sub-group of KM systems and, to our knowledge, there is no research on competence systems apart from our own work. The typical competence system is designed to support organizations in their competence management processes by providing information about competence status and competence development needs of organizational members.

Our studies to date have largely considered competence systems that store and categorize individuals' competencies in well-defined and structured ways, i.e., competence systems based on a hierarchical competence structure consisting of sub-levels that are constituted of the competencies (see e.g., Lindgren, 2002; Lindgren and Henfridsson, 2002; Lindgren et al., 2002). In Lindgren et al. (submitted), however, these types of competence systems are problematized. Building on an action case study of an implemented interest-activated recommender system prototype, we suggest a new design rationale for competence systems promoting that such systems should have the potential to detect, visualize, and leverage interests of organizational members. In this paper, we further develop these ideas by presenting results based on an action case study of Volvo IT's competence system Tieto Persona/Human Resource (TP/HR) and the implemented Volvo Information Portal (VIP). More specifically, we describe:

- The emerging organizational understanding of the problematic aspects related to the adoption and use of TP/HR, which is a hierarchically structured and multi-levelled system containing

information about formalised competencies. The identified problematic aspects provided useful input to the VIP experiment.
- The agent-based intranet recommender system VIP that facilitates searching for information related to a specified competence. This means that, in sharp contrast to TP/HR, VIP does not rely on database records of formal competencies but on interest-driven actions of the organizational members.

This paper's overarching research question is how interest-activated technology can be exploited and developed in order to support competence management. The main objective is to present general design implications for future competence systems based on interest-activated technology.

The paper is organized as follows. Section 2 outlines existing competence systems research. Then follows a presentation of the research method. Section 4 describes competence management at Volvo IT including a presentation of the TP/HR system. The next section introduces the recommender system approach, i.e., the VIP system. Section six discusses the research results and presents our five general design implications for future competence systems. Section seven concludes the paper.

2. Competence systems research

The concepts of knowledge, expertise, and competence are closely related and the literature defines both expertise and competence as knowledge applied and enacted in work practice (cf., Allee, 1997). However, there is a difference between the two: whilst expertise is typically considered an individual aspect, competence is usually discussed on an organizational level.

In the KM literature, there are many studies focusing on IT support for both knowledge and expertise (see e.g., Karduck, 1994; McDonald and Ackerman, 1998; Smith and Farquhar, 2000; Stenmark, 2001). Examples of such IT support are expertise profiles applications and personal skill databases (see e.g., Abecker

et al., 1999; Becerra-Fernandez, 2000), which are primarily intended to facilitate expertise identification and project configuration in operative daily work.

Mainstream competence systems store descriptions of employees' competencies in hierarchical competence structures. With the collected competence data as a point of departure, such systems are supposed to support organizations in having the right competence both in the present situation and in the future. In contrast to expertise profiles applications and personal skill databases, competence systems also include a strategic dimension. Therefore, competence systems have features beyond those that exist in expertise profiles applications and personal skill databases. To be able to support competence management in the long-term perspective, competence systems are geared with features that handle, for instance, resource gap analyses, which aim at identifying differences between existing competencies and future competence demands within an organization. For a thorough presentation of competence systems features, see Lindgren and Henfridsson (2002).

Apart from our own work, studies that explicitly focus on competence systems are rare. Accordingly, we shall below account for and summarize our previous work on competence systems to provide a background for this paper. In particular, we draw on the idea of interest as a vital component of competence, as introduced in Lindgren et al. (submitted). The final part of this section outlines this paper's main contribution to competence systems research.

Based on a multiple-case study conducted in six user organizations, Lindgren and Henfridsson (2002) examine barriers to competence systems adoption. By outlining a technology review and a user site investigation, the authors relate technical features of the investigated competence systems with the adoption barriers found in organizations. On the basis of the identified adoption barriers, it is argued that the competence systems can be characterized as merely traditional personnel administration systems with features that passively archive formalized competence descriptions. The authors' main argument is that competence systems need to convey a technology spirit more in line with the knowledge work practice found in organizations.

With a field research study of a knowledge-intensive, fast-growing, and dynamic organization as a point of departure, Lindgren et al. (2002) illustrate how evolution, which refers to the process in which organizations and information systems change over time, can result in competence systems failures. Of particular interest to competence systems research, the authors show how organizational changes such as new business models, new subsidiaries, and new competencies affect the adoption and use of IT support for competence management. Based on their research findings, the authors outline suggestions regarding how the evolution process could be managed.

In Lindgren (2002), two of the adoption barriers (group level imprecision and competence direction inattention) presented in Lindgren and Henfridsson (2002) are addressed. More specifically, this paper describes and evaluates the design of Competence Visualizer, which is a competence system generating competence patterns of organizational groups. The developed system provides novel features that support competence analyses of groups in different sizes and identification of employees' interests for competence development. The evaluation results cover fields of application, future design challenges, and organizational issues.

In Lindgren et al. (submitted), which is the starting point for this paper, we investigate competence systems design based on an action-oriented view of competence. We argue that current IT support for competence management is designed with a rationalistic perspective of competence as a basis. While competence systems based on such a rationale may work in job-based organizations, competence management in knowledge-based organizations requires different types of IT support. With these two organization forms as a starting point, we interpret and classify research findings from an action case study of an implemented interest-activated recommender system prototype. The findings illustrate that competence was apprehended as complex and multifaceted. Three views of the relationship between interest and competence were derived: competence as a formalized merit; interest as a complementary aspect of competence; and interest as something that transcends competence. Drawing on the identified categories, we claim that traditional competence systems only

handle the formalized view of competence as applied in the job-based organization. Since organizations tend to be more and more knowledge-intensive and innovative, the importance of the other two perspectives will increase. Therefore, we argue that competence systems need features that detect, visualize, and leverage interests of organizational members.

While our previous paper (Lindgren et al., submitted) suggested interest-activated technology as a new design rationale for competence systems, this paper contributes with design-specific knowledge about how to exploit and develop such technology for competence management. Based on an action case study of Volvo IT's competence system TP/HR and the implemented VIP system, we seek to inform the general design of competence systems that support organizations striving to activate their members' competence.

3. Research method

The initial focus of our research was to gain in-context understanding of prevailing attitudes towards competence and examine the practical use of the TP/HR system within Volvo IT. However, since one of the authors was employed by the organization under study, there was also a desire to use this understanding to change the way the organization comprehended competence and improve their IT support for competence management.

While not explicitly adhering to the grounded theory research methodology as suggested by Glaser and Strauss (1967), we have applied elements that may be traced back to this framework. The main objective, however, has not been to induce theory but to inform design of competence systems. This will be evident in this section, where we account for our research approach.

3.1 Action case research

When the researcher's intention not only is to observe, interpret, and understand, which is typically the objective in post-positivistic case study research (Galliers, 1993), but also to intervene in and change the practice under study, the approach can be described as action case research.

In action case, the researcher mixes a deep contextual understanding with small-scale intervention and action case research should be seen as a trade-off between being an observer interpreting case study data and a researcher involved in practical change (Braa and Vidgen, 1999). Much design-oriented work on computer systems has applied what can be categorized as "quick-and-dirty" ethnography (Hughes et al., 1994). The drawback with such an approach is that the snapshot captured depicts merely a specific situation, which can be difficult to interpret without knowledge of the larger picture. This paper is a useful contrast since the authors during their 18-month study have been able to observe how the organization became aware of emerging problematic aspects it had not foreseen at the outset. The in-context understanding in our case thus comes from one of the authors being employed by the organization and from the 18-month study of the competence system implementation project conducted by both authors. The change-oriented part lies in our desire to make the organizational members aware of and appreciative of a broader understanding of competence (see Lindgren et al., submitted) and to inform the design of competence systems capable of embracing this new conception. Since introduction of new information systems normally brings about a certain amount of disruption, the VIP application prototype was instrumental in provoking the organizational members to a more explicit sensemaking than otherwise necessary (cf., Zubuff, 1988; Schultze, 2000).

3.2 Data collection

The interpretive part of action case research needs data to work with and since the informants' own interpretations are best

captured in interviews, this method should be the primary source of such input (Walsham, 1995). However, critical voices have claimed that interview data is not a suitable foundation for design (cf., Fagrell, 2000). We have, therefore, in addition to semi-structured interviews, collected data also via observations, archival records, and focus groups. Such triangulation requires both time and human resources and besides the two authors, four master students were engaged in the fieldwork that stretched over 18 months. From the project start on June 1, 1999, six months were spent building a shared understanding of competence, discussing how IT could support competence management, and setting the project agenda. This was achieved through ten seminars or workshops, which included the authors, the master students, and project members from Volvo IT. The following six months were spent on designing, implementing, and evaluating two different systems. The master students were part of the team that prepared and carried out the implementation of the organization-chosen competence system (TP/HR) and they evaluated and studied the use of the prototype system (VIP), which was implemented by one of the authors. By following the development of these two activities closely, we gained a thorough understanding of capabilities and shortcomings of IT support for competence management in an organizational context.

User viewpoints from the TP/HR competence system were collected through 10 semi-structured interviews, which lasted between 45 minutes and one hour, with employees from different parts of the organization. These interviewees were selected to represent different organizational roles and positions and included management consultants, systems programmers, and personnel from the human resource (HR) department. The interviews focused on the topics of work practice, competence, competence development, and IT support for competence management. Key questions on these topics were followed by questions that depended on the answers of the respondents. All interviews were recorded and later transcribed. We also conducted ethnographic observations of the pilot users while entering competence data into the system and performing competence analyses. Besides interviews and observations, an important source of data was

archival records and project documentation. This data consisted mainly of strategy plans for competence development within Volvo IT and written material about technical aspects of TP/HR.

The prototype system (VIP), which was meant to contrast the TP/HR system, was an intranet application informed by previous research (see Stenmark, 1999; 2001) and by the tentative research results from the work with TP/HR. We conducted 16 semi-structured interviews with the prototype system users where each interview lasted approximately one hour. The interviewees again occupied different positions within the organization, ranging from non-technicians such as HR staff members, project managers, department managers, and financial controllers to technology watchers and systems programmers. Questions covered topics such as Internet and intranet applications, portals, information seeking, competence, and competence systems. The purpose was primarily to gain knowledge about how interest-activated technology, such as the VIP prototype system, could be exploited as well as developed to support competence management. During these interviews, the respondents were allowed to express and elaborate the aspects that were most relevant from their perspective. However, in order to test the stability in the interviewees' expressions, we encouraged them to reflect upon their assumptions. Again, all the interviews were recorded and transcribed.

The final six months, from June to December 2000, were spent compiling, analyzing, verifying, and writing-up the research results. During this phase, we engaged the organizational members in eight focus group meetings. These meetings, where the organizational members offered comments on and corrections to our interpretations, also played a vital part in our analysis efforts, as described next.

3.3 Data analysis

The data given by the informants should not be accepted at face value since it only represents their interpretations of the actions in which they are involved. When the researcher then reads the data,

it in turn is subjected to the researcher's interpretation of the respondents' words (Walsham, 1995). To transform these second-order data (Van Maanen, 1979) to useful insights is indeed a complex iterative and comparative process that requires the researchers to reflect also on their own theoretical assumptions.

The role of theory in interpretive studies may take one of three forms: as an initial guide to the study as such; as part of the data collection and analysis phase; and as a research outcome (Eisenhardt, 1989). The boundaries between these are obviously somewhat fuzzy. Since we did not enter the research field free of theory, this colored our initial approach. Likewise, our mission was not to test hypotheses but to gain knowledge, including theoretical aspects. However, our primary use of theory has been as part of the iterative process of data collection and analysis, as in Orlikowski's (1993) study of CASE tool adoption. Instead of contrasting two organizations, as in Orlikowski's work, we studied two different systems within the same organization. The initial theories, which were based on our previous work (Lindgren et al., submitted; Lindgren, 2002; Lindgren and Henfridsson, 2002), were applied to the TP/HR system data in an open-minded manner in order not to stifle "potential new issues and avenues of exploration" (Walsham, 1995, p. 76). Typically, this meant that we let the data itself suggest categories and concepts rather than imposing an existing scheme. This approach is similar to the open coding technique used in grounded theory (Strauss and Corbin, 1990). The TP/HR data were re-interpreted, re-coded, and re-categorized in dialogue with the project members until the categories covered all data and made sense to the practitioners. Out of consideration for the tentativeness of the pilot project, we chose to discard feature-related aspects and focus more on generic themes that were more likely to be generalizable. For example, we dropped integration of free-text and formalized competence descriptions and size-limitation of competence analyses since these obviously were system specific. The aspects of TP/HR that surfaced during this process were boiled down to competence mapping, competence evolution, competence input, and competence isolation. These aspects are further explained in the subsection presenting the TP/HR evaluation.

As suggested by Orlikowski (1993), we deliberately left this first round of analysis rather open and broad. When we next turned to the VIP data, we could be more targeted and seek categories more specifically related to systems design. The concepts derived from the TP/HR case were thus compared with and contrasted to those suggested by the VIP data, and as a consequence, the initial categories were revised and refined when it became evident that they the could not hold all data from the VIP prototype. For instance, the TP/HR study did not explicitly indicate a problem with the relationship between espoused theory and theory-in-use, which was evident in the VIP case. Having updated the set of concepts we returned to the TP/HR data to re-analyze. The progress of the data analysis work thus took place on several levels in an iterative and comparative fashion, until the concepts satisfactory explained both cases. The analysis work also included the use of focus groups, as proposed by Agar and MacDonald (1995), to learn how well ratified categories and aspects were by the group as a whole. The foci concentrated on were the concepts suggested by and derived from the data and the outcome of these focus groups resulted in us re-arranging and/or re-labeling some aspects or categories based on the group members' indexing. To give the reader a feel for the two systems and the attitudes of the organizational members, the next two sections present empirically grounded accounts of the systems in use structured according to the tentative analysis results. The final set of design implications resulting from the synthesized analysis of TP/HR and VIP are then discussed in a subsequent section.

4. Competence management at Volvo IT

Below, we present the Volvo IT site in Gothenburg, Sweden, and their competence management efforts. We focus our description on the TP/HR system and the results from the system evaluation interviews.

4.1 The site

This research was carried out from June 1999 to December 2000 at the Gothenburg office of Volvo IT, which is a Swedish IT service providing company within the Volvo Group. The Volvo IT site was selected basically for two reasons: First, Volvo IT was in the process of introducing and establishing more explicitly formulated competence management routines including IT support and did thus provide excellent opportunities for competence systems research. Second, one of the authors was employed at Volvo IT, which facilitated easy access in general and opportunities to intervene by implementing and deploying prototype systems.

Though being an IT company, the legacy from the manufacturing industry was evident. Volvo IT was primarily organized to meet the business requirements from its customers, which at the time mostly meant the other corporate companies. Furthermore, like many other large and dispersed organizations, Volvo IT had recognized the major problem regarding knowing who knows what. Accordingly, large investments were being made in both organizational arrangements and IT for supporting competence management. Moreover, Volvo IT planned to start offering their services also on the open market, which meant approaching customers outside the Volvo Group and thereby having to compete with external IT service providers. In such a situation, competence management became even more prioritized in order to take control over the internal competence.

At the time of research, Volvo IT had approximately 2,400 employees worldwide, and as many other large organizations with industrial connections it was rather hierarchically organized. A high degree of standardization was hailed as the optimal situation and its centralized mainframe operation, which had received several international awards for high efficiency and cost-effectiveness, was considered something of a role model. In contrast to the highly standardized mainframe environment, Volvo had a large and rather decentralized intranet. The intranet, consisting of over 700 web servers and approximately 750,000 web pages, was characterized by a bottom-up approach. Although less that 10% of the servers where “official”, i.e., administrated by the information departments, these servers hosted nearly 25% of the

web pages. Volvo IT's highly distributed and decentralized web-publishing policy, which de facto allowed their employees to publish whatever they considered worthwhile, resulted in many semi- or unofficial web servers. Despite this seemingly uncontrolled situation, the contents of these servers were first and foremost work-related and business-oriented.

4.2 The TP/HR project

As explained above, Volvo IT needed to initiate a number of activities in order to strengthen their competence management. One such activity was the TP/HR project, initiated in June 1999. This project had two main objectives: First, to identify a competence structure for Volvo IT that could serve as a foundation for the mapping of employees' competencies. Second, to implement the identified competence structure in the TP/HR system and to define a maintenance organization that on a regular basis keeps the TP/HR's structure updated and relevant. Although the first part turned out to be more complicated than Volvo IT had anticipated and in itself worth further research, we have in this paper focused on the TP/HR system and the process of maintaining it.

4.3 The TP/HR system

TP/HR was a commercial off-the-shelf module-based client/server system developed by Tieto Datema AB in Sweden. Running on a Windows 98/NT platform, TP/HR served as an interface between the user and an Oracle database server. This paper's focus is on the Education/Competence module and when we hereafter refer to TP/HR we mean this module only. The TP/HR system was implemented in February 2000 through a top down strategy where the competence structure was defined by management alone. Furthermore, managers were also responsible for the input of the employees' competence data. Volvo IT's organizational structure can be described as hierarchical and this was reflected in TP/HR's

closed system structure. While managers were authorized to see competence information about all their subordinates, employees in other positions could only see their own competence descriptions.

In Volvo IT's implementation of TP/HR, competence was divided into functional and technical skills. Functional skills referred to the work tasks an employee performs, e.g., Application/Infrastructure Development or Support, and measured how well the employee carried out the task. Technical skills were about the methods or techniques required by the work tasks, e.g., Programming Languages/Tools or Data Management. What Volvo IT called technical skill was thus what we normally would refer to as competence. The functional and technical skill categories, in turn, had their sub-levels and all this was grouped and ordered in a tree structure, as illustrated in Figure 1.

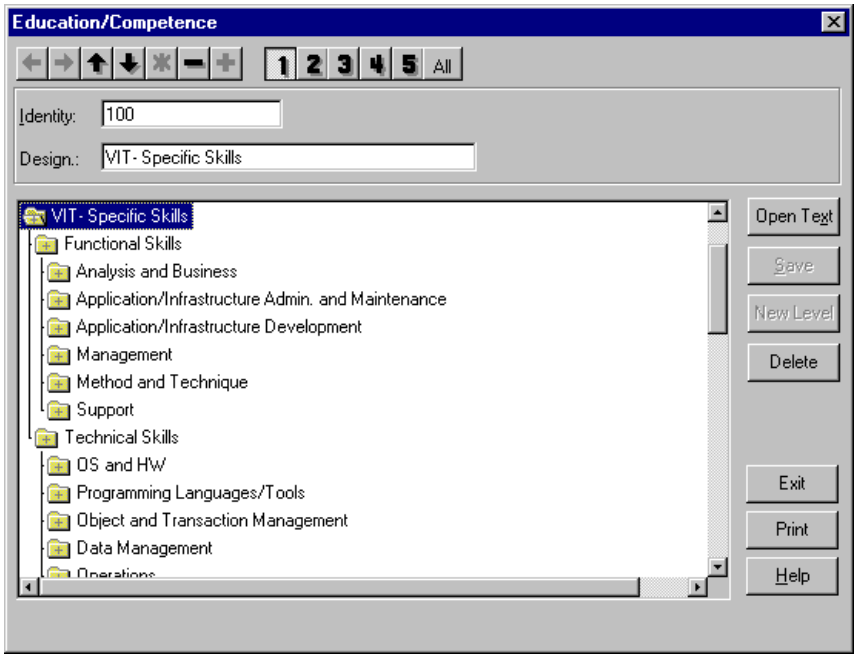

Figure 1: Portion of the competence tree structure in TP/HR.

Volvo IT implemented five levels of competence grading ranging from 1 (no competence) to 5 (expert competence). The search feature in TP/HR made it possible for management to search for employees holding a particular competence on a certain level, e.g., a java programmer on level 3 or above. Further, there were features for measuring employees' competencies status and for competence gap analyses.

The gap analyses were based on either an individual, a group of individuals, or a work task, and these analyses indicated the differences between existing and wanted competencies. If there is a difference between the existing situation and the future demand for a specific competence, there is said to exist a competence gap. More specifically, there were two types of gap analyses: Group analysis 1 showed how well the employees' competencies matched the given competence demands for each work task. Group analysis 2 indicated how critical competencies related to specific work tasks were distributed within a certain group. Volvo IT planned to use these analyses as a support for organizational activities such as resource and availability planning, internal and external recruiting, goal and personal development discussions, forming teams of employees, finding competence when manning assignments, and mission steering. Consequently, the TP/HR system was assumed to support Volvo IT in managing their competence in both a short and a long perspective.

4.4 Evaluation of the TP/HR system

In the previous subsection, we described technical data, features, and organizational aspects of the TP/HR system. Below, we report the four problematic aspects of TP/HR that emerged during the first round of analysis. These aspects are illustrated by quotations from the evaluation interviews.

4.4.1 Competence mapping

Volvo IT tried to implement a competence structure that was common to and accepted by the entire organization. To produce such a map, however, turned out to be a non-trivial task and required much more work and consideration than the project team had anticipated. A management consultant phrased:

> "We have competencies ranging from this more technical, like infrastructure and hardware, to soft systems developers such as management consultants and stuff like that. Consequently, it is a wide spectrum of competencies that we have within the

> organization. The difficult part is that some claim that their way of representing the competencies is the best. They claim they are so unique that they have to have this structure and these groups. Actually, it is not possible to do it differently."

Volvo IT's heterogeneous activity was difficult to map to a single competence structure since different parts of the organization had varying demands on what competencies should constitute the structure.

4.4.2 Competence evolution

Even if a competence structure could be agreed upon, it would not remain correct for long. The pace with which old competencies changed and new emerged made the mapping process even more difficult. A management consultant articulated this:

> "Earlier it was easier since there were few programming languages. Now the development is so fast. Yes, there are the fourth, fifth, and sixth generation. And individuals change as well; their competencies change over time. Things that people do today and did yesterday do not necessarily represent their aspirations for tomorrow."

Apart from alterations in the variety of competence within the organization that affected the structure per se, competencies and interests changed on an individual level as well. In order to cope with this evolution, Volvo IT established a maintenance organization for this purpose, but keeping the competence structure and the competence data up to date remained a burdensome task. In fact, the map always tended to be behind the reality.

4.4.3 Competence input

A system is never better than its content and this content has to be provided by someone. One HR manager touched upon the producer/consumer dilemma when discussing input of competence data to the TP/HR system:

> "TP/HR is a tool for management to keep track of the employees. But, there has to be a motivating factor for the

> employees to participate and express their competencies. They should not feel that they are merely parts of a passive register. In some way you have to be motivated to expose your competencies. Otherwise it is difficult to make this system work."

TP/HR was primarily designed to support management in activities such as recruiting, resource planning, and project steering. The individual employees, presumed to regularly provide accurate information about their competencies, did not get much in return and hence had no incentive for participation.

4.4.4 Competence isolation

In addition to the fact that the TP/HR system was fundamentally designed to serve management, the system was constructed in a way that counteracted the employees' commitment to the system. A management consultant commented:

> "TP/HR is hierarchically structured and closed. As an individual, you can see nobody but yourself. If I search for a certain competence, the system should support me in identifying the appropriate person. Such features are missing in the system. Instead, I have to talk to someone who is familiar with the employees' competencies. In any case, I can't use the TP/HR system for doing it myself."

Organizational position determines how an employee can use the TP/HR system. Managers were authorized to see every subordinate's competence description, while organizational members in other positions could only see their own descriptions. Consequently, these employees could not use TP/HR in order to find people with a specific competence.

When Volvo IT decided to implement the TP/HR system they did not foresee the problematic aspects above described. Instead, these emerged during the system implementation and while evaluating the system. Based on the troublesome work with creating a competence structure and keeping the structure relevant and updated in combination with the problems regarding competence data input and lack of commitment among the employees, the organization realized the potential danger of the

TP/HR system becoming an archive that would passively store increasingly inaccurate competence descriptions. This insight offered an opportunity for our research team to introduce and evaluate a technology, which, by being based on interest-driven actions instead of formalized representations, contrasted the basic tenet of TP/HR.

5. The recommender system approach

The rationale behind recommender systems (RS) (Resnick and Varian, 1997) has been the fact that we in everyday life often rely on others with more experience to provide us with recommendations. Such collaborative filtering (Goldberg et al., 1992) based on the "word-of-mouth" (Shardanand and Maes, 1995) is spontaneously performed by humans in order to hint friends and colleagues about what is believed to be things of interest. The aim of early RS was thus to augment this social process by aggregating recommendations from more people that you would normally interact with, thereby increasing domain knowledge and minimizing bias. The focus on connecting people with objects, e.g., books, films, music, or web pages, which characterized early work, has continued to dominate also in more recent group-related research (cf., Grasso et al., 1999). The incentive-related problem faced by the early developers (i.e., we like to receive recommendations, but why would we provide any) has been solved in part by using implicit recommendations. In such an approach, rating is obtained by methods other than obtaining it directly from the user (Oard and Kim, 1998; Claypool et al., 2000) and one alternative could be to engage personalized agents to perform the recommendations.

The fact that people share a certain taste or interest has not explicitly been used by RS to connect the users with each other. Two people, perhaps even in close proximity to each other, may be working with the same problem without being aware of each other and without knowing that they are reading the same literature. However, when both these individuals are using the same

recommender system, it is possible to automatically detect similarities between the two as represented by their agents or profiles and introduce these to each other (Foner, 1996; Stenmark, 1999). In line with this reasoning, RS have recently been employed to locate and leverage expertise within organizations (McDonald and Ackerman, 2000) and to find and communicate unarticulated knowledge (Stenmark, 2001). In the latter case, the incentive problem of providing knowledge explicitly is addressed by utilizing the spin-offs from recommending web documents. Armed with this knowledge and tentative indications from the TP/HR evaluation, the VIP system prototype was implemented and presented as a contrasting competence system.

5.1 The VIP prototype

VIP was an agent-based recommender system built on Autonomy's AgentWare platform (Autonomy, 2000), which is a commercially available tool that uses neural networks and advanced pattern-matching techniques to find similarities between texts. The AgentWare toolkit provides the developer with a Dynamic Reasoning Engine (DRE), which is the proprietary neural network "black box" and a set of Application Programming Interfaces (APIs). On top of this, the developer is free to code the application and the user interfaces as wanted and to include or leave out whatever features he or she decides upon.

In our implementation, VIP allowed the users to define information agents that searched an index database for intranet documents matching the users' interests. Each user could define several agents targeted on a particular interest area. The interests were defined in a free-text natural language sentence from which the system created an internal digital representation. The search results from each agent were displayed in a simple list similar to those generated by most search engines, and by clicking on the associated hyperlinks the actual documents were retrieved. When the user had read and identified one or more of the returned documents as indeed relevant, the user could provide the agent with explicit feedback by marking the document(s) and clicking the

retrain button. The digital signature of the agent was then merged with the signature(s) of the selected document(s) and the result became the new signature, replacing the previous one. From a user's point of view, the motive for using a recommender system is to receive relevant and targeted information as effortless as possible. It is therefore in the users' own interest to set up and cultivate their agents to be as good as possible.

In compliance with an earlier version of the system (cf., Stenmark, 2001), we designed the VIP system to include a Community feature, i.e., Find Users with a Similar Interest, which was intended to enable users to locate colleagues with similar information needs or interests. When this feature was invoked, the profiles of the user's agents were matched with the profiles of all other agents resulting in a list of users who had defined a similar interest. This list displayed the name, company, department, geographical location, telephone number, and email address of the matching users. The intention was to make the users aware of each other's presence and thus facilitate the emergence of informal networks and online communities.

So far, this has all been standard RS procedure. Our research interest is, however, not in recommender systems per se. We simply find RS to be a useful vehicle to study phenomena related to knowledge applied and enacted in work practice (Stenmark, 2001). In addition to the traditional RS features described above, we therefore furnished the VIP prototype with a Find competence button. This feature, illustrated in Figure 2 below, enabled the VIP users to enter a natural-language text describing a specific interest. VIP would then list all users with matching agents, i.e., all users who had agents actively searching for information related to the specified interest. Whereas the Community feature returned the names of those who shared your interest, the Find Competence feature could be used to find a person with an arbitrary interest. To label this feature Find Competence was a deliberate provocation intended to cause the organizational members to reflect. In contrast to general competence systems such as TP/HR, which rely on in beforehand-codified database records of formal competence, the VIP prototype

based its results entirely on interest-driven and dynamically detected actions of organizational members.

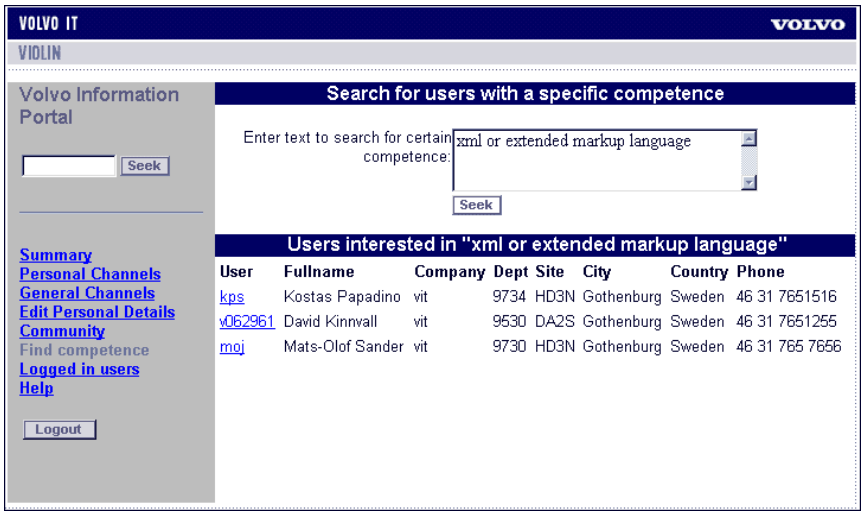

Figure 2: Output from the Find Competence feature.

5.2 Evaluation of the VIP system

When interviewed about how they used the VIP system prototype, the respondents discussed their experiences either in terms of existing usage areas or as thoughts regarding possible future enhancements of the system. Below, we report our findings grouped according to these categories.

5.2.1 Existing VIP usage areas

Some of the interviewees were aware of or even acquainted with the TP/HR system and often used this circumstance to describe the contrast between the two systems. Some users meant that while TP/HR presents a rear-mirror view of competence, VIP gives an idea of competencies applied on an everyday basis, as the features Find Users with a Similar Interest and Find Competence were based on employees' actions in form of information seeking. The following HR staff member discussed VIP as a tool to find organizational members not based on the formal representation of their competence but on their actions:

> "TP/HR is a lot more about order and to be in control of the situation. And to know what we have and the level of education of our co-workers; how many of these and how many of those. Then this [VIP system] is something else. It's what people do on an everyday basis. It's about for what they use their skills. It's sort of the next step."

The VIP system, by reflecting implicit roles, could also contribute to the creation of networks or communities of practice within the organization. The respondents considered the building of such informal networks important since they are a prerequisite for cooperation. However, the organizational members' ability to actually be able to do this, according to this project manager, is incorrectly taken for granted:

> "[The Find Users with Similar Interest feature] is very interesting. I see this as a very useful feature; as an enabler for building [human] networks. It is interesting to be able to find colleagues who are interested in the same things. Because our main problem here is that there are people working with similar things everywhere and you don't really find them. When we started the project manager group we thought that since [human] networks have existed since the dawn of times, there must be a whole bunch of people who know how to build them. But, it turned out that there were not."

This project manager saw how the VIP system could function as a community enabler, and other respondents shared this view. Moreover, there were also interviewees who pointed to VIP's potential as a strategic tool. For instance, one project manager expressed it as follows:

> "If you can utilize people's interests and put that into action in their work, you gain momentum […]. Should you start a new job function and you don't know if anybody in the organization is interested in working with this, then it might be interesting [to use the Find Competence feature]. Because you don't walk around asking all 400-500 managers if they have someone who would be interested in working with this."

With the results from the Find Competence feature as a point of departure, the above interviewee saw the VIP system as a useful tool when planning the application of the organization's competencies. In addition, one technology watcher highlighted the

possibility to use VIP to visualize the development of different competencies over time:

> "The most powerful thing I see is a mapping opportunity. If one could use this tool there is a possibility to map out what is currently happening and to get a quick feeling for where people are heading and what they want. And where they have been, obviously, but that is easy. It is the future that is the tricky part."

Alongside facilitating analyses of existing and emerging competencies, the respondents also envisioned VIP as a tool for detecting competence gaps.

5.2.2 Possible future VIP enhancements

Regarding how the VIP system's design could be improved in relation to competence management, the interviewees discussed several areas related to both managerial and non-managerial activities. The two features Find Users with a Similar Interest and Find Competence offered organizational members the possibility to find out more about other individuals within the organization, e.g., name, organizational belonging, position, and telephone number. Several respondents expressed desire for more detailed information than was currently offered in VIP:

> "[In VIP] there are only email addresses. Most of the employees have some form of personal presentations on the intranet. So, had there been links to those pages one could have seen what these persons had created on the intranet. It could be a photo, where they can be found, and what areas they work with. Or information that they have authored."

Access to a deeper level of personal information is important since the establishment of new contacts depends heavily on trust and compatibility, as this department manager pointed out. More personal data, be it adding a photograph, a link to a homepage, or information about current and previous assignments, can be a means to facilitate cooperation that cuts across traditional organizational lines, according to the department manager. A systems programmer suggested an additional way:

> "I am not able to access the [results from someone else's] agent. The fact that [this person is returned by the Community feature] indicates that she has the same interests as me, but the question is how to take this one step further so that this [VIP system] can turn into a forum where individuals share their interests, too. Not just that their search results has a point in common."

Making it possible for individuals to see the results of other organizational members' agents would support the employees in competence identification, this respondent argued. Besides accessible agents and deeper level of personal information, links pointing to formal competence descriptions was a desired feature. Since VIP handles unstructured information and does not distinguish between different levels of competence, the drawback is that the users must be able to read between the lines and draw their own conclusions about individuals' competencies. A different but related problem is that an employee who has not defined an agent within his or her area of competence cannot be identified as competent in that area. An HR staff member explained:

> "I may need information on something I am interested in, but my competence is recruiting and people want to find me for that reason. But, I do not express recruiting competence in this system [by training an agent]. So, there can be a gap [between my agents and my competence]. You can end up finding people who are only interested and not competent. Often, interest indicates competence, but not always."

While the discussion so far has concentrated on enhancements related to non-managerial activities, the following deals with how to support management work. The information in VIP is not compiled or aggregated, which makes it difficult to spot organizational trends. One user said:

> "I can see other people's agents and find things out, but I would like to have a picture of the number of users searching within a particular area. [It would be useful] to get a map of how many users look for a certain topic, not who looks for what."

If information could be aggregated more automatically, it would be easier to plot the overall direction of changing interests. Such a comparison would give management a quick and flexible overview

of the organization's status, this technology watcher claimed. Other respondents had similar ideas regarding this type of aggregated information-based analyses:

> "Information that would be interesting to find here is some kind of analysis of the persons' agents within an area. If you have two different agents in the same area, then you're really interested. How many [agents you have] and even things like how much time you have spent building your agent, how often it is updated, and that kind of information, is really very interesting."

A compiled and aggregated picture of the number of agents searching a certain area and how frequently they are updated would show, according to this interviewee, how different groups of individuals use their competence in practice. Furthermore, the users saw the lack of historic data in VIP as a problem. A technology watcher discussed this:

> "The drawback of these agents is that they lose their historic information since they keep changing all the time. Therefore, you would like to take snapshots of the competence development. Historic information is always interesting to get the direction. Because you know for a fact that a certain interest group has a certain appearance right now, but four years later it has changed and you want to be able to see that there has been some development."

According to this technology watcher, management would need information about the organization's past as well as present competence status, and therefore features to store and handle historic information are important.

6. Discussion

Today's organizations have a need for quick overall pictures of the present situation as well as to be able to detect trends and directions with regard to changes of the organizational members' competence. Although this particular study has focused on how Volvo IT decided to implement the TP/HR system in order to be

able to conduct this type of competence analyses, the problematic aspects that arose are in no way unique to Volvo. We have noticed identical difficulties, i.e., competence mapping, competence evolution, competence input, and competence isolation, in other Swedish organizations (cf., Lindgren and Henfridsson, 2002). This, we argue, increases the generality of our findings.

In this paper, we have illustrated how the VIP prototype contrasts the TP/HR system in two fundamental ways. First, we have shown how traditional competence systems such as TP/HR describe competencies according to predefined categories. The advantage, once the competence structure has been established, is that it is easy to search for members with a specific competence. The problem, however, is that such a structure can never fully be implemented since it describes a changing world. New competencies emerge, old ones disappear, and individuals change and develop their competencies more frequently than the system is updated. Our experience from this 18-month study is that maintenance of traditional competence systems is very laborious and consequently done very infrequently, which de facto makes TP/HR a "static" system with more of a historic view of the competencies. What people did yesterday does not necessarily express their ambitions for today or tomorrow (cf., McDonald and Ackerman, 1998). Consequently, TP/HR, at best, provides limited support for competence identification. One of the advantages with the interest and action based approach is that the organization can begin to find competencies as soon as they start to emerge. This is particularly important today, when complex and non-routine issues emerging from rapidly changing environments require the application of knowledge and competence that is not known by a single individual (cf., Tsoukas, 1996).

Second, we have also shown that a bottom-up approach to competence mapping, which starts with the actions of individual organizational members, can be used as alternative to a predefined top-down categorization. Although we stress the importance of the commitment of the individuals, the VIP approach does not depend on any particular individual. In contrast to a system such as TP/HR, which has to be maintained by some administrator, a recommender system approach is built up by the efforts of all

organizational members collectively. On the one hand, the focus of some researchers, e.g., members of the CSCW community, has largely been on the individual and small group level. Consequently, the results may be difficult to apply on or to scale up to an organizational level (cf., Greif, 1998). Researchers within the IS field, on the other hand, discuss theories and applications from an organizational point of view, but tend to neglect or marginalize that organizations consist of individuals and that success on the organizational level often requires commitment on the grass-root level. In this research, we have combined these two approaches by studying individuals and small groups to gather insights that have enabled us to draw organizational implications in relation to the design and use of competence systems for tomorrow.

As we show elsewhere, interest makes a plausible substitute for competence, especially so for competencies of tomorrow (Lindgren et al., submitted). In this paper, we have therefore inquired into the consequences of such a view and examined how a system based on these premises can be exploited and developed. However, we do not advocate a total abolishment of traditional competence systems since, as is evident from our analysis, there are certain aspects worth preserving. Instead, based on lessons learned from both traditional and action-driven competence systems, we offer five design implications for future competence systems based on interest-activated technology.

6.1 Implication 1: Search for action-based competence

Competence management systems of the future should include features for locating people based on what actions they perform on the network. This could include actions such as creating, annotating, accessing, printing, bookmarking, or searching for documents and web pages, sending, printing, or replying to emails, querying databases, or participating in chat forums or discussion groups. Competence systems on the market today merely store formal descriptions of what work tasks or roles the employees have been assigned by the organization, while jobs often require us to act outside such pre-established definitions (Stenmark, 2001). An

action-based system has the potential to reflect the role an employee has de facto assumed. In a project organization, employees' work tasks or roles often vary from one project to another, again making it difficult to keep an explicit record up to date.

6.2 Implication 2: Awareness of communities of interests

Tomorrow's competence systems should support the establishing of informal networks. Relying on the same mechanisms as above, this design feature is not intended to locate experts or possible project members, but to make individuals with similar interests aware of each other. Facilitating communities of practice by allowing users to find colleagues with similar roles and interests in turn supports sharing of competence between individuals (cf., Brown, 1998). These kinds of organizational activities are not supported by today's competence systems, where employees in non-managerial positions typically only can see their own competence descriptions (Lindgren and Henfridsson, 2002). However, though awareness is a necessary condition for social networking, awareness alone is not sufficient. It seems that a certain threshold has to be reached before a person goes from being aware of another individual to actually contacting him or her.

6.3 Implication 3: Deeper level of personal information

It is important for the next generation competence systems to include personal details about the employees, and to let these data be accessible to everyone in the organization. As was indicated in the interviews, the threshold discussed above will not seem quite as high if more knowledge about the person in question is available. A deeper level of personal information would increase the sense of familiarity and thereby make it easier for organizational members to contact each other for information exchange, competence sharing, and building of communities (cf., Davenport and Prusak, 1998). Another important aspect would be to make

available more information about the signaling artifacts themselves. By making details such as the updating or visiting frequency available, the users would be able to derive the owners' level of engagement.

6.4 Implication 4: Formal descriptions of competence

Competence systems should pair the dynamic information and the personal details advocated above with links to historical records and formal descriptions of achievements and competencies. As pointed out by McDonald and Ackerman (1998), most recommender systems do not distinguish between different levels of knowledge, which makes it impossible to tell an expert from a novice. An action-driven competence system would thus benefit from including also more formal competence descriptions, e.g., a CV. Such information would not only help eliminate possible misunderstandings and enhance the perception of an individual's background, but also provide the historical coupling that is otherwise missing in ephemeral systems. An alternative approach touched upon above would be to make salient the duration of a user's interests, thereby indicating whether or not the user is new within the field.

6.5 Implication 5: Aggregation of competence data

Future competence systems should be able to aggregate and visualize the competence information known to the system. Today's competence management systems are primarily designed for managerial purposes. Hence, the systems incorporate a variety of features for competence analyses, facilitating organizational activities such as recruiting, resource planning, and mission steering. To be of strategic value, action-based systems must also have these abilities, and there are ways to achieve this. For example, by analyzing the employees' information-seeking activities, management can become aware of which competence areas attract the attention of the organization's members at a

specific moment in time. By saving such "snapshots" at regular intervals, it would be possible to take a bearing on the direction of different competence groups within the organization. The difficulty is that the information now has to be compiled and aggregated manually. Mechanisms should therefore be provided to retrieve, aggregate, and visualize this information automatically. This process would give management a tool for a quick and flexible overview of the organization's status and direction. Such features would help facilitate continuous competence development in order to avoid competence traps (cf., Levitt and March, 1988). Aggregation of interest profiles not only increases the strategic value of the information, but also helps preserve integrity by de-individualizing the information.

7. Conclusions

Through our 18-month action case study, we have been able to identify four seemingly general problematic aspects of traditional competence systems (competence mapping, competence evolution, competence input, and competence isolation). These difficulties stem from the fact that the systems available on the market are de facto competence silos, which passively store competencies rather than activating them.

Although our prototype system was far from perfect, it served its purpose to illustrate that such technology is useful within the area of competence management. Building on the lessons learned with both the TP/HR system and VIP, we conclude that future competence systems based on interest-activated technology should provide features to facilitate:

- Search for action-based competence.
- Awareness of communities of interests.
- Deeper level of personal information.

- Formal descriptions of competence.
- Aggregation of competence data.

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Sixth paper[22]

Facilitating the Adoption of a New Competence Systems Agenda: Applying Adaptive Structuration Theory in Action Research

Abstract

This paper examines and demonstrates how competence systems can be designed to facilitate their adoption in organizations. The authors argue that successful competence application and development require a competence systems agenda more suited for knowledge work practice. The use of adaptive structuration theory in an action research study of adoption processes in six Swedish organizations indicates that existing competence systems are virtually counter-productive to their intended purposes. While competence systems are found to be espousive, reproductive, isolative, and rigid, the joint collaborations between the academic research team and the practitioners in the investigated organizations show that the practical competence problems existing in knowledge work practice require transparent, interest-driven, media-rich, and flexible systems. The action research study consisted of two action research cycles. As a result of researcher-practitioner intervention within the realm of existing systems, the first action research cycle identified a number of competence systems adoption barriers. On the basis of the learning outcome of this intervention, a second cycle was designed with the ultimate

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research goal of overcoming the identified adoption barriers by formulating new design principles for competence systems. Two organizations were selected as "organizational laboratories" in which two competence systems prototypes were tested and evaluated in actual knowledge work practice. The findings of this paper have implications for a variety of clients such as practitioners, action research initiators, research sponsors, and students. On a general level, the paper illustrates that action research can be a promising methodology for producing consumable research with the potential to have an impact on the future direction of our technology-induced society. To exploit this potential, however, the information systems community has to identify ways to design action research studies with the capacity to simultaneously contributing to knowledge and practice. This paper presents and clarifies one such way.

1. Introduction

The design, implementation, and use of knowledge management systems have received much recent attention within the practice of information systems. This attention covers a whole range of different knowledge management systems including document repositories, data warehousing, collaborative filtering, intranets and search engines, yellow pages of experts, expertise profiles and databases, and electronic discussion forums (Hahn and Subramani, 2000). The focus of this paper is on a particular type of knowledge management system called competence systems. Using Hahn and Subramani's (2000) classification of different knowledge management systems, competence systems can be referred to as advanced "expertise profiles and databases", which describe and present measures of individual competence within areas such as programming skills and project management experience. By providing competence overviews, the mainstream competence system is used by, for instance, account managers and HR managers for facilitating staff allocation and competence

development in organizations such as consultancy firms, software developers, and information technology (IT) support organizations.

There exist few empirical studies of the uptake and usage of competence systems in organizations (for two exceptions, see Lindgren and Henfridsson, 2002; Lindgren and Stenmark, 2002). Reviewing the general literature on knowledge management, however, empirical studies show that most knowledge management systems fail when they meet the knowledge work practice found in organizations (see e.g., Fahey and Prusak, 1998; Newell et al., 1999; Schultze and Boland, 2000; Storey and Barnett, 2000). Despite reasonable organizational change strategies and seemingly sophisticated technologies, the current knowledge management agenda seems unable to account for the adoption barriers existing in organizational settings. This inability becomes a problem in light of the heavy spending on knowledge management systems in business organizations, without any obvious productivity gains.

In this paper, we examine and demonstrate how competence systems can be designed to facilitate their adoption in knowledge work. The paper draws on an action research study conducted as a joint collaboration between academics at the Viktoria Institute in Gothenburg, Sweden, and practitioners in six different user organizations (EHPT (former Ericsson/Hewlett-Packard Telecom), Frontec, Guide, Volvo Car Corporation, Volvo IT, and Volvo Truck Corporation). Concurring with the tenets of action research (Baskerville and Wood-Harper, 1996), this joint study represented a mutual learning effort intended to contribute to both the acquisition of scientific knowledge and practical problem solving. Following Susman and Evered's (1978) classical definition of the action research cycle, the action research study consisted of two full cycles including diagnosing, action planning, action taking, evaluating, and specifying learning. The first cycle examined how to develop and implement IT support for competence management in organizations. This cycle involved all organizations mentioned above and covered five different competence systems (three standard software packages and two in-house developed systems). The learning outcome of this cycle was the identification of a number of different adoption barriers, which inhibited successful adoption of the competence systems in the knowledge work

practice of the investigated organizations (Lindgren and Henfridsson, 2002). On the basis of this learning outcome, a second cycle was initiated together with two of the six organizations where the ultimate research goal was to overcome the identified adoption barriers by formulating new design principles for competence systems. These design principles were used for designing two competence system prototypes, which were later implemented for evaluation in the real context of each of the two organizations.

While action research has been linked to systems theory from its inception (Baskerville and Wood-Harper, 1996, p. 237), this paper draws on adaptive structuration theory (DeSanctis and Poole, 1994) for informing the general pursuit of facilitating competence systems adoption. Since the early 90s, structuration theory has been an accepted theoretical base for understanding the relationship between IT and organizations (Barley, 1986; Jones, 1999; Orlikowski and Robey, 1991; Orlikowski, 1992), and the theory has lately been adapted for use in action research settings (Rose, 2000; Rose and Lewis, 2001). Adaptive structuration theory, as a variant of structuration theory, is useful in action research because its constructs provide links between inherent properties of the IT artifact and the social setting in which the technology is implemented and used. In action research settings, such links are important as bridges between the knowledge orientation of social theories and the pragmatic problems that practitioners experience in their day-to-day activity. However, few social theories brought into the information systems field can be said to provide the fine-grained framework needed for understanding the complex relationship between IT and its social context (Kling, 1991; Monteiro and Hanseth, 1995). Because these theories have been developed outside the IS context, they tend to be weaker in theorizing the IT side of this relationship (Orlikowski and Iacono, 2001). Adaptive structuration theory can be seen as an attempt to adapt structuration theory in order to partly overcome this problem.

There are at least two reasons why the research presented here is important. First, there seems to exist a misfit between the knowledge work conducted in organizations and the underlying

view of knowledge in existing knowledge management systems (Bannon and Kuutti, 1996; Ackerman and Halverson, 1998; Schultze, 1999, Swan et al., 1999). While knowledge work literature portrays knowledge work as a dynamic undertaking that involves intersecting elements such as action, human sensemaking, and intellectual challenges (Alvesson, 1993; Blackler, 1995; Boland and Tenkasi, 1995), existing competence systems basically convey a static view on knowledge. This paper asserts that this gap is problematic and needs to be resolved. On a general level, we suggest that competence systems need to be designed to better reflect the dynamic nature of knowledge work. In order to do this, however, it is important to produce a better understanding of how this dynamics can be conceptualized and implemented in actual competence systems. In making this claim, we subscribe to the recent call for more technology-specific information systems research (Monteiro and Hanseth, 1995; Dahlbom, 1996; Orlikowski and Iacono, 2001), which basically builds on the observation that IS research seldom relates the contextual issues discussed with the actual nature of the IT artifacts studied. This paper intends to make sense of both sides of the complicated relationship between IT and social context by operationalizing the general tenets of adaptive structuration theory and implementing these by means of two prototypes tested in the real-life setting of competence systems adoption.

Second, the recent debate about the relationship between academic rigor and practical relevance in IS research calls for reflection over the criteria by which research should be valued (see e.g., Benbasat and Zmud, 1999; Lyytinen, 1999). We subscribe to Robey and Markus's (1998) view that it is not only possible but also necessary to overcome the widely assumed tradeoff between rigor and relevance. In this paper, we hope to demonstrate that academic rigor and practical relevance can be combined by using action research. Action research can make the research output consumable to a variety of clients such as academics, practitioners, research sponsors, and students. As Robey and Markus (1998) recommend, the research presented here is partly sponsored by practitioners (by means of Viktoria Institute partnerships and time invested). Practitioner sponsorship can be a

valuable mechanism to ensure that the research is pursued in a direction that is deemed valuable for practitioners. In addition, and concurring with Robey and Markus's (1998) recommendation to adopt new models of research, the research here applies a social theory with high explanatory power to a practical problem with high relevance for the organizations involved. In this regard, our research effort should be evaluated on the basis of its ability to present a practical solution coinciding with a reasonable and justifiable explanation by the theory used.

The remainder of this paper is structured as follows. Section two provides the related literature on IS adoption in organizations, a presentation of the theoretical framework used, and a summary of our theoretical outlook in this paper. Section three describes the research strategy and methodology used, while section four reports the first action research cycle. Section five describes the second action research cycle, section six analyzes and discusses what can be learned from the two action research cycles, and section seven concludes the paper.

2. Theory

2.1 Information systems adoption in organizations

Over the years, the relationship between IT and organization has been a core issue for information systems scholars. Many of the recurring problems in business as well as non-profit organizations relate to this relationship and much effort is therefore invested in developing theories, methods, and best practice case studies with which one can understand its tenets. Organizational uptake and adoption of information systems is one target of these efforts and is the subject of this paper.

There is a considerable body of literature on information systems adoption in organizations (see e.g., Ciborra and Lanzara, 1994; Hanseth and Monteiro, 1997; Holmström and Robey,

submitted; Orlikowski, 1992, 1996b; Walsham, 1993). In following Orlikowski (1992), one can say that this stream of research developed, in part, as a complement to models such as the technological imperative and the strategic choice ones. While these latter models provide valuable historical accounts of the design and use of information systems, they cannot fully account for the contradictory consequences (c.f., Robey and Boudreau, 1999) that the increasingly intertwined nature of IT and organization tends to have in the everyday work of modern organizations. New accounts are therefore needed, not least in view of the technically sophisticated and well-planned information systems that nevertheless fail (Sauer, 1993) when they meet the power struggles (Markus, 1983), learning barriers (Henfridsson and Söderholm, 2000), and incentive systems (Orlikowski, 1996a) that real-life organizations possess. In efforts to overcome these obstacles, it has therefore been necessary to find and develop useful theoretical frameworks with which to understand the structures and behavior that shape the use of IT in organizations.

There are at least three theoretical frameworks that have been recognized as useful candidates for understanding information systems adoption processes in organizations. First, actor-network theory (Akrich and Latour, 1992; Callon, 1991, 1994; Latour, 1987) is a theoretical perspective that has attracted recent attention for understanding the dynamics of information systems adoption (see e.g., Monteiro, 2000; Walsham, 1996). Hanseth and Monteiro (1997) provide, for instance, an analysis of how certain behaviors can be “inscribed” into large and complex information systems of infrastructure-like character. These inscriptions are the results of “translation” processes, where the interests of particular actor groups become embodied in the technology as the systems development process unfolds. The authors illustrate this phenomenon by describing the integration of EDIFACT in Norwegian healthcare and they show, for example, how barriers to end user involvement were inscribed into this particular system by the whole range of heterogeneous elements surrounding the IT initiative. A key contribution of actor-network theory to the field of IS adoption is its highlighting of technology

itself as an important actor beyond any single stakeholder's control.

Second, another sub-stream of the information systems adoption literature can be described as the interpretivist perspective. This perspective asserts that the social context in general, and human sensemaking in particular, largely influence the success or failure of information systems in organizations. Ciborra and Lanzara (1990, 1994), for instance, argue that systems development can be best described as the process of inquiring into the formative context of a social setting, i.e., "the pre-existing institutional arrangements, cognitive frames and imageries that actors bring and routinely enact in a situation of action" (1994, p. 70). Because the systems development process cannot be separated from the surrounding social context, the design and use of IT is best understood as a sensemaking process where organizations need to engage in what the authors refer to as "designing-in-action". In short, Ciborra and Lanzara (1994) provide an interpretivist perspective on information systems adoption in which the focus is on the processes by which people make sense of technology in action. Orlikowski and Gash (1994) outline another interpretivist perspective on how to understand information systems adoption. In doing this, they introduce technological frames as a notion intended to assist researchers and practitioners in identifying and analyzing the underlying assumptions, expectations, and knowledge that different key actor groups have about technology. The authors argue that the assessment of the technological frames of particular actor groups, such as managers, systems designers, and users, facilitates the prediction of potential difficulties and conflicts around a particular introduction of an information system. A successful adoption of an information system in an organization, they assert, requires a certain congruency between the technological frames of key groups, so that unnecessary conflicts and difficulties (such as consequences of different understandings of the information system) are avoided. As another illustration, Henfridsson (2000) observes how the adaptation of an email and conference system resulted in the reinforcement of already existing communication patterns. Relative to the institutionalized and historically grounded professional

virtues of social workers, the overall intentions of the system to enable vertical integration and promote internal information exchange were weak triggers of innovative use. The virtue of making a difference for disadvantaged people, which lies at the heart of social workers' professional identity, was much more influential in how the system was adopted in the department. Because administrative work has always been considered a puissance to the caring side of social work, the staff was very alert to adopt features of the system that decreased the administrative workload, while other opportunities remained unnoticed. In sum, a key contribution of the interpretivist perspective to the field of information systems adoption is that it reveals how human interpretation influences the outcome of the design and use of information systems.

Third, Barley (1986), Orlikowski (1992), Orlikowski and Robey (1991), and Walsham (1993) offer structurational accounts for information systems adoption. Structuration theory (as it is used in information systems research) posits that IT both enables and inhibits human action. Drawing on the work of Giddens (1979, 1984), these accounts use the notion of structuration as a way of capturing the process by which structural properties (in these cases, instances of IT use) are used and re-produced in social action. As an illustration, Orlikowski (1996b) notes how the adoption of the groupware technology Lotus Notes™ in a management consultancy resulted in using it as an individual productivity tool, rather than as a technology for collaboration and communication. It turned out that existing reward systems and the "up-or-out" culture were obstacles to adopting Notes as anything other than a single-user application. Expressed differently, in the flow of everyday work, existing structural properties restricted individuals from applying the technology for group work, while these properties, at the same time, enabled them to exploit it for reinforcing individual productivity. A key contribution of structuration theory is that it provides a balanced view of how the interaction between human agency and structural properties is carried out in the actual process of designing and using information systems.

A general lesson learned in the information systems adoption literature is that successful adoption processes require a good match between the system characteristics and organizational sources of commitment and incentive. While this lesson is less obvious in actor-network theory in that it partly questions the distinction between the social and the technical, both interpretivist and structuration theory clearly posit that this matching is necessary. In the interpretivist perspective, it is considered important that the technological frames match the systems characteristics (in this context, it is important to note that discrepancies between systems and interpretations of these systems can sometimes be important sources of innovation) so that the meaning enacted by a user is supported as much as possible by the system characteristics. Structuration theory, for its part, views successful information systems adoption as the successful integration of IT in the ongoing process of structuration, where the design and usage of an information system both enable and restrict certain types of human action. While the general wisdom in the information systems adoption literature is rather straightforward, it is, however, unclear how a practitioner can use this body of knowledge in an effort to manage information systems adoption so that the sought after match is achieved. This problem is partly associated with the relative absence of analytical distinctiveness, and empirical sensitivity to the role of technology, in existing frameworks (Monteiro and Hanseth, 1995; Orlikowski and Iacono, 2001), but it also depends on their general exclusion of prospective outlooks. While subscribing to the general ambition to theorize the fit between system characteristics and organizational sources of commitment and incentive reflected in the theoretical perspectives reviewed above, we specifically apply a variant of structuration theory, namely adaptive structuration theory (AST), to understand the adoption of competence systems in organizations. This choice can be traced to the fact that this theory is just as specific about technology as actor-network theory is claimed to be (c.f., Monteiro and Hanseth, 1995; Walsham, 1996), while it also offers a promising platform for developing a prospective approach by means of blending its conceptual strength with the action research methodology. In the next section, we describe adaptive

structuration theory (AST) as a useful alternative for understanding and ultimately improving the practice of competence systems adoption.

2.2 Adaptive structuration theory

AST (DeSanctis and Poole, 1994) is both a theory and a methodological strategy for theorizing and researching the adoption and use of IT in social settings. Drawing on Giddens' structuration theory (1979, 1984), the theory offers a fine-grained framework with which to analyze how social structures are produced and re-produced when IT is adopted in work environments. AST complements the more general orientation of other applications of structuration theory (Orlikowski, 1992, Orlikowski and Robey, 1991, Walsham, 1993) by providing a detailed and practical account of micro-level adoption aspects of structuration in information systems development and use. While structuration theory has experienced a growing acceptance and has been applied in a variety of contexts, there are still only a limited number of empirical studies informed by the theory. AST, as a variant of structuration theory, confirms the broader picture in that it is widely cited in recent discussions of the use of structuration theory (see e.g., Rose and Lewis, 2001), but nevertheless seldom applied empirically. While critiques of structuration theory suggest that the theory is too general and abstract (Ciborra and Lanzara, 1994; Monteiro, 2000; Monteiro and Hanseth, 1995) for empirical analysis, we find AST particularly useful for tracing processual aspects of information systems adoption. Subscribing to Orlikowski and Iacono's (2001) call for more technology-near information systems research (see also Monteiro and Hanseth, 1995), we also find AST to be specific about the role of technology in the social shaping of information systems adoption processes. This usefulness is a result of both its analytical distinctiveness and, perhaps even more important in action research settings, its practical applicability in researcher-practitioner relationships.

AST's central concepts, structuration and appropriation, are both examples of concepts that can assist the information systems

researcher in better understanding how information systems such as ERP systems, group decision support systems, and knowledge management systems are actually incorporated into the work setting and practices of modern organizations. Structuration is the overall process by which social structures are produced and re-produced in social settings. In Giddens' (1984) work, this process is a general one involving interaction between human agency and structural modalities such as signification, domination, and legitimation. With regard to AST's special emphasis on the role of technology in the structuration process, DeSanctis and Poole (1994) describe how information technologies bring social structures to the work settings in which they are used. They describe these structures in terms of the structural features of a given technology and the spirit of this feature set, which taken together form the structural potential of a particular technology.

First, the structural features of a particular technology are "the specific types of rules and resources [...] offered by the system" (DeSanctis and Poole, 1994, p.126). Structural features give meaning to the technology and enable the user to actually perform his job in a given work situation. Examples of structural features of competence systems such as Prohunt Competence (Prohunt), SAP R/3 Human Resource Competence Module (SAP R/3), and Tieto Persona Human Resource (TP/HR) are competence gap measures and competence grading. These features enable HR and project managers of, for example, consultancy organizations to allocate staff to customer projects as well as to identify competence development needs.

Second, the spirit of a particular feature set is described as "the general intent with regard to values and goals underlying a given set of structural features" (DeSanctis and Poole, 1994, p.126). This intent is not to be confused with the technology designers' intentions, but is rather associated with how the system presents itself to people who use it. In this regard, the concept of technology spirit is closely related to the notion of inscription (Akrich and Latour, 1992; Hanseth and Monteiro, 1997) in that it aims at conceptualizing the interest "pursued" by technology itself. As actor-network proponents have often had to clarify with regard to the notion of inscription and its consequences for machine

agency, the notion of technology spirit is not intended to inflate human value by subscribing interests to technology. Rather, technology spirit pays attention to the relative autonomy that technology has and communicates to users through elements such its underlying design metaphor, the features it incorporates and how they are named and presented, the user interface, the training material, and help provided by the system.

While structuration is the on-going process by which social structures are produced and re-produced, DeSanctis and Poole (1994, p. 128) describe appropriation as an analytical concept with which to capture the structuration process by isolating a user group's "[…] application of a specific technology-based rule or resource within a specific context and at a specific point in time". There are four aspects of appropriation that can work as lenses through which the application of the structural potential of a given system can be analyzed. First, the technology structures can be appropriated in different ways. Examples of different appropriation moves of a user or user group include: to use the structures directly, to relate the structures to other structures, to constrain or interpret the structures as they are used, and to make judgments about the structures. Second, the structural potential of a technology can be appropriated faithfully or unfaithfully. Having said this, it must be emphasized, however, that unfaithful appropriation is not always a negative thing but can often be a source of innovation (c.f., Orlikowski, 1996a, on emergent change). Third, users can decide to appropriate a technology for instrumental uses. In other words, users can deliberately appropriate the structural potential of a technology to serve instrumental purposes. By exploring appropriation for instrumental uses, one can uncover the motives for understanding a technology in a particular way. Fourth, appropriation can be analyzed in terms of the attitudes that users show as they appropriate the structural potential of a system. These attitudes can convey the confidence, perceived value, or willingness with which a particular system is appropriated.

2.3 Our approach

Encouraged by DeSanctis and Poole's (1994, p. 143) observation that the research strategy they propose "[…] could be specified in more detail and tested for its usefulness across a range of advanced information technologies and organizational contexts", we apply AST to understanding the adoption of competence systems. The theory is used in accordance with its original intent with one notable exception. Subscribing to Jones (1999, p. 123-124) critique of AST's identification of other independent "sources of structure", we disregard this dimension of the theory. As suggested by Jones (1999), these sources of structure (DeSanctis and Poole (1994, p.128) point out task and organizational environment as the specific "external" sources of structure for groups) are, surprisingly enough, attributed existence outside the structuration process. In line with Gidden's (1984) original work, we argue that these dimensions should be understood as elements within the structuration framework.

Despite our slight sidestep of AST's view of other independent sources of structure, AST affords an applicable way of investigating the structuration process of competence system adoption. While Orlikowski (1992) and Orlikowski and Robey (1991) have demonstrated structuration theory's usefulness for re-conceptualizing technology and tracing false dichotomies in IS research, AST provides a theoretical framework that provides rich analytical insight to specific contexts of IT use. This analytical insight is, moreover, gained without taking on board the empirical insensitivity that general structuration theory has been criticized for. In developing AST, one might expect that DeSanctis and Poole were encouraged by Giddens' (1984, p. 281-88) remark that social research needs to be sensitive to cultural and local variation regardless of social theory used. AST represents an effort to provide such sensitivity in the context of the adoption of advanced information technologies, which fits our purpose of examining and demonstrating how to design competence systems for facilitating their successful adoption in organizations.

In short, AST is suitable for conducting action research in that it provides a conceptual language that can appeal to practitioners. The inclusion of an experience-near concept, such as

structural features of technology, is important for facilitating the engagement of practitioners in establishing the relations to more experience-distant concepts of explanatory power sought after by researchers. By analogy, it is equally important that users of AST are encouraged by the theoretical framework to relate their undertakings and analysis to the reality of practitioners. Because faithful application of AST in action research requires engagement from researchers in the practical matters of practitioners and vice versa, we consider the theory to be a suitable one for avoiding the tendency of "convenient fiction" that Kling (1991, p. 356) has observed in social theory informed information systems research. Indeed, one might argue that it is ethically correct to avoid "fictional" accounts when dealing with the problems that practitioners struggle with on an everyday basis.

The following sections of the paper outline how we applied AST in a researcher-practitioner collaboration aimed at re-designing competence systems for practical relevance in six Swedish organizations. Section four identifies and examines the existing barriers to adopting competence systems in the investigated organizations. Section five demonstrates how to overcome these barriers by re-designing the systems to respond to the actual problems that practitioners experience in their daily undertakings. Section six discusses the implications of our action research for both the practice of information systems adoption and action research.

3. Research methodology

3.1 Our action research approach

Action research (Argyris et al., 1985; Baskerville and Wood-Harper, 1996; Susman and Evered, 1978) has been described as "a post-positivist social scientific research method, ideally suited to the study of technology in its human context" (Baskerville and

Wood-Harper 1996, p. 235). More specifically, action research combines an interest in both knowledge and practice. First, action research allows the researcher to test a working hypothesis about the studied phenomenon by implementing change in a real-world setting. By analyzing discrepancies between the expected and actual change of what Susman (1983) calls the "client-system infrastructure", the action researcher gains knowledge of the researched phenomenon. In this regard, the action performed is as essential to knowledge as the intervention itself and its resulting change are elements of the process that validates the knowledge produced. Epistemologically, action research can be traced back to the pragmatism developed by Dewey (1938) and Levin (1951), in which knowledge and action are considered as inseparable elements of social life. Second, action research posits that the action itself is an important outcome of research. In researching the real-world problems that practitioners deal with on an everyday basis, it can be regarded as unethical of the researcher not to apply the knowledge gained to assist in the practical problems that practitioners struggle with.

The action research reported in this paper has been conducted within a 30-month (July 1 1999-December 31, 2001) research project called the Competitive Knowledge-Intensive Firms project. The project was a joint research effort between the Viktoria Institute, Gothenburg, Sweden, and nine participating business organizations (Astra Zeneca, EHPT, Ericsson Mobile Data Design, Ericsson Microwave, Frontec, Guide, Volvo Car Corporation, Volvo IT, Volvo Truck Corporation). In line with Robey and Markus' (1998) recommendation to pursue practitioner sponsorship as a means of overcoming the commonly perceived rigor and relevance trade-off, the project was equally funded by the Swedish research funding agency Vinnova (www.vinnova.se) and the nine participating organizations. Of the nine organizations included in the overall research project, six organizations (EHPT, Frontec, Guide, Volvo Car Corporation, Volvo IT, and Volvo Truck Corporation) were singled out for the sub-project on the use of competence systems in competence management. Following the preferred conduct in action research (see Baskerville and Wood-Harper, 1996), these organizations were part of the research

question formulation process. The objective of this joint process was to identify the practical concerns experienced by the practitioners and in turn assess how these concerns could be addressed by pursuing action research. As early as 1945, Lewin and Grabbe (1945) underlined how practitioners are more likely to accept and act on research findings if they were part of the research design process. To avoid any potential conflicts over each party's contribution and to secure the role of the research in the project (cf., Rapoport's (1970) discussion about the role dilemma of action research), an agreement that specified the expectations from Viktoria Institute and the participating organizations was signed. This agreement covered resource allocation in terms of direct funding, invested working hours, and equipment as well as regulations for the potential commercial utilization of the research results produced in the project.

The organizations included in the study were of slightly different character. Volvo Car Corporation and Volvo Truck Corporation are manufacturing companies competing on mature markets where both cost efficiency and shortened product development circles are important means of survival. EHPT is a telecom company working on a growing market characterized by technological shifts and unsettled customer behavior. Volvo IT is a service provider primarily supplying other companies within the Volvo group with state-of-the art competence in both hardware and software. Frontec and Guide are Swedish IT consultancy firms offering services on a market that can be described as dynamic and rapidly changing. Despite the obvious differences, there are at least two things that these organizations have in common: First, they are working on markets that require on-going technical competence to stay competitive. Second, they all invest considerable effort in developing and managing competence in their organizations. As a manifestation of their competence focus, they invest in competence systems as a type of information system intended to support organizations in efforts to handle their competence in an efficient and structured way.

The particular combination of organizations was useful for introducing a variety of organizational contexts, but it was perhaps even more valuable in terms of the width of competence systems

covered. The systems ranged from off-the-shelf software such as Prohunt, SAP R/3, and TP/HR to in-house developed systems like Guide's Competence marketplace system and Frontec's Compass system.

3.2 Research design

Our research design follows Susman and Evered's (1978) action research cycle consisting of five phases: diagnosing; action planning; action taking; evaluating; and specifying learning. (1), Diagnosing refers to the joint (researcher-practitioner) identification of the problems and underlying causes experienced by the practitioners. This phase is intended to formulate a working hypothesis regarding the researched phenomenon, which in turn works as the basis for planning the action. (2), Action planning refers to the process of specifying the actions that can improve the problems identified in the diagnosing phase. (3), Action taking refers to the actual implementation of the actions outlined in the action planning phase. (4), Evaluating denotes the process of assessing the outcome of the action taken. This evaluation is intended to be a collaborative effort between the researchers and the practitioners. (5), Specifying learning refers to the ongoing process of documenting and summing up the learning outcomes of the whole action research cycle. The learning outcomes represent the knowledge contribution to both theory and practice. Concurring with the hermeneutic circle of interpretive field studies (Klein and Myers, 1999), these contributions are temporary understandings that work as inputs (or pre-understanding) into new cycles of inquiry.

Even though most action research efforts (including the one reported here) fail to exactly map the "ideal" exemplar of Susman and Evered's (1978) formulation of the action research cycle, it is fair to say that our action research study consisted of two full action research cycles. The first cycle can be described as an effort to identify existing problems in adopting competence systems in the six organizations included in the study. As an important part of the diagnosis and action planning phases of this cycle, we

participated in many of the activities that were necessary for the organizations to even start using the competence systems (between July 1, 1999, and August 31, 1999). These activities included the development of competence definitions and structures as well as systems education participation. In collaboration with the practitioners, two practical problems (competence representation and competence representation maintenance, see subsection 4.1) were identified as key concerns that have to be overcome in order to implement successful competence systems. While these problems intersect with classic concerns in the field of information systems, they are nevertheless problems in today's information systems practice and were therefore the initial starting-point for our action research study. At this stage, we were not using any specific theoretical framework for guiding our action planning. We basically drew on general lessons found in the existing body of knowledge on the adoption of information systems in organizations. At this stage, we had several useful theoretical framework candidates (which are presented and reviewed in subsection 2.1) including actor-network theory, interpretivist perspectives, and structuration theory. While not directly using any of these candidates, we adopted the general lesson learned in this body of literature, namely that all forms of technology implementation are associated with certain barriers. These barriers are often of a situated nature, suggesting an inductive approach in which the emerging empirical results work as inputs for deciding which theory to use. The delay in committing to a specific theory was a deliberate strategy to enable us to apply what Klein and Myers' (1999) refer to as "the principle of Dialogic Reasoning". This principle advises interpretive researchers to be sensitive to "the story that the data tell" when exploring a phenomenon in light of the pre-conceptions of a theoretical framework. The action taking consisted of the implementation of the competence structures and competence definitions that were intended to overcome the diagnosed problems. A multiple-case study was conducted between September 1 and October 31, 1999 to evaluate the action taking outcomes. Not surprisingly, this research identified a number of adoption barriers that inhibited a successful adoption of the implemented competence systems.

On the basis of the learning outcome of the first action research cycle, the second action research cycle started out with a diagnosis of how the identified adoption barriers could be addressed. This diagnosis concentrated on the problems experienced by two (Guide and Volvo IT) of the six organizations included in the first action research cycle. Two things guided the selection of these two organizations: First, Volvo IT and especially Guide were more mature in terms of both competence management activities and actual use of competence systems. Because we were interested in studying as ambitious attempts as possible, these organizations were considered suitable. Second, we had good access to these organizations. The general manager of Viktoria Institute at the time of the study had been Guide's chief knowledge officer, while one of the persons participating in Viktoria Institute's industrial Ph.D. program was a Senior Information Architect at Volvo IT's Web Program Center. These contacts were important in our pursuit of implementing action, in the form of prototypes in real business settings. The diagnosis phase of the second action research cycle involved in-depth case studies (between November 1999 and April 2000) of Guide and Volvo IT, where the specific objective was to acquire a deeper understanding of how these organizations adopted their respective competence systems. First, we conducted an in-depth case study of how Guide adopted the in-house developed Competence marketplace system in their practical day-to-day activity (see Lindgren et al., 2002). Second, we conducted an in-depth study of how Volvo IT adopted TP/HR in their daily activity (see Lindgren et al., 2001). As Walsham (1995) observes, in-depth case studies facilitate contextual understanding of IT and its use and consequences in organizations. The two case studies primarily resulted in a deeper understanding of how seemingly sophisticated information systems were marginalized when they were put into knowledge work practice. Moreover, we observed how these information systems failures could be analyzed using adaptive structuration theory.

Noting how the identified adoption barriers were related to what seemed to be problematic technology spirits of the competence systems, we planned two interventional studies conducted on the basis of what we learned from the in-depth case

studies. The primary objective was to test the knowledge gained to see how these results could be used for implementing change at the studied research sites. As Argyris et al. (1985) suggest, an important part of gaining knowledge is to actively implement changes based on promising research assumptions. In this vein, we actively developed competence systems prototypes (see Lindgren, 2002; Lindgren and Stenmark, 2002), based on the knowledge produced in earlier phases of the research project, in order to better understand how to facilitate the adoption of competence systems in organizational knowledge work practice.

3.3 Data collection and analysis

The overall action research study covered a variety of data sources including document reviews, focus group sessions, interventions, interviews, participant observation, participation in educational sessions, testing of systems, and workshops. The data was analyzed using the general attitude of the interpretive information systems approach (see e.g., Klein and Myers, 1999; Walsham, 1995) in the sense that the research results were generated by going back and forth between the empirical data and the emerging research themes, understood within the broader framework of information systems adoption theory. To facilitate such "dialogic reasoning" (Klein and Myers, 1999), all data material was collected and documented in a systematic way.

The first action research cycle (July 1, 1999 – October 31, 1999) included a technology review of the five investigated competence systems (see Lindgren and Henfridsson, 2002). This review analyzed the competence systems manuals and tested the systems. The initial intention with this technology review was to learn how to make the best use of the newly acquired competence systems. Later on, however, this review worked as important background material for capturing and analyzing the technology spirits of the Competence marketplace system and the TP/HR system. In addition, we conducted 24 semi-structured interviews covering topics such as competence, competence development, competence systems, and work practice. The interviews (lasting

between 45 minutes and one hour) were conducted with staff in different organizational positions: account managers, CEOs, CKOs, consultants, consultant managers, HR managers, project leaders, and project managers. We also collected observational data by making field notes about project activities and day-to-day work practices. These notes were important in formulating the questions used in the interview study. Apart from the data sources listed above, we conducted at least one workshop session covering the development of competence definitions and competence structures at each company. These sessions were not only important in getting the competence systems going, but also in concretizing the problems associated with storing accurate and updated competence data. We also carried out a workshop on competence systems features involving participants from all organizations included in the multiple-case study. Moreover, in order to validate the results from this action research cycle, we conducted a workshop where we presented and discussed our tentative research results.

The second action research cycle (November 1 1999 – December 31, 2001) included a document review study. The focus of this study was on competence system manuals, strategy plans, competence plans, and annual reports at Guide and Volvo IT. Furthermore, user viewpoints from the Competence marketplace and TP/HR were collected through 32 semi-structured interviews (22 at Guide and 10 at Volvo IT), which concentrated on issues such as competence development, competence management, and work practice. These interviews lasted approximately 45 minutes and were conducted with employees from different parts of the organizations. The interviewees were selected to represent different organizational positions such as account managers, business area managers, CEOs, competence development managers, HR personnel, management consultants, project leaders, project managers, sales managers, and systems programmers. Besides the document review study and the interviews, we conducted participant observation of users entering competence information into the systems and performing competence analyses. Informed by the empirical findings from the in-depth studies of Guide and Volvo IT, two competence systems prototypes (the Competence visualizer

system and the Volvo Information Portal) were developed, implemented, and evaluated (information about how these prototypes were introduced is presented in subsection 5.3). The competence systems prototypes were evaluated by means of participant observation, interviews, and focus groups. The participant observations focused on how people used the prototypes for different types of competence analyses. The interview study included 34 semi-structured interviews (18 at Guide and 16 at Volvo IT), which covered topics such as information seeking, intranet systems, competence, competence systems, and work practice. The interviews (each interview lasted approximately one hour) were conducted with people in the following organizational roles: account managers, business area managers, CEOs, consultant managers, group managers, HR managers, management consultants, project leaders, project managers, software developers, systems programmers, and technology watchers. Contrary to the original plans, the interviews conducted at Guide's office in Gothenburg excluded business area managers and the CEO. The merger between Guide and an Internet consultancy company, Framfab, occasioned this exclusion. In short, Guide's top management had a heavy workload at the time of the interview study (cf., Rapoport's (1970) discussion about practical pressures in action research). In addition to the participant observations and the interviews, focus group studies (Agar and MacDonald, 1995) were conducted to triangulate the data collected during the interview studies. Four focus group sessions were carried out at Guide, while two were conducted at Volvo IT. Finally, a workshop was conducted where the results from the prototype systems evaluation were discussed with practitioners from Guide and Volvo IT.

Action research cycle	Cycle one (July to October 31 1999)	Cycle two (November 1 1999 to December 31 2001)
Research sites	• EHPT • Guide • Frontec • Volvo Car Corporation • Volvo Information Technology • Volvo Truck Corporation	• Guide • Volvo Information Technology
Data sources	• Focus groups • Participant observation • 24 semi-structured interviews (3 at each site, except at Guide where 9 interviews (Gothenburg [3], Oslo [3], Stockholm [3]) were conducted • Technology review • Workshop sessions	In-depth studies: • Document review • Participant observation • 32 semi-structured interviews (Guide 22 [18 in Gothenburg and 4 in Stockholm] and Volvo Information Technology 10) Prototypes evaluations: • 6 focus group studies (Guide 4 [Gothenburg 2, Oslo 1, Stockholm 1] and Volvo Information Technology 2) • Participant observation • 34 semi-structured interviews (Guide 18 [Gothenburg 6, Oslo 6, Stockholm 6] and Volvo Information Technology 16)

Table 1: Overview of the action research cycles, research sites, and data sources.

4. AR cycle #1: Configuring and evaluating the structural features of competence systems

4.1 Diagnosing

The diagnosing phase of AR cycle #1 built on the general intent of the participating organizations to adopt competence systems as a potential solution to the over-abundance of competence data handled in both strategic and daily operations. Because competence systems were more or less new to these organizations, their adoption involved a number of important practical considerations. In terms of AST, the organizations were interested in how the structural features of existing competence systems could be configured so that they contained competence descriptions useful for the structuring of knowledge work practice. This problem appeared at the time to be two-fold (see subsection 3.2). It was considered to be a problem of competence representation and competence representation maintenance. This two-fold problem was the starting point for the action planning, and action taking, of AR cycle #1.

4.2 Action planning and action taking

At an early stage (between July 1 and August 31, 1999), we (the research team and the participating organizations) identified two key questions important for all organizations to address in configuring their chosen competence systems for knowledge work practice:

The competence representation problem:
- What do useful competence descriptions look like?

The competence representation maintenance problem:
- How can competence systems be kept updated over time?

Despite the obvious differences in terms of organizational contexts and structural potentials of the investigated competence systems, these two generic questions were considered relevant for any organization intending to adopt competence systems in their daily activity. Over a number of workshop sessions with all participating organizations, as well as meetings with individual organizations, these questions were addressed with regard to both the structural potential of each competence system and the specific needs of each organization. This procedure was important in obtaining a general understanding of the practical difficulties involved in adopting competence systems in competence application and development practices.

As discussed in classic IS literature (see e.g., Churchman, 1971), a representation highlights certain aspects of a phenomenon at the expense of others. In terms of what a useful competence description looks like, there were two main issues assessed in our action research project. First, over the series of workshops and meetings, we concluded that it was important to balance objective and subjective measures of competence in competence descriptions. Objective measures are important in establishing a basis for comparison and analysis of competence data, while subjective measures in the form of, for instance, free text expressions are important in providing context-specific data. Even though all participating organizations shared this view, on the general level, this shared understanding was implemented to a varying degree. Because Prohunt and SAP R/3 did not include free-text features, the organizations that had decided to implement these systems (EHPT and Volvo Car Corporation) were more or less forced to exclude qualitative measures of competence. To compensate for this drawback, they maintained qualitative measures included in, for instance, competence development plans in parallel systems. Moreover, the organizations organized their respective competence definition and classification processes differently. Guide, Volvo Car Corporation, Volvo IT, and Volvo Truck Corporation applied a top-down approach in which managers were responsible for the classification and definition work. This strategy was chosen because it was thought to ensure a controlled process where previously decided competence definitions

would benefit organizational goals. Contrary to this top-down process, Frontec used a bottom-up one where consultants were an important element in defining competence definitions and structures. EHPT used a combined approach in which the HR department developed and presented a tentative competence structure, which was later evaluated through a user workshop.

Second, as suggested above, it was important to implement strategies for keeping the competence systems updated over time. Such strategies include both organizational routines for entering competence data and methods for collecting data from other administrative systems. Drawing on the lessons learned in groupware research (Grudin, 1994; Orlikowski, 1996a), we (as action researchers) advised a bottom-up strategy where the subjects of competence descriptions also had a reasonable degree of control over what was entered into the systems. Partly drawing on this advice, Guide and Frontec pursued a bottom-up strategy. However, four out of the six organizations (EHPT, Volvo Car Corporation, Volvo IT, and Volvo Truck Corporation) decided to let group managers enter and maintain competence data. This decision was based on the assumption that distribution of data entry would require resource-consuming development, and enforcement of procedures, to ensure standardized data collection.

4.3 Evaluating the implemented competence systems

By late August 1999, all six organizations (EHPT, Frontec, Guide, Volvo Car Corporation, Volvo IT, and Volvo Truck Corporation) had put their competence systems into use. In order to understand how the competence systems were received in knowledge work practice, we conducted a multiple-case study over two months of use (September 1 and October 31, 1999). This subsection of the paper presents the findings of this study.

On a general level, the study noted the existence of apparent discrepancies between the intentions of the systems and how the users perceived these intentions in using the systems (see Lindgren and Henfridsson, 2002). We refer to these discrepancies as adoption barriers throughout this paper. Drawing on AST, we

understand adoption barriers as discrepancies (that negatively affect the appropriation of the technology in the structuring of their work practices) between the intended support that particular structural features of a technology provide to a user or group of users and the support that users perceive they have. In what follows, we identify eight adoption barriers found in the investigated organizations.

First, one of the identified barriers concerned the problems involved in combining objective and subjective measures in using competence systems. A project leader at Frontec highlighted these problems when analysing the difference between the Compass and the Prohunt system:

> "Prohunt is more strict since you define what competencies should constitute the structure. The Compass system is based on free-text that in some cases can be more suitable than the formalized approach. The major weakness of rational descriptions is that they miss important aspects of knowledge work. You know, more soft dimensions like attitude and other personal characteristics. This type of information can be found in the Compass system and it would be really interesting to integrate these different approaches."

As discussed by this project leader, it is problematic to describe knowledge work with a formalized declaration of competence as a basis. In order to handle subjective aspects such as the attitude of the employees, the project leader suggested free-text expressions as an interesting complementary approach. Since the Compass system only handled free-text, Frontec discussed the possibility of complementing the system with a formalized competence structure. Several respondents affiliated to other organizations also discussed the need for competence systems features that manage both formalized and free-text descriptions. Such features would, they argued, allow better representations of knowledge work practice. The investigated competence systems supported one or both, but not an integrative view, of these approaches. This disintegration resulted in the situation that a search in one of those representation forms would not return information from the other (a search for a German-speaking consultant in the formalized competence declaration, for example, would not track an employee

who had stated “I have worked in Germany for five years” in the free-text part). Despite this lack of integration, organizational members were supposed to update both formalized and free-text descriptions of competence. As suggested by these observations, the adoption barrier disintegrated competence representation negatively affected organizational members’ commitment to accurately update their competence descriptions.

Second, in all of the organizations included in this study, a recurring task was the composition of project teams with good mixes of competencies and experiences. As highlighted by several consultants and project managers, it is important that a competence system indicates whether or not an employee is available for an assignment. However, none of the investigated competence systems had features that facilitated the manning process by providing the availability status of the employees. Several consultants and account managers at Guide’s offices in Oslo and Stockholm highlighted this problem:

> “Some search mechanisms have to be implemented [in the competence system]. One such parameter that must be searchable is availability. […] To be able to find out what resources are available is important if the system is supposed to be useful for managers when they configure projects.”

> “To my mind, the fact that there are no features that handle availability might be the most significant problem with the Competence marketplace system. You can almost anticipate in advance that the identified person is unavailable. To be sure, you have to check another list to find out whether or not this person is available. We have an Excel sheet, the so-called “free list”, which indicates who is available and not.”

A HR manager at Volvo Car Corporation also touched upon this issue when discussing the TP/HR system:

> “Information about who is occupied in a project or which people are available is needed [in the competence system]. In other words, information presenting the resources at one’s disposal in the present situation.”

As illustrated by these comments, the competence systems had to be complemented by additional information sources in order to

support informed project-manning decisions. According to several respondents, this inability to show the availability status of employees can be considered a barrier to adopting the systems in organizational daily activity. We refer to this inability as the staff availability blindness barrier of competence systems.

Third, it seemed difficult to keep competencies updated as they changed in the ongoing flow of knowledge work. In fact, documented competencies always tended to become outdated. In relation to the Compass system, a HR manager at Frontec observed:

> "The employees' competencies are usually not properly represented in the system structure. Moreover, the stored competence descriptions are not up to date and therefore of limited use to the organization. As a consequence, we have tried to develop an organizational function that is supposed to deal with questions related to the quality of our competence descriptions."

In line with the above quotation, an account manager at Guide's office in Stockholm expressed the following about the Competence marketplace system:

> "I have searched [...] several times for staff skilled in particular programming languages. Names are listed, but when I contact these people they often answer that I am not doing that any longer. They are capable, but not interested."

Considering that a recurring task of account managers is to locate skilled staff for their "accounts" or customers, the frustration expressed in the quotation is easy to understand. Indeed, a competence system like the Competence marketplace would be very useful in matching desired competencies with available ones. However, as long as the available competence is defined and classified on the basis of past and often outdated experience, the system almost becomes counterproductive to the work of the account manager. These two quotations illustrate how existing competence systems fail to support the way in which competencies evolve over time. We refer to this barrier as the reproduction bias of competence systems. This barrier encouraged employees to "hide" competencies to avoid unwanted assignments.

Fourth, there were many interviewees who discussed the closed system structures of many of the systems as obstacles to knowledge work activities such as communication, collaboration, and sharing of knowledge. The CKO at EHPT commented on the system structure of Prohunt:

> "Prohunt is hierarchically structured and as a co-worker you cannot see your colleagues in the system. However, as a team leader you can see your own profile and your team and as a CEO for an organizational unit you can see yourself as well as all of your subordinates."

An HR manager at Volvo Car Corporation familiar with both Prohunt and SAP R/3 said:

> "You can only see the extensive list of information about yourself in these systems. Even though it is possible to search for colleagues, the only information you get is in which organizational unit the particular competence is located and the contact information of this unit's CEO."

The point that this HR manager wanted to make is that the competence systems have features that handle a lot of personal information, while the support for internal networking and co-operation is limited. We refer to this problem as the user isolation barrier of competence systems.

Fifth, as argued by many respondents, it is not enough to have a competence system with an open structure. The systems should also facilitate the creation of communities within the organization in a more active way. Although Guide's Competence marketplace had an open system structure, the system tended to lack support for connecting people with the same competencies and interests. A project manager at Guide's office in Gothenburg highlighted this when analyzing the Competence marketplace system:

> "Maybe it should be possible to in some way connect a group of people with similar interest profiles. For instance, mark here [in the competence system] that I am a member of this network. Then I have more search paths and this would make it easier to find peers. At present, there is no interactive forum for exchange of opinions and sharing of competencies. It is important to make it easier to initiate a dialogue."

The quotation indicates how interaction between knowledge workers can be important for developing the competence of the staff. In light of the relative isolation that project managers find themselves in, it is not surprising that it was a project manager that expressed this concern. The mainstream consultant often works closely in projects with people sharing the same competencies and interests, but the project manager needs to find the project management-related stimulation elsewhere. We refer to this barrier as the knowledge sharing disability of competence systems.

Sixth, one project leader at Guide in Oslo expressed the following:

> "It is not sufficient to know the employees' competencies. You must be able to manage those competencies in a strategic way, but it [the competence system] does not contain a complete package. Our intention is to categorize the activity with regard to strategic goals and critical competencies. At present, however, we can merely visualize competencies on an individual level by using the Competence marketplace system. But, we want to manage competence on, for instance, a departmental level. When analyzing different groups of employees, we need it [the competence system] as a management tool for the activity."

This project leader observed that there is a need for features in the Competence marketplace system that facilitate flexible analyses of the competence status of teams of varying sizes. As pointed out by several other Guide managers, such features are important because almost all customer projects depend on a successful composition of several competencies. In line with the Guide respondents, project leaders at Volvo Car Corporation discussing TP/HR highlighted inflexible group analyses as a barrier to adopting the competence system in their managerial work practice. We refer to this adoption barrier as the group level imprecision of competence systems.

Seventh, the investigated competence systems generally lacked future orientation, which was problematic in terms of competence development planning. The lack of future orientation was underlined by the CEO of one of Guide's subsidiaries in discussing the Competence marketplace system:

> "There [in the competence system] you should also have directions, aspirations as well as ambitions related to employees' competencies. If not, you will only base competence decisions on the competencies that people have had or have today. This means, basically, the competencies that they have documented in the existing competence descriptions. A complementary and important approach is to try to identify the interests, aims, and directions of the employees. […] If the competence system had this type of features it would surely become a more integrated part of our competence development activities."

A HR manager at Volvo Truck Corporation took a similar standpoint when examining the TP/HR system:

> "A project requires certain competencies. In some cases, it can be difficult to find the competencies needed and then you have to, for instance, develop these through competence development. One has to create a competence development plan that outlines what competencies the employees have to develop from the organization's point of view. […] The problem is, however, that the system does not support us in identifying what competencies the employees want to develop in the future and that is critical since we are trying to work with scenarios for the future. What competencies will we have in the future and what types of projects are we able to handle? Basically, we need to know what competence we will have within our organization the year 2005. Today, we can measure the difference between existing and wanted competencies merely with the organization's perspective as a basis. What we need is, however, more information about our employees and what they want to do tomorrow."

In line with this HR manager, many respondents at Volvo IT and Volvo Truck Corporation also suggested that the inability of individuals to express their competence development interests was problematic. In a similar vein, several consultant managers at Guide observed this problem with the Competence marketplace system and they described how consultants manipulate their competence data in order to get assignments in which they could develop a certain competence. We refer to this problem as the competence direction inattention barrier of competence systems.

Eighth, there were several respondents primarily working at EHPT and Guide's offices in Oslo and Stockholm who discussed

the relationship between the use of competence systems and strategic business planning. As an illustration, the CEO of Guide's Stockholm office said the following about their competence system:

> "In order to understand market demands, it would be useful to be provided with information about market research and market analyses. We have to be sensitive to the world around us in order to handle our competencies more professionally. What is the market direction and what are our abilities to pursue that direction ourselves? Important issues are our track record and competence status in those areas. Because the system's features do not handle this type of information it is of limited use for top management and strategic planners within the organization."

This quotation indicates that the Competence marketplace system needs to be geared with features that manage information about the surrounding world if the system is to be used by, for instance, Guide's strategic planners. Interviewees at EHPT and Guide in Oslo also confirmed this inability. We refer to this problem as the environmental exclusion barrier of competence systems.

4.4 Specifying learning

Looking back at AR cycle #1, it can be concluded that the identified adoption barriers (Disintegrated competence representations, Staff availability blindness, Reproduction bias, User isolation, Knowledge sharing disability, Group level imprecision, Competence direction inattention, and Environmental exclusion) negatively affected the way in which the investigated competence systems were used. The study showed that the competence systems were used differently and that appropriation practices varied. In some of the organizations employees appropriated the competence systems features unfaithfully. As an example, one might consider the competence visualization feature that most competence management systems have. This feature is intended to document and update the competence descriptions of individual consultants in order to facilitate the manning of customer projects. However, competence descriptions often consolidate an individual's role in an organization in that skilled workers continue to be assigned

tasks that they are good at. Competence visualization features therefore often become subject to unfaithful appropriation, as workers tend to exaggerate their competence in areas of desired career paths and downplay their competence in areas they want to avoid. Furthermore, the variation in the interaction processes was highlighted by different groups of users' appropriation moves. Given the set of existing system features, some groups of users related other structures to the competence systems. To be more specific, the competence systems were complemented with information sources and systems in order to support competence analyses of employees and project-manning decisions.

Several of the adoption barriers can be seen as results of the fact that the competence systems' technology spirits were not perceived as corresponding to the structuring of knowledge work practices. While knowledge work can be characterized as difficult to describe in job descriptions (Brown and Duguid, 1991), conducted by self-motivated individuals (Nonaka, 1994), based on co-operation between people having different knowledge and experiences (Boland and Tenkasi, 1995), and disorderly in comparison with administrative business processes (Davenport et al., 1996), the competence systems were espousive, reproductive, isolative, and rigid. First, competence systems contain primarily formalized descriptions of existing competence. Such descriptions consist of the competencies and roles that match an organization's formal documents in terms of job descriptions and policy statements. Many times, however, formalized descriptions of existing competencies are out of line with the actual actions of the organizational members. Second, competence systems are built-up of predefined competence structures, which are congruent with the formal charts that describe an organization. Such a competence structure functions as a built-in mechanism that retains and reinforces the already existing situation. Third, competence systems have a hierarchical and closed system structure. Such a closed system structure separates the individual user from other organizational members. Fourth, competence systems offer a low degree of flexibility with regard to analyses of the employees' competencies. Competence analyses can be conducted for merely predefined and limited sizes of groups at given points of time.

Most of today's competence systems can be considered as traditional personnel administration systems for the passive handling of formalized competence descriptions conveying an archiving technology spirit. In contrast to the competence systems' designed purpose, as described in the manuals, a faithful appropriation of these systems would be counter-productive to, for instance, the competence development plans of the individual. In sum, the empirical findings highlight the importance of designing competence systems that convey a technology spirit more in harmony with the nature of organizational knowledge work practice (see Lindgren and Henfridsson, 2002).

5. AR cycle #2: Re-designing competence systems

5.1 Diagnosing

The general lesson learned from AR cycle #1 is that there seems to exist a discrepancy between existing competence systems and the structuring of knowledge work found in daily organizational activity. Many of the practitioners with whom we engaged in the field highlighted the immaturity reflected in the competence systems put into the practice of knowledge work. Conceived to be almost counter-productive, the competence systems were unfaithfully appropriated in day-to-day knowledge work. Returning to our original research objective, we need to assess what this means for the adoption of competence systems in organizations. What are the consequences of the static nature of competence systems? What does it mean that the competence systems' structure is usually closed? What are the implications of the fact that competence systems generally lack a future-orientation, while knowledge work tends to be based on continuous learning? To investigate these dimensions in closer detail, we decided to conduct two in-depth case studies (Guide and Volvo IT) where we more actively and over a longer time period explored competence

systems adoption in the structuring of knowledge work. The chief objective of these case studies was to learn how to overcome the identified adoption barriers (see subsection 4.3) by formulating new design principles for competence systems.

5.1.1 Guide's adoption of the Competence marketplace system

Background

The Swedish IT consulting organization Guide was founded in 1988. At the time of this study, Guide had approximately 800 employees at ten offices located in three countries and had an annual turn over of 66 million USD. Guide can be described as a fast growing and knowledge-intensive organization. Since the start in 1988, the business concept has been to run Guide as a lean and nimble "learning organization" and to offer top expertise in the above mentioned business areas. This strategy was manifested by the introduction of consultant profiles containing brief descriptions of individuals' competencies in 1989. The objective of this strategy was to highlight Guide's competence focus and to attract customers. Thus, development, as well as managing knowledge and competence, were recognized as significant issues and Guide has since 1988 annually invested 15 percent of turnover in competence development activities.

More specifically, Guide has focused on four types of competence-oriented activities: First, Guide pursued a "spill-over" strategy where competence-areas such as client-server technology and project management consisted of a mixture of experienced and non-experienced organizational members. The idea was that individual consultants would be able to learn from others by being exposed to their earlier experiences. Second, a number of individuals with competence and interests in areas outside Guide's formal competence areas (but with potential business relevance) were assigned to conduct competence surveillance. This surveillance was intended to cultivate the basis of informal competence networks, where the participants of these networks could develop their competence in areas outside their ordinary work areas. Third, Guide developed formal development programs

in, for instance, project management and systems design. This activity was designated “Guide academy” and its objective was to recycle the experienced consultants’ knowledge into the company’s own activities through internal education. Fourth, and yet another competence-oriented activity, was the development of individuals’ competence in assignments. When manning assignments, Guide’s business and group managers were supposed to configure teams in ways that supported the consultants’ interests in personal development and new experiences.

Competence development in assignments

Competence development in assignments was considered the most important competence development activity in Guide. This activity was based on the quite straightforward assumption that the more consultants learn the better they perform. Drawing on this assumption, Guide intentionally recruited consultants with considerable experience (the average experience was around 15 years) to offer a mentoring base for less experienced and knowledgeable individuals within the organization. With the idea of competence development in assignments as a basis, Guide’s ambition was to simultaneously assure the development of individual consultants’ competence as well as customer satisfaction.

Over the years, Guide developed several different initiatives to support competence development in assignments. In 1994, the company implemented routines to enable customers to value specific consultants’ competence and performance in assignments. In 1995, two manual systems, i.e., the Competence matrix and the Competence stairs, were developed for supporting individual competence development discussions and evaluating the competence development of the staff as a whole. Moreover, in 1996, Competence development ratings were implemented for measuring the consultants’ perceived competence development in assignments. These ratings were intended to indicate whether an assignment had been developing, impoverishing, or if the consultant preserved existing competence. This rating multiplied by the financial outcome of an assignment returned a competence-weighted result. Such a result enabled management activities

based on other parameters than merely traditional economic ratios. In 1996, Guide was ISO-certified, which demanded standardized routines for managing knowledge and competence. As part of the ISO-certification process, competence descriptions were developed and implemented. These descriptions were stored as word documents containing detailed descriptions of the consultants' competencies. These documents were mainly used for manning assignments and to show customers the various competencies available. The competence descriptions could be edited and used by everyone, i.e., both management and consultants. In the same year, Guide's Intranet was launched, containing HTML-based competence descriptions, project information, prospects, and information about competence-areas. In 1998, the Job assignment system was developed and implemented at Guide's office in Gothenburg. This system was based on Lotus Notes and contained competence information and prospects. The Job assignment system was used to match incoming prospects with the consultants' competencies and interests, which were identified during the personal development discussions once a year. Only management could access this system.

As illustrated above, Guide initiated a variety of different arrangements and systems for supporting the management of competence and knowledge. However, most of these have been local initiatives and Guide had problems with parallel systems, poor updating, static documents, and lack of critical mass of users (see Lindgren et al., 2002). In an effort to co-ordinate the competence management activities within the organization, Guide launched the Competence marketplace system project in 1999 (see Lindgren, 2002; Lindgren and Henfridsson, 2002). In what follows, this system will be the focus of our analysis of competence systems adoption at Guide.

The Competence marketplace system

The Competence marketplace system was a competence system intended to facilitate staff allocation and competence development. Originally developed at Guide in Oslo, the system was up and running at Guide's offices in Gothenburg, Oslo, and Stockholm in August 1999. The Competence marketplace system was accessible

via Guide's intranet and the system was built on a database storing descriptions of staff competence levels and overall competence measures of areas such as client-server technology and project management. The database used was an SQL (Structured Query Language) server and the information was presented through ASP (Active Server Pages) on an IIS (Internet Information Server). ASP generated the HTML (Hypertext Transfer Protocol) pages, which were viewable via a web browser.

The system was designed with the consultants' competencies as a basis and there were no predefined roles such as project manager, sales manager, HR manager, and so on, in the Competence marketplace system. The top level of the competence structure consisted of four different groups and each of these had sub levels that consisted of the various competencies. The systems' competence grading consisted of four levels: Beginner, some knowledge, experienced, expert. The Competence marketplace system was implemented through a top-down strategy, which means that the management defined which competencies should constitute the system structure. The consultants were, however, responsible for the input of their competence data. Guide's organizational structure can be considered to be flat, which was reflected in the system where everyone could see everybody, i.e., the management was able to see their subordinates' competence descriptions and vice versa.

The evaluation of the Competence marketplace system

As mentioned above, the Competence marketplace system was put into use in the fall of 1999. After a six-month test period, i.e., in February 2000, we initiated our system evaluation, which proceeded intensively over an eight-week period. The evaluation results highlighted that the organizational adoption process of the Competence marketplace system had been problematic. Although the Competence marketplace system provided features that facilitated activities, such as competence identification, internal networking, and gap analyses of the organization's competencies, the system was not fully embraced by the organization. As an illustration, a systems programmer at Guide in Stockholm said:

> "I marked those areas in which I consider myself to be competent. When doing this, I took the opportunity to check out which other people were to be found on the same level. Sure, I'm familiar with the guys here [at Guide's Stockholm office], but when it comes to Gothenburg and Oslo the situation is obviously different. So, the possibility to get to know those fellows' competence is certainly a positive aspect of the system. […] Although most of us see the advantages [of using the system], there have been difficulties during the initial usage phase."

During the interviews, the respondents discussed different possible causes of the problematic adoption process such as unsatisfactory marketing and insufficient training and education. There were, however, several interviewees who highlighted the time consuming work required to keep the Competence marketplace system's data updated. An account manager at Guide's office in Gothenburg commented on this issue:

> "What is needed is an organizational function that on a regular basis cultivates the content of the system. It should be possible to register new competencies as well as interests [in the system] since people change. When the employees do not find what they are looking for; if the appropriate competencies are missing in the structure, we cannot blame the employees when the system fails. To create a relevant and dynamic competence structure is problematic."

As highlighted by many respondents in managerial positions within Guide, competence-areas within the IT consultancy business are not static. The development is rapid with regard to both the content of a certain area and the growth of new areas. Moreover, individuals' competencies and interests also change, which makes it even more complicated to keep a competence structure dynamic, relevant, and up-to-date. During the fall of 1999, Guide realized this and decided to create a decentralized maintenance organization, with the main objective of cultivating the Competence marketplace system's competence structure regularly. The plan was that the consultants themselves would send proposals regarding new competencies to a working group at Guide's office in Oslo. The group then examined the proposals and if these were found to be relevant it was intended that they be implemented in

the competence structure. In practice, however, a specific competence had to be proposed several times before it was implemented. As a result, this arrangement did not work as intended and in light of this Guide discussed alternative organizational solutions. One suggestion was to establish a link between the competence-areas within the organization and the Competence marketplace system. The idea was that the competence-areas could identify and maintain the competencies in the system's structure. A different solution debated was to automate the information flow to the Competence marketplace system. A competence development manager at Guide's office in Gothenburg explained:

> "The main problem is, as always, the input of competence data into the system; the classic problem so to speak. It is about identifying the forms or routines to making this process more automatic. The critical success factors are the flow of information to the system and then make the information accessible. [...] The compulsory instrument that we have is the time report. Actually, we must get it there since every assignment always has a description of the applied competencies; for example, the programming language Cobol. So, what it is all about is creating some scripts that scan the documents and then you have a backlog of the jobs done and the competencies used. [...] It is sufficient if this scanning is conducted once a month; basically, you do not change your knowledge more often than that."

In order to receive their salary, Guide's consultants must report their working-hours. The time report describes what assignments the consultant has had. The time report also outlines what competencies a certain assignment has required. As several respondents highlighted, it should be quite simple to scan the time reports and in this way update the Competence marketplace system. Such an automatic updating process was considered by the Guide management. It was concluded, however, that this type of approach did not support the "Guide philosophy". Guide's consultants were supposed to manage themselves and actively cultivate their competence and in this process the competence descriptions were regarded as an important tool. Thus, the idea of automatic updating was rejected and the manual approach has

been applied throughout the whole organization. For the purpose of strengthening the consultants' commitment to the Competence marketplace system and thereby facilitating the manual updating process Guide, in late 1999, intensified the marketing of the system. Management's main argument was that the Competence marketplace system should be viewed as a tool for employees to market themselves internally. By using the system the consultants could show their competence and by that means influence the assignments they received. The CEO for Guide in Stockholm discussed this topic:

> "It's important that the consultants realize that their wishes regarding future work tasks, as well as the competencies that they have marked in the system, function as a basis for the organization when it comes to offering and manning assignments, internal education, and so on. This would result in a very strong motivation among the employees and it also creates a unifying bond between the management and the consultants."

Since this argument supported the idea of development of the consultants' competence in assignments, it was well accepted within Guide's organization. As many interviewees pointed out, however, any immediate effect was conspicuous in its absence. The use of the Competence marketplace system was still sporadic and the system's data quality remained low. A business area manager at Guide's office in Gothenburg discussed one reason for this:

> "The business model resulted in certain questions such as; are there any persons who are suitable for this project? This is reflected in the competence marketplace system. However, reality as well as business models change, but this is not mirrored in the systems. Our business has changed from selling individuals to selling complete solutions."

As early as in 1996 (recall that the Competence marketplace system was put into use in 1999), Guide's business strategy changed from selling individual consultants to selling teams and complete solutions. Features supporting flexible and aggregated analyses of team members' competencies were, however, not implemented in the Competence marketplace system (cf., the adoption barrier group level imprecision). In this regard, the

system did not support the way in which Guide conducted their work. A project leader at Guide in Gothenburg highlighted an additional reason for the problematic adoption of the Competence marketplace system:

> "The competence development ratings were basically developed in order to facilitate management based not only on traditional economic parameters like contribution margin. And Guide has historically striven to find alternative means of control related to the development of consultants' competencies. […] The fundamental idea of the competence development ratings was to put pressure on the sales organization; before making a tender, they were supposed to evaluate the project's possible competence development contribution. […] Business ratios like the competence development ratings are, however, not implemented in the competence marketplace system."

In line with this project leader's reasoning, many respondents in managerial positions pointed out that there was an obvious discrepancy between the intended management practice within Guide and the managerial information provided by the Competence marketplace system. While people in management-oriented roles expressed the above-discussed reasons, interviewees at the grass-root levels primarily addressed the following aspect. A systems programmer at Guide's office in Stockholm commented:

> "One can assume that the consultants who have marked a competence in the structure are interested in working with assignments requiring that particular competence […]. In order to avoid assignments in certain areas, I hide competencies that I do not want to apply. This kind of misuse of the system is similar to what happened with the competence descriptions that were implemented in 1996. […] I'm capable of working in a Cobol project, but I do not want to do it. If I express my competence in Cobol, there is an obvious risk that I have to take on assignments where this kind of programming skills are needed. So, my group leader advised me to leave out Cobol when I filled in my competence description."

According to the respondents, much ambiguity as to using the Competence marketplace system emerged since the system downplayed individual competence development interests. Because consultants wanted interesting and developing assignments, they

quite often manipulated their competence descriptions. While some consultants overrated their competence in order to receive certain assignments and thereby developed the desired skills in action, others were more humble when valuing their competencies. This was, as highlighted by many interviewees, a result of the missing correlation between the Competence marketplace system and the way of working within the organization. The system did not support, for instance, Guide's idea of configuring teams so that the consultants' aspirations for future competence development were taken into consideration (cf., the adoption barrier competence direction inattention). There was a feature that enabled the employees to express their wanted skill level and/ or new areas of interest in the form of free-text expressions. This free-text feature, however, did not support statistic analyses of the expressions and there was no possibility to aggregate information in order to visualize interests. As a result, consultant managers, for example, did not use the Competence marketplace system when manning assignments, which in turn affected the consultants' commitment to use the system.

During the spring of 2000, Guide's management became aware of the problematic aspects of adopting the Competence marketplace system. In March of the same year, a working group including our research team was created for the purpose of planning the organization's future use of the Competence marketplace system. A key task for the working group was to figure out a strategy for making the competence system a part of a consultant's toolbox.

Several members of the working group argued that the Competence marketplace system had to be geared with features that handle information about the consultants' ambitions with regard to future assignments and competence development. According to those interviewees, such a change in the Competence marketplace system's design would address the critical problem of motivating the consultants to update the system on a regular basis. In line with this, an account manager at Guide's office in Gothenburg expressed the following:

> "The consultants are interested in having the right assignments and if the system facilitated this the incentives would be in

> place. […] The opportunity to register new competencies and interests is important since there is no given correspondence between a consultant's competence and wanted work tasks. Therefore, it is important to keep track of existing ability as well as ambition of competence development. If the system would handle information about ambitions and interests there would be an incentive for the consultants to use the system. […] The consultants should feel that they are able to influence which assignments they get by using the system."

Furthermore, there were working group members who argued that the lack of features supporting management in different competence analyses has to be addressed. One consultant manager at Guide in Gothenburg touched upon this issue:

> "It is possible to do gap analyses by using the system. However, these gap analyses only deal with present competencies. What is needed are features [in the competence system] that can display a historical description of the organization's competence status."

In accordance with this consultant manager, other respondents also requested features that would make it possible to survey the competence status of groups of different sizes at a specific moment, and over a particular period. Several interviewees expressed the view that this type of features would increase the Competence marketplace's value as a tool for competence development planning and recruiting.

5.1.2 Volvo IT's adoption of the TP/HR system

Background

With a global presence including offices in Belgium, Brazil, Great Britain, Malaysia, Sweden, and USA, Volvo IT is the Volvo Group's resource and expertise center for IT systems. Although owned by Ford Motor Company since April 1999, Volvo Car Corporation is also part of Volvo IT's customer base. At the time of the investigation, Volvo IT had approximately 2500 employees. Some 1400 of those worked in Sweden and roughly 900 in the Gothenburg area where Volvo IT's head office is located. The main objective of Volvo IT was to create global IT systems that generate

value for their customers. This was basically achieved by developing cost-effective systems where a significant percentage of the solutions were the same for the entire Volvo Group. A high degree of standardization was thus hailed as the optimal situation and Volvo IT's centralized mainframe operation, which had received several international awards for high efficiency and cost-effectiveness, had always been one of the corner stones. By routinizing as much of the work as possible, Volvo IT intended to ensure predictability, consistency, and quality in their services. Volvo IT was, however, not the exclusive provider of IT services since the companies within the Volvo Group could purchase IT services from external providers if they so desired. But, as long as mainframe processing was the core of the business, Volvo IT was on top of the competition. The shift in the 90s towards more web-enabled solutions, however, opened the field for new, smaller, and quicker players. This put new demands on Volvo IT's ability to change and adapt to new business solutions.

The continuous development of skills and expertise needed for mobile services, telematics, and IT in vehicles was essential for Volvo IT to continue to be a competitive partner in the future. The organization became therefore, in part, more project-oriented and decentralized and in that situation empowering the employees to act more quickly and autonomously was important. The more rapidly changing environment and the more frequent exposure to previously unknown problem areas resulted in a learning-by-doing situation rather than an attend-a-course approach to competence development. Skills were thus acquired and disposed of at a more rapid pace than earlier and, like many large organizations, Volvo IT recognized the problem of knowing who within the organization knows what. In particular, this problem became obvious in 1999 when Volvo IT was formed by consolidating the old Volvo Data with the systems developers and other IT personnel from the product companies, thereby expanding from 900 to 2400 employees. The prevailing approach of using Excel spreadsheets and personal contacts as a basis for project configuration and competence management became unmanageable. Volvo IT had only a vague overall picture of the existing competencies within the organization and could therefore not conduct goal-directed competence

development on either the organizational or the individual level. As a consequence, Volvo IT decided to reinforce their competence management process by initiating a number of activities such as: creation of homepages for projects, groups, and departments, establishment of human networks related to particular competence areas, evaluation of search engines and agent technology for the intranet, implementation of IT support for managing competence and resource and availability planning, development of strategies for competence development, trainee programs, research and development, and management development. In this particular research, we have focused on Volvo IT's efforts to implement and use the competence system TP/HR.

The TP/HR project

The TP/HR project was initiated in June 1999. This project had basically two objectives: First, to develop a competence structure for Volvo IT that could function as a basis for the mapping of employees' competencies. Second, to implement the developed competence structure in the TP/HR system and to create a maintenance organization that regularly keeps the TP/HR's structure dynamic, relevant, and updated (see Lindgren and Stenmark, 2002).

To define a competence structure for Volvo IT that could be implemented in the TP/HR system was, however, no trivial task for the project members. Similar competence mapping projects within the Volvo Group during the 90s had failed due to problems with defining the competence concept and static databases that could not handle organizational changes. To be able to draw on previous experiences within the Volvo Group, Volvo IT approached Volvo Truck Corporation in the fall of 1999. Volvo Truck Corporation had spent two years trying to develop a common competence structure for Volvo Group and they were still not finished. This was mainly because of the rapid pace of change in their work tasks related to product development. Moreover, Volvo Truck Corporation had since 1995 evaluated different competence systems like People Soft, SAP/R3, and TP/HR. Volvo Truck Corporation decided to respond to Volvo IT's call for co-operation and the two organizations joined forces. Besides Volvo IT and Volvo Truck

Corporation other Volvo companies were also part of this constellation, albeit more passively. At the initial 2-day meeting, where our research team was represented, Volvo Truck Corporation introduced their tentative competence structure and explained its rationale. Volvo IT adopted most of the structure as a starting point for their work. Soon, however, Volvo IT realized that the Volvo Truck Corporation approach was far too specific to be useful at the Volvo Group level. Volvo Truck Corporation regarded, for instance, truck cab assembly to be a general skill, although no other Volvo company required such competence. Since much time and effort had been invested in the competence structure, Volvo Truck Corporation was unwilling to change it even though they could appreciate the point made by the other companies. The ambition to define a competence structure for the entire Volvo Group was eventually abandoned due to the complexity problem.

To be able to make progress, the Volvo IT pilot group decided to define their own competence structure. In a published corporate report, Volvo defined competence as consisting of five aspects: skills, knowledge, experiences, relationships, and values. In addition to these aspects, motivation was identified as an inner source of energy required for activating competence (AB Volvo, 1987). The pilot group had access to this document, but decided that relationships, values, and motivation were too difficult to codify and make explicit. As a result, these parameters were not to be included in the TP/HR system's formalized competence structure. Instead, the employees themselves should handle information regarding relationships, values, and motivation. As pointed out by several pilot group members, however, the TP/HR's free-text based personal plan could be used for this purpose. Thus, the pilot group concentrated on skills, knowledge, and experiences. Despite this demarcation, the task of constructing a common competence structure for Volvo IT turned out to be more complicated than the project members had anticipated. A management consultant responsible for the development of Volvo IT's competence structure explained:

> "We have competencies ranging from more technical aspects like infrastructure and hardware to soft systems developers such as management consultants. Consequently, it is a wide

> spectrum of competencies that we have within the organization. The difficult part is that some claim that their way of representing the competencies is the best. They claim they are so unique that they have to have this structure and these groups. Actually, it is not possible to do it differently."

Different parts of Volvo IT's organization had its own particular demands as to what competencies should constitute the structure. As described by the pilot group members, this resulted in a complicated and time-consuming competence mapping process. After weeks of consideration, however, a common competence structure for Volvo IT was finally agreed upon. In February 2000, the developed competence structure was implemented in the TP/HR system.

The TP/HR system

TP/HR is a commercial off-the-shelf module-based client/server system developed by Tieto Datema AB in Sweden. Running on a Windows 98/NT platform, TP/HR served as an interface between the user and an Oracle database server. The focus of our research was on the Education/Competence module and when we hereafter refer to TP/HR, we mean this module only.

In Volvo IT's implementation of TP/HR, competence was divided into functional and technical skills. Functional skills referred to the work tasks an employee performs, e.g., Application/Infrastructure Development or Support, and measured how well the employee carried out the task. Technical skills concerned the methods or techniques required by the work tasks, e.g., Programming Languages/Tools or Data Management. In turn, the functional and technical skill categories had their own sub-levels and all of this was grouped and ordered in a tree structure.

Volvo IT implemented five levels of competence grading ranging from 1 (no competence) to 5 (expert competence). With existing competence documentation like Excel spreadsheets as a point of departure, Volvo IT managers entered the employees' competence data into the TP/HR system. Based on the collected competence data, the search feature in the TP/HR system made it possible for management to search for employees holding a specific competence at a certain level, e.g., a C++ programmer of level 3 or above. In addition, there were features for competence gap

analyses. The gap analyses were based on an individual, a group of individuals, or a work task. These analyses indicated the difference between the existing situation and the future demand for particular competencies within the organization. More specifically, there were two types of gap analysis: Group analysis 1 showed how well the employees' competencies matched the given competence demands for each work task. Group analysis 2 indicated how critical competencies related to specific work tasks were distributed within a particular group. As explained by the manager for the TP/HR project, the TP/HR system was assumed to support Volvo IT in organizational activities such as goal and personal development discussions, forming teams of employees, finding competence when manning assignments, resource and availability planning, external recruiting, and mission steering (see Lindgren and Stenmark, 2002).

The evaluation of the TP/HR system

Many of the participants in the TP/HR pilot project were positive about the system, which, in their opinion, was a first step towards some structure and order in an otherwise rather chaotic situation. Even though they complained about the old-fashioned user interface, they thought that TP/HR would be a useful tool, particularly, in establishing a common terminology. A previously agreed common vocabulary helps make competence more tangible and thereby assists managers in both coaching dialogues with the employees and competence gap analyses. A project manager commented:

> "As TP/HR looks today, it will be used to delineate competence and skills, work tasks, and map these out and make them tangible. And then you will take individuals and describe them and work with gap analyses, coaching dialogues, and potentials [...]."

Updating of the competence description should be a responsibility shared jointly by the manager and the employee. The employee typically performed the physical input closely assisted by, and in dialogue, with the manager. The competence description should be updated as often as possible, but at least once or twice a year to reflect developments since the last update. However, not only did

the employees' competencies change frequently. The competence structure itself would not remain correct for long. Entirely new competencies made their appearance and existing competencies became obsolete much faster than the TP/HR system was designed to handle. A management consultant stated:

> "Earlier it was easier [to have a updated competence system] since there were few programming languages. Now the development is so fast. Yes, there are the fourth, fifth, and sixth generation."

To cope with this evolution, Volvo IT established a maintenance organization. Keeping the competence structure and the competence data up-to-date was a burdensome task, however, which required a lot of administration. As the project proceeded negative aspects started to surface. It seemed that employees at the grass-roots level had no direct interest in providing their competence data since they could not benefit from using the system. A management consultant pointed out:

> "TP/HR is hierarchically structured and closed. As an individual you can see nobody but yourself. If I search for a certain competence, the system should support me in identifying the appropriate person. Such features are missing in the system. Instead, I have to talk to someone who is familiar with the employees' competencies. In any case, I can't use the TP/HR system for doing it myself."

Despite the intended change towards a more project-oriented and decentralized organization, Volvo IT's organizational structure can be described as hierarchical. This was reflected in TP/HR's closed system structure. While managers were authorized to see competence information about all their subordinates, employees in other positions could only see their own competence descriptions. During the initial phase of the TP/HR pilot project, however, the ability to search for and find a person with a specific competence was considered an obvious feature. As the pilot project advanced this changed. The project manager for the TP/HR pilot project explained:

> "So, you have a fixed organization and fixed work tasks, so the predominant thing will be competence gap analyses and

> competence planning. The search ability [for competence] does not even come second hand; it is way down on the priority list. [...] This is interesting because it has emerged during the project that there is a shift in perspective here. Everybody saw searching as something important and many still desire it, but it is not perceived as a primary thing as the approach is today."

Thus, the TP/HR system was primarily a management vehicle including features for measuring the status of employees' competencies and gap analyses. The employees were presumed to regularly feed the system with competence information, but they did not get much in return. As highlighted by several respondents, this producer/consumer dilemma counteracted the employees' motivation to use the TP/HR system. During the evaluation of the TP/HR system, the interviewees discussed different motives as to why Volvo IT had chosen to implement a system with a closed structure. The following member of the TP/HR project group pointed out one reason:

> "The more people involved in competence registration, the more regulations there must be. We don't want other managers to be able to conduct internal recruiting [by using the TP/HR system]."

In line with this quotation, several project group members claimed that the TP/HR's closed system structure was basically a means for avoiding internal recruiting within the organization. An additional reason discussed was culture, as illustrated by the following HR manager:

> "TP/HR could be used as a search tool to find someone who has the requested capability. [...] However, to use the system for such a purpose requires a certain way of thinking; I have to expose my competence. Thus, I make my description visible for the whole organization; everybody can see my competence ratings. We don't have that kind of culture here; actually not even close. Some of us might get on with it, but certainly the majority would not."

However, there were project group participants who viewed the cultural dimension differently. A management consultant gave her opinion of the matter:

> "[To use the system] should be a way to market yourself in order to get interesting assignments. The opponents to this argument are surely those ten percent who have come to a stand still in their competence development. Presumably, there are many managers in this group."

Several members of the project group argued that the TP/HR system could have been an important tool for employees to communicate their existing competence and ambitions for future development. As highlighted by some interviewees, the closed system structure, however, conveyed that competence was primarily a personal thing of no interest to others (cf., the adoption barrier user isolation). Moreover, the TP/HR system lacked features that managed information about employees' wanted competencies and desired work tasks. Related to the latter, a project manager stated the following when analyzing the TP/HR system's content:

> "Things that people do today and did yesterday do not necessarily represent their aspirations for tomorrow."

However, the TP/HR system included, as mentioned earlier, a free-text area designed to hold records of things that did not fit the formalized competence structure. It could be personal experiences, competencies outside one's direct line of work, hobbies, or remarks about future plans. Since this was the only place to record personal interests, employees used this area to indicate, for instance, competencies that they were interested in applying, and desired future assignments (cf., the adoption barrier reproduction bias). Although this area was indexed and thus searchable, the information could not be aggregated and it was not in any way related to the formal competence structure of the system. Project management members did not seem to think, however, that this was much of an issue. One key person in the project team claimed:

> "If you look at TP/HR, there is nothing that really indicates what you're interested in. And if there had been, I think many would have thought that there is no reason for me to register that. […] I don't want that in a system."

The TP/HR project manager shared this view and said:

> "Yes, interests are a long way down on the list. It is fundamentally a personal thing; interests have no strategic value according to my point of view. Interest is for your own sake and therefore it is not reasonable to assume that people should register this type of information in the system. […] People won't invest their time in such work because they simply don't benefit from it."

However, there were some project members who did not fully appreciated the above cited project manager's standpoint because they saw interest as an important component related to competence. As an illustration, the following project manager clearly indicated the relationship between interest and competence:

> "[…] It is important that we are able to find and take care of people's interests. Definitely you perform better if you are interested in the work-task in question. And surely people's potential to learn increases when they find the actual area exciting."

In line with this project manager, there were interviewees who criticized the rationale of the TP/HR system. One HR manager commented:

> "TP/HR is mechanical since it indicates that either you have the competence or you don't. But, you could be interested in something even though you don't have formalized competence in that area."

Obviously, there were participants within the project group who had different perspectives as to what type of competence information that should be handled by the TP/HR system.

The TP/HR system never took off after the initial evaluation, although the overall impression was rather positive and the project participants pointed out the obvious benefits of having a common structure and language. When analyzing the underlying reasons for the problematic adoption process of the TP/HR system, most of the project members discussed lack of management commitment and too little training and education as being matters of vital importance. Some of the project members were, however, more specific about the technology and its relation to Volvo IT's work practice. The closed system structure and the system's lack of future orientation had, according to these individuals, negatively

affected the employees' adoption of it. Not surprisingly, these project members considered it necessary to concentrate future competence systems evaluations on systems addressing the above design dimensions.

5.2 Action planning and taking

As suggested earlier in this paper, one useful assumption is that the adoption of competence systems would be more successful if these systems reflected the dynamic nature of knowledge work. In order to address the static character of existing competence systems, as illustrated by the results from the in-depth studies, our research team used conceptualizations of people's interests as the basic rationale for re-designing competence systems. In co-operation with Guide and Volvo IT two competence systems prototypes were developed and implemented during the spring of 2000.

At the beginning of April 2000, the working group at Guide decided that an add-on module handling flexible analyses of existing competencies and competence interests of organizational members should complement the original version of the Competence marketplace system. In collaboration with the working group and three M.Sc. students, one of the authors developed the Competence Visualizer system, i.e., the original version of the competence marketplace system with the addition of an add-on module.

Volvo IT's experiences from the TP/HR project offered our research team an opportunity to introduce and evaluate a technology that contrasted with the TP/HR system. More specifically, the Volvo IT case inspired us to investigate how the organizational members would adopt an interest-based competence system with an open structure. At the time of this research, one of the members of our research team had the responsibility for the Volvo IT intranet. Based on his knowledge on search engines and recommender systems, the Volvo Information Portal (VIP) system was developed. In late March 2000, it was decided that the VIP

system should be implemented as a complementing competence system to TP/HR.

In the context of this research effort, these prototypes were intended to work as tools for improving our understanding of whether or not inscribing dynamics into the competence systems facilitates their adoption in organizations. More specifically, the main objective was to gain knowledge as to how competence systems can be re-designed so that they support the dynamic nature of knowledge work. What follows is a presentation of the prototype competence systems' design and how these systems were implemented in the organizational practice of Guide and Volvo IT respectively.

5.2.1 Guide and the Competence visualizer system

The Competence visualizer system consisted of the original version of Guide's Competence marketplace and the developed add-on module (see Lindgren, 2002). By handling flexible analyses of existing competencies and competence interests of organizational members, the developed add-on module addressed the general adoption barriers group level imprecision and competence direction inattention. This subsection presents the add-on module and the Competence visualizer's user interface and output.

The add-on module was, like the original version of the Competence marketplace, based on ASP scripts, an IIS server, and a SQL server. Furthermore, the add-on module was constructed on the basis of the system structure and data of the original version of the Competence marketplace. However, since the Competence marketplace system did not handle data regarding competence interests, data for this purpose was simulated. The simulated competence interests were based on the same competence tree and competence grading as the original version of the Competence marketplace.

Regularly, the server created copies of Guide's competence tables that contained information regarding competence areas and competence levels for all consultants within the organization. On the basis of the simulated data for competence interests, the add-on module was able to generate competence patterns of existing

competencies and competence interests of particular groups, i.e. teams of consultants of different sizes, or the whole organization. These competence patterns could consist of either the Competence marketplace's competence grading or an aggregated competence value. A competence value was calculated based on a weighting of the Competence marketplace's competence grading. The weighting of the competence grading was developed in co-operation with Guide's management and was as follows: Beginner was valued 0,25; some knowledge was valued 0,5; experienced was valued 1,0; expert was valued 1,25. This weighting was based on the assumption that an experienced Guide consultant is able to work independently and handle project assignments without the need for assistance while a consultant with some knowledge has basic competencies within the area in question and thus needs support in order to complete assignments.

Regarding existing competencies and competence interests, the user had the possibility of choosing between two different chart types: snapshot of competence status at a particular point of time and development over a certain period. Further, the user could choose between the following scopes: the whole organization, a subsidiary, and a user created list. Finally, the user had the possibility to choose between the four competence areas represented in the competence tree.

The Competence visualizer's output was displayed in either a chart of horizontal bars representing a snapshot of the competence status at a certain point of time or a linear chart regarding development. The competence patterns could be based on existing competencies as well as competence interests. Each horizontal bar could consist of up to four parts, which represented the different competence levels: Beginner; some knowledge; experienced; expert. If there were no consultants at a particular competence level, for instance beginners, the horizontal bars would be presented as three bars and so on. In relation to the chart, a table was displayed containing the number of consultants that the horizontal bars were based on. The combined linear chart was based on existing competencies and competence interests. The lines represented the existing competencies or competence

interests in a specific competence area. Each dot on the lines displayed the aggregated competence value at a specific moment.

During April and May 2000 the competence Visualizer system was evaluated. The results from this system evaluation are presented in subsection 5.3.

5.2.2 Volvo IT and the VIP system

As described elsewhere (see Lindgren et al., 2001; Lindgren and Stenmark, 2002), VIP was an intranet agent-based recommender system prototype developed by one of the members of our research team. Based on interest-driven actions of organizational members and geared with two specific features, the VIP system addressed the general adoption barriers reproduction bias and user isolation. This subsection presents the VIP system's design. In particular, we describe the two features Find users with similar interests and Find competence.

The rationale behind recommender systems (RS) (Resnick and Varian, 1997) is the fact that people in everyday life frequently rely on others with more experience to provide them with recommendations, e.g., what restaurants to visit, what films to watch, or, as in our case, what web documents to read. Based on "word-of-mouth" (Shardanand and Maes, 1995) such collaborative filtering (Goldberg et al., 1992) is spontaneously performed by people to suggest to friends and colleagues what are believed to be things of interest. The objective of early RS was to augment this social process by aggregating recommendations from more people than you usually interact with, thereby increasing domain knowledge and minimizing bias. The focus on connecting people with objects, e.g., books, films, music, or web pages, which characterized early work, has continued to dominate also in more recent group-related research (cf., Grasso et al., 1999). The incentive-related problem faced by early developers (i.e., we like to receive recommendations, but why would we provide any) has been solved in part by using implicit recommendations. Rating is acquired by methods other than obtaining it directly from the user (Oard and Kim, 1998; Claypool et al., 2000) and one alternative

could be to engage personalized agents to perform the recommendations.

The fact that people share a certain taste or interest has, however, not been explicitly used by RS to connect the users with each other. Two people, perhaps even in close proximity to each other, may be working with the same problem without being aware of each other and without knowing that they are reading the same literature. However, when both of these individuals are using the same RS, it is possible to automatically detect similarities between the two as represented by their agents or profiles and introduce these to each other (see Foner, 1996; Stenmark, 1999). In line with this, RS have recently been employed to locate and exploit expertise within organizations (McDonald and Ackerman, 2000). From a competence management point of view, it has been shown that RS can be used to tap into the users tacit knowledge by communicating their professional interests (Stenmark, 2001). Interests, it has been argued, reflect the commitment and passion that are prerequisites for all knowledge (Polanyi 1958; Habermas, 1986) and can thus be seen as indicators of future competence. To exploit personal interests therefore seemed worthwhile and to facilitate this, the VIP system was implemented.

As mentioned above, VIP is an agent-based RS built on Autonomy's AgentWare platform (Autonomy, 2000), which is a commercially available tool that uses neural networks and advanced pattern-matching techniques to find similarities between texts. VIP allowed the users to define information agents that searched an index database for intranet documents matching the users' interests. By defining one or more agents and providing each of these with an interest profile, VIP users were thus able to have the corporate intranet monitored for interesting items. From a user's point of view, the primary objective is to receive relevant and targeted information as effortlessly as possible. Therefore, it is in the users' own interests to define the interest areas as well as possible since a well-defined profile rewards the user with high precision search results. The users defined their interests in a free-text natural language sentence from which the system created an internal digital representation. The search results from each agent were displayed in a simple list similar to those generated by most

search engines, and by clicking on the associated hyperlinks the actual documents were retrieved. When the user had read and identified one or more of the returned documents as indeed relevant, the user could provide the agent with explicit feedback by marking the document(s) and clicking the retrain button. The digital signature of the agent was then merged with the signature(s) of the selected document(s) and the result became the new signature, replacing the previous one.

Furthermore, the VIP system provided a "community" feature, i.e., Find users with a similar interest, which enabled users to locate colleagues with similar information needs or interests. When invoking this feature, the profiles of the user's agents were matched with the profiles of all other agents resulting in a list of users who had defined a similar interest. This list displayed the name, company, department, geographical location, telephone number, and email address of the matching users. The motive was to make the users aware of each other's presence and thus facilitate the emergence of informal networks and online communities.

In addition to the traditional RS features described above, the VIP prototype was equipped with a Find competence button. This feature allowed the VIP users to enter a natural-language text describing a particular interest. VIP would then list all users with matching agents, i.e., all users who had agents actively searching for information related to the specified interest. Whereas the Find users, with the aid of a similar interest feature returned the names of those who shared your interest, the Find competence feature could be used to find a person with an arbitrary interest. In contrast to general competence systems, such as TP/HR, which rely on pre-codified database records of formal competence, the VIP prototype based its results entirely on interest-driven and dynamically detected actions of organizational members.

During the period May to June 2000 the VIP system was evaluated. In subsection 5.3 the evaluation results are presented.

5.3 Evaluating

5.3.1 The evaluation of the Competence visualizer system

In the middle of April 2000, the Competence visualizer system was introduced to Guide's organization. System presentations were conducted at Guide's offices in Gothenburg, Oslo, and Stockholm. During these presentations, the users were allowed to test the Competence visualizer and ask questions about the system's features and its usage possibilities. As described in the method section, the Competence visualizer was evaluated through interviews with individual users, participant observation, and focus groups. In this subsection, the results from the system evaluation are presented. The results highlight the merits of the Competence visualizer, possible improvements to the system, and organizational aspects related to its use.

On the basis of the empirical material, it was obvious that the greater part of the interviewees was attracted by the Competence visualizer's flexible visualizations of competence information. The possibility to visualize groups of employees of varying sizes at different points in time was considered as facilitating management's work with competence analyses. Several respondents, however, saw possibilities for improving the different charts that the system generated. The HR manager at Guide in Oslo discussed the need for features in the Competence visualizer system that deal with personal information about the consultants. According to this respondent, a current and previous assignments record is one example of personal information that can facilitate both project-manning decisions and the planning of competence development activities. The CEO for Guide in Oslo discussed an additional improvement:

> "It would be great to see the development over time with regard to different competence levels, the number of beginners in proportion to the number of experts and so on, and how the relationships between these levels are changing as times goes on."

According to many respondents in managerial positions, the development chart should not only present an aggregated competence value but also the different competence levels. The possibility of seeing the distribution between the different levels would support the organization's management of resources, they claimed. Furthermore, there were interviewees who discussed the need for features that handle information about the relationship between employees' existing competence and competence interests. More specifically, information as to whether the employees were competent and interested, competent and not interested, or not competent but interested was requested. A project leader at Guide in Gothenburg said:

> "The usefulness of the chart that presents an aggregated value of competence interests is limited since I don't know whether or not these consultants are competent in that area. Maybe they are merely interested."

In line with this project leader, several respondents argued that it must be possible to evaluate competence interests to existing competencies. Since formal competence is the cornerstone in Guide's offers to their customers, they argue that the identification of merely interested employees is of little value. However, there were respondents who contrasted this perspective. These persons highlighted several interesting possibilities based on the Competence visualizer's ability to visualize competence interests in the organization. First and foremost, implementing this type of system that handles information about the employees' ambitions regarding competence development is a good way to communicate Guide's competence focus within the organization. If the employees experience Competence visualizer as an important means in their striving toward the development of new competence, this contributes significantly to their commitment towards the system, as pointed out by the respondents. The CEO for Guide in Oslo commented:

> "The interest dimension is the new thing that you are introducing. This interest aspect will be a vital incentive for the consultants since they are able to signal their competence interests and this fosters the use of the system within the organization."

An additional possibility discussed by the interviewees, was to use the Competence visualizer as support for managing the organization's experts. The CEO for Guide in Stockholm articulated this:

> "The competence interests show in which direction we are going. In some ways the driving force within the organization. We can use our experts in the identified competence areas since their extra competence is essential for the development of these areas."

According to many respondents, there were no facilities for capturing interest directions within the organization at the present situation. Thus, the Competence visualizer could fulfill an important function in Guide's activity. Besides competence interests as indicators of driving forces within the organization, there were interviewees who argued that employees interests also provide information about the surrounding world. One consultant manager in Gothenburg explained this in terms of market analyses:

> "The possibility to search [in the Competence visualizer system] for fields of interests is attractive. These fields of interest reflect what is in the wind within this line of business."

There were interviewees, however, who defused the value of Competence visualizer as a tool for market analyses since employees, they claimed, tend to be interested in competence areas that the market demands. Accordingly, it is problematic to consider the employees interests as indicators of what the market will ask for in terms of competence. An account manager at Guide in Gothenburg commented:

> "Hard to say actually; for some people the interest surely precedes the market, but for the majority I believe that it is the other way around. I imagine that there is a docility between what the market demands and people's interests."

Independent of the actual relationship between the employees' interests and the market's future profile, several respondents thought that the Competence visualizer system addressed the problematic fact that employees manipulate their competence data

to get certain assignments in which they are able to develop a particular competence. A consultant manager in Gothenburg pointed out:

> "The worst thing that can happen is that I get a person who was an expert in this area ten years ago and then you tell this person: I plan to use you in this area. The person in question answers: But, that was ten years ago. I still have competence in that area, but I prefer to work with other things. And then I don't use this person. This is supposed to be handled in the personal development discussions. During those, it sometimes turns out that consultants don't want to work with certain areas any longer; they want to downplay particular competencies. Then you have to decide whether or not to do so. If a competence was indeed removed, you're in a problematic situation. When using the Competence visualizer, however, the consultants' existing competence can be made visible on an aggregated level, but on the individual level you can be informed that a person doesn't want to make use of a special competence in the present situation."

In accordance with the consult manager, a group manager at Guide's office in Gothenburg expressed:

> "As an example: I have been working with Fortran for ten years; I'm a really good Fortran programmer, but I don't want to work with it. Then I have removed that competence in the system [the Competence marketplace]. For this reason, this interest dimension is not that bad; I'm good at it and I want to work with it, I'm good at it, but I'm not interested in working with it, and my knowledge is limited at the moment, but I'm eager to learn more."

According to these two interviewees, Competence visualizer offers a possibility for the employees to describe their competence in a more detailed way since they are able to express both existing competencies and competence interests. Competence interests are not to be represented at the expense of existing competence and thereby Guide can receive a more accurate picture of the immediate competence situation within the organization. In relation to this, there were respondents who argued that the activity in which employees' think about their existing and future competence is important from a learning point of view. The competence development manager in Gothenburg said:

> "By using this system the process of entering competence data becomes an important part of the consultants' competence work. They have the opportunity to more actively market their competence and their wishes and in this process of thinking about one's competence there is surely a learning dimension."

If Guide succeeds in establishing an active use of the Competence visualizer, the system would be an important asset in the organization's strategic competence work, as expressed by the interviewees. The possibility of regularly comparing the employees' existing competence with the competence interests constitutes a significant foundation for Guide when it comes to formulating strategies for future competence development activities. Moreover, some respondents highlighted that the Competence visualizer system has the potential to be an interesting marketing tool for Guide. A group manager at Guide's office in Gothenburg pointed out:

> "It's quite easy to appreciate the value of this system. It's really interesting to check out the competencies within the organization on a regular basis; be able to find out our strengths and weaknesses. And the interest module indicates what work tasks the employees are interested in working with. But, then it is our duty to create an interest; you have to introduce what they choose. That is the best approach. In this way you are able to affect both of the curves; it is simply a matter of marketing."

However, there were also discussions regarding problematic aspects related to the Competence visualizer's features for measurements of existing competence and competence interests. A group manager at Guide's office in Gothenburg commented on one such aspect:

> "There is a risk associated with this system since you map the whole organization and its individuals. You can visualize their wishes, in which direction they want to go, and what abilities they have and so on. This kind of information is really valuable. If you close the system, people tend to think that you are up to something underhanded. Usually, openness is the winning approach in the long run even though you sometimes get walloped because someone has misused it."

In line with this group manager, some respondents argued that an increased precision in the mapping of competencies would most likely result in employees who worry about the system being misused. This type of integrity issue will, as the interviewees pointed out, negatively affect the users' commitment to use the Competence visualizer.

5.3.2 The evaluation of the VIP system

In the beginning of April 2000, the VIP system was implemented on the Volvo IT intranet. Related to the implementation, a workshop was conducted at Volvo IT's headquarters in Gothenburg, Sweden. At this workshop, the VIP system was introduced as a complementing competence system to TP/HR and its basic features were described. As outlined in the method section, VIP was evaluated after a ten-week test period through interviews with individual users, participant observation, and focus groups. The evaluation was concentrated on the users apprehensions of VIP, possible usage areas, design improvements, and organizational aspects related to the system use. Below, follows a presentation of the results from the VIP evaluation.

During the analysis of the empirical material, it appeared that the interviewees viewed VIP and its content in different ways. Some users thought that VIP contained formal competence descriptions in a similar manner to TP/HR, while others did not relate the system's information with competence. The greater part of the respondents, however, was uncertain as to what type of information VIP handled. This ambiguity is illustrated by this quote from a software developer:

> "Well, the find competence feature [in the VIP system]; first I interpreted it as if you came to some kind of competence database. There is one competence database that I subscribe to where you search for competencies. If someone knows, for example, C++ and Cobol and what have you; then you can search for it. So, it does not seem intuitive that this is called find competence, but maybe it's right. I guess it is something you have to get used to if you want to use it. But, it does not seem intuitive […]. I'm still puzzled when I look at it."

Several respondents meant that this uncertainty could be addressed by adding features to VIP that managed formalized competence representations. According to those persons, an important condition for VIP to be embraced by the users is that individuals identified by the system can be evaluated with regard to formal competence. If this was not the case, the interviewees asserted, the information would hardly be considered as trustworthy. Besides formalized competence descriptions, several respondents argued that the VIP system should contain more detailed personal information than was currently offered. According to those, a picture, a homepage, or information about assignments would support the employees in competence identification. A department manager said:

> "[In VIP] there are only email addresses. Most of the employees have some form of personal presentations on the intranet. So, had there been links to those pages one could have seen what these persons had created on the intranet. It could be a photo, where they can be found, and what areas they work with. Or information that they have authored."

The majority of the interviewees were, however, rather attracted to the fact that VIP handled a different type of information than TP/HR. These persons recognized two different design rationales for competence systems, both with their respective pros and cons. When analyzing the systems, the respondents discussed different aspects. One aspect, highlighted by several users, was the problem that traditional competence systems, like TP/HR, rarely contain updated information, which entails that people tend to work with things not expressed by the system. Since VIP is based on people's actions in the form of information seeking activities, however, the interviewees asserted the system's potential to present an updated picture of the organization's competencies. In line with this reasoning, one HR manager argued that the VIP system indicates what people use their skills for:

> "TP/HR is a lot about order and being in control of the situation. To know what we have and the level of education of our employees; how many of these and how many of those. Then this prototype is something else. It is what people do on

> an everyday basis. It is what they used their skills for. It is sort of the next step."

According to many interviewees, VIP can provide Volvo IT with information about the different competencies that are applied within the organization. Other respondents pointed to an additional difference between VIP and traditional competence systems like TP/HR. While TP/HR show roles and positions that the employees have been assigned by the organization, VIP makes it possible to identify people searching for information outside their formal area of responsibility. As highlighted by the respondents, such actions typically indicate a natural driving force. For those interviewees, competence was thus not only a question of specific knowledge but also a question of attraction, commitment, and passion towards the area in question. A systems programmer explained:

> "Yes, I search for competence. And this is separated from searching for certain knowledge. Searching for competence is in some way a bigger issue than just finding Chris because he has knowledge in the area I'm interested in. […] But, you won't get such contacts by using a traditional competence system. Today, I call certain persons within Volvo IT although they are not connected to this thing, but they have the ability, they will make things happen, and they have the commitment. So, it is surely a roundabout route in comparison to the intended way. Therefore, this system [VIP] is an excellent means if you don't know."

The fact that VIP was an open system with the ability to visualize people's interests and commitment attracted most of the participants in the system evaluation. One of those, was the TP/HR project manager:

> "[The find users with similar interest feature] is very interesting. I see this as a very useful feature; as an enabler for building [human] networks. It is interesting to be able to find colleagues who are interested in the same things. Because our main problem here is that there are people working with similar things everywhere and you don't really find them. […] For me it was natural to see the other users but also to signal my own presence and interests to them."

As people added, deleted, or retrained their agents, these unnamed communities would constantly change members to reflect the current situation and the actions of the users themselves. No organizationally appointed administrator had to define communities in advance according to some espoused theory and the organizational members were instead in control. A software developer, familiar with both information retrieval tools and the TP/HR system commented:

> "The advantage with this approach is who controls it, I guess. In a normal [competence] system, the administrator or some organizational function measure the information and controls it, and builds the system himself. Here, I am, as a user, able to influence the result to a much higher degree. […] In traditional competence systems that handle formalized competence descriptions you define what dimensions are to be measured. In contrast, this system [VIP] is built on organizational needs. […] By using this system, I can affect my situation by expressing my wishes. I want to work with XML, for instance, although I don't do this in the present situation."

While traditional formalized competence systems, like TP/HR, usually build on a controlled and hierarchical top down-approach, the VIP system was based on the intentions and actions of individuals. In accordance, several respondents meant that VIP conveyed a high degree of individual autonomy, which facilitated, as they asserted, an active use of the system. In line with the above argument, the following technology watcher expressed:

> "You cannot build hierarchically; you have to build on interest. […] People must prioritize this against their daily work and how do you accomplish that? Yes, one must appeal to their interest. That is basically the way to go. I consider that extremely important. Maybe, it is not the complete solution, but certainly a part of it; a substantial part of the solution."

Besides that VIP was apprehended as a decentralized system where the users themselves to a large extent affected and decided upon the content, there were interviewees who argued that the system communicated the importance of development, change, and learning. A technology watcher expressed this when analyzing the VIP system:

> "Interest is tremendously important for the development of competence. When you appreciate something and find it challenging, the fundamental conditions for learning are in place. Basically, this is the argument that you should buy new golf clubs for your children and the rationale for doing this is that if they find golf exciting, they will learn to play better. If you on the other hand say that a skilled golf player is not dependent on the clubs and consequently buy poor golf clubs for your children, they will not learn to play golf. […] So, to cultivate learning, it is important to provide positive tools like VIP; tools that cultivate a positive spirit increase the competence, the interest, the speed, and the quality. […] We [Volvo IT] are not good at taking care of individuals' interests and creating an environment that supports those. […] However, if it deals with the organization's core competencies, we are ambitious. But, when it comes to areas that presently are peripheral but could be significant in five years time, it is really bad. And this adds to the inertia of the organization."

According to this technology watcher, it is important for Volvo IT to identify and develop competence that could be decisive in the future. To implement competence systems like VIP that harmonize and support this ambition is thus critical, this respondent argued. As several interviewees highlighted, a considerable part of the VIP's attractive force was dependent on its future orientation, which, they claim, would cater for a widespread use. To the extent that a critical mass of VIP users is reached, some respondents saw strategic dimensions related to Volvo IT's use of VIP. One project manager said the following:

> "If you can utilize people's interests and put that into action in their work you can gain momentum. Should you start a new job function and you don't know if anybody in the organization is interested in working with this, then it might be interesting [to use the find competence feature]. Because you don't walk around asking all 400-500 managers if they have someone who would be interested in working with this."

In relation to this, there were interviewees who discussed the fact that VIP did not handle historical data. According to those persons, there should be features that manage aggregated information about interests at different points in time. One user expressed:

> "I can see other people's agents and find things out, but I would like to have a picture of the number of users searching within a particular area. [It would be useful] to get a map of how many looks for a certain topic, not who looks for what."

From a strategic point of view, Volvo IT would benefit from knowing how different interest groups develop over time, many respondents argued. To have strategic information about the employees' interests is, however, dependent on there being searchable information related to these areas on the organization's intranet. A project manager discussing the use of the VIP system said this:

> "There will always be things that are not to be found on the intranet. […] And then you don't find those people who did not find the information that they searched for. It happens that information about, for instance, new technologies is missing on the intranet because of the rapid pace of change. Actually, these are the people that we want to find."

Besides the importance of having the right information on the intranet, some respondents discussed the high quality of existing information as a critical factor related to the use of VIP. The following technology watcher meant that an unsuccessful search could indicate that there is no created information about a certain area, which in turn could point to missing competence areas within the organization:

> "Yes, it could mean that there are missing competence areas. Unfortunately, the information quality on the intranet does not allow such a conclusion. It is an indication, however, that there are missing competence areas."

As this technology watcher emphasized, the possibility of identifying missing competence areas is dependent on the information quality of the organization's intranet. In addition to the above-described conditions for a successful use of VIP, there were interviewees who raised concerns about the system's rationale. The following project manager was one of many respondents who highlighted the integrity issue:

> "Certainly, there are people who would never use this system. By using the system people are able to see what I have searched for. I expose myself in this system. However, it's about my

> personal integrity; what I search for is my business and no one else's."

Although those respondents saw several merits of VIP as a competence system, they clearly pointed to the fact that this type of system brings the question of employee integrity to the fore. While formalized bureaucratic systems, like TP/HR, tend to oversee the individual, VIP, on the contrary, reveals individuals' actions in a way surely not appreciated by everyone.

5.4 Specifying learning

Based on the first action research cycle, it was concluded that there seems to be a misfit between existing competence systems and the dynamic nature of knowledge work. Different barriers to the adoption of competence systems, as illustrated in subsection 4.3, embodied this problem. On the basis of the adoption barriers, the competence systems can be described as espousive, reproductive, isolative, and rigid conveying an archiving technology spirit. The competence systems were used as traditional personnel administration systems for the passive handling of formalized competence descriptions. As formulated in subsection 5.1, the main objective of the second action research cycle was to produce new design principles for competence systems in order to overcome the identified adoption barriers. Based on lessons learned from Guide and Volvo IT, we offer four principles for designing competence systems:

- Competence systems should include features that facilitate searches for action-based competence. An action-based system has the potential to capture people's competence on the basis of their actions. In contrast, existing competence systems simply manage formalized descriptions of the work tasks or roles that the employees have been assigned by the organization.

- Competence systems should contain features supporting the creation of communities of interests. Such informal networks make organizational members aware of colleagues with similar

interests and competence. In contrast, existing competence systems typically restrict employees in non-managerial positions to merely seeing their own competence descriptions.

- Competence systems should have features that handle a deeper level of personal information. Such information must be accessible to everyone in the organization since this would facilitate competence sharing and community building. In contrast, existing competence systems only handle information as to name, organizational belonging, position, and telephone number.

- Competence systems should include features that enable flexible and aggregated visualizations of formalized competencies and competence interests of organizational members at particular points of time and over certain time periods. In contrast, existing competence systems handle analyses of formalized competence in fixed sizes of teams over predefined periods of time.

With these principles as a starting point, competence systems that are transparent, interest-driven, media rich, and flexible can be designed. By conveying an activating technology spirit such competence systems better reflect the dynamic nature of knowledge work thereby facilitating their adoption in organizations.

6. Discussion

6.1 Towards a new competence systems agenda

The general wisdom of the last decades of information systems research is that the practice of information systems is largely influenced by the surrounding social context. As early as in 1967,

Ackoff (1967) remarked how the knowledge management systems of that time, management information systems, were often sources of "misinformation" because they could not relate to the social and cultural context in which decisions were made on a daily basis. Today, more than thirty years of information systems practice later, it seems that many of these problems still remain. As noted in recent knowledge management studies (Bannon and Kuutti, 1996; Ackerman and Halverson, 1998; Schultze, 1999, Swan et al., 1999), for instance, there seems to exist a mismatch between the underlying view of knowledge in knowledge management systems and how knowledge is made actionable in the context of organizational everyday work.

Competence systems, as one type of knowledge management systems, exemplify how these mismatches have unintended consequences when they are revealed in the practice of knowledge work. Looking at our examination of the adoption of existing competence systems at EHPT, Frontec, Guide, Volvo Car Corporation, Volvo IT, and Volvo Truck Corporation, one can see how the use of today's competence systems presents a number of barriers (Disintegrated competence representation, Staff availability blindness, Reproduction bias, User isolation, Knowledge sharing disability, Group level imprecision, Competence direction inattention, and Environmental exclusion) that are basically counter-productive to competence application and development in knowledge work settings. These barriers are fundamental ones in that they inhibit individuals from applying and developing the competence they draw on in their day-to-day activity. Ultimately, this is negative for both the individuals themselves and the organizations for which they work. The main problem with existing competence systems is that they convey a technology spirit that makes them virtually unusable in knowledge work practice. In view of the fact-oriented, formalistic, systematic, and top-down nature of these systems, one might refer to them as archiving technologies.

There are basically four negative aspects of the archiving technology spirit of competence systems. First, competence systems are espousive in that they seldom contain useful competence descriptions in the first place. Typically competence systems merely manage formalized descriptions of organizational

members' existing competencies. Information about the employees' interests, desired assignments, and future plans are ignored by the systems. As a result, the competence descriptions are manipulated for instrumental uses. Because individual staff members soon understand the flaws of the competence systems, they provide the system with competence data that facilitate the career path that they aim at. In order to get Java assignments, the competent Cobol programmer would exaggerate her Java skills and downplay her Cobol skills. Second, competence systems are reproductive in that their use for manning project assignments, for instance, tends to reinforce the career path that organizational members already pursue. Because the systems keep track of historical competence data, their use tends to ensure, for example, that competent C++ programmers continue to get C++ assignments and competent project database specialists continue to get database assignments. In short, while the competence systems, for good reasons, reveal people's earlier competences, they also tend to inhibit competence application and development outside the competence domain that people already possess. Third, competence systems are isolative in that they rarely allow staff members to access and assess other members' competence descriptions. While this "user isolation" is often intended to obstruct internal recruiting, it also undermines the possibility of connecting people with similar competencies and interests. Fourth, competence systems are rigid in that they only support analyses of employees' competencies in fixed group sizes at predetermined points of time. The fact that the competence systems are not adaptable to changing conditions makes them, for example, almost unusable for account managers who need quick and flexible competence analyses as support for their decision-making.

Our action research study implies the need for developing a competence systems agenda with the potential to overcome the archiving spirit of existing competence systems. As is the case in almost all type of IT adoption processes, the potential success of such an agenda depends on its ability to build a basis for developing technology that caters for the practical matters that engage practitioners on a day-to-day basis. Developed and formulated together with practitioners in the participating

organizations, our second action research cycle points out a new direction for developing competence systems. Following AST, this direction needs to manifest a technology spirit that better fits the practice of knowledge work. The Competence visualizer and the VIP systems represent attempts to re-design competence systems so that they convey an activating technology spirit more in line with the dynamic nature of knowledge work.

On the basis of the evaluation of the prototype competence systems, we suggest four design elements that can be seen as the first steps towards a new competence systems agenda. First, instead of the exclusive orientation on primarily formalized competence descriptions, competence systems need to be transparent in that they should reveal the action-based competencies that exist in an organization. One strategy is to design competence systems to primarily keep track of what people are interested in for the future, rather than putting the emphasis on what competencies people have applied. Second, the competence systems need to be interest-driven in that they put the interests that people have at the forefront and make these available to anyone within the organization on individual, group, and organizational levels. Third, competence systems need to be media rich in terms of the descriptions that are stored in the systems. Since competence sharing and community building depend heavily on trust and compatibility competence descriptions need to include a deeper level of personal information. Fourth, in order to be useful as a basis for competence development decisions as well as project manning situations, competence systems need to be flexible. Real-world organizations require that the competence systems used have a flexibility that matches their complexity.

So, what are the benefits of using competence systems? Do we really need a new competence systems agenda? First of all, competence systems can be useful in downplaying arbitrariness in terms of who gets appointed to new job positions and project assignments. In this regard, competence systems put the emphasis on documented competencies at the expense of informal contacts and personal opinions. This is not to say that intuition and personal judgment are not valuable ingredients in the decision-making surrounding competence application and development, but

rather that competence systems can potentially provide valuable support for making such decisions better informed. In addition, well-designed competence systems can support both individual and organizational learning by paying systematic attention to how competence is defined within the organization, how competence is applied in organizational day-to-day activity, and how organizational members' existing competence and competence interests develop over time.

While these advantages can be of substantial value for most organizations, it is important to consider the privacy issues occasioned by the use of competence systems. As was raised in our study, several individuals were worried that increased transparency would put too much emphasis on competence descriptions. Even with much effort invested in making accurate competence descriptions, they argued that increased competence description precision could give rise to violations of the personal integrity of employees. While there is little doubt that unreflective use of rich competence descriptions may raise privacy concerns, the worries expressed by some of the respondents can be interpreted as a manifestation of what Argyris (1990) calls "organizational defensive routines". Because some people experience richer competence descriptions as a potential cause of embarrassment or threat, they highlight how competence systems could be misused in a way that violates personal integrity. While it is important to implement policies that keep track of potential misuse, we subscribe to Argyris's (1990, p. 25) view that this type of routine can often be "antilearning, overprotective, and self-sealing".

6.2 The use of social theory in action research

In light of recent perspectives on the role of theory in information systems research (Jones, 1999; Monteiro, 2000; Orlikowski and Iacono, 2001), there are reasons to comment upon our use of AST in our action research study. Because action research simultaneously supports practical problem solving and the expansion of scientific knowledge (Hult and Lenning, 1980), our

use of theory in this research work should be understood as an attempt to apply a solid conceptual basis for achieving these parallel goals simultaneously. In this regard, some trade-offs have been necessarily implemented into the action research process to address the concerns of the practitioners with whom we engaged in the field. We subscribe to Rose and Lewis' (2001, p. 278) view that "structuration theory is too complex and diverse to be adapted wholesale" and our application of AST, as a variant of structuration theory, can be described in basically two ways. First, we have used AST as an in-action conceptual basis for assisting the practical decision-making made throughout the process. In this process, there were basically two concepts of AST (structural features of the technology and technology spirit) that were the primary conceptual tools used in the two action research cycles of diagnosing, action planning and taking, evaluating, and specifying learning. These concepts and their inter-relation together with empirical insights occasioned throughout the process were the key components in guiding the inquiring process. Apart from this example of more explicit use of AST, other parts of the theory were used implicitly in our framing of the problems identified at the research sites. The prime intention with the in-action use of AST was to transcend the common-sense understanding used in everyday action in the process of joint identification and formulation (researcher-practitioner) of the research issues. Second, we have also used AST retrospectively. As Weick (1995) outlines, sensemaking is largely a retrospective endeavour. In our efforts to make sense of what was learned during the two action research cycles, we added the full conceptual apparatus of AST (with the exceptions specified in subsection 2.3) when writing up this paper. This retrospective use of AST was important as a means of increasing the precision of our analysis and even though these concepts have not been important parts of the actual researcher-practitioner collaboration, they were important for increasing the analytical distinctiveness.

Drawing on Thorngate (1976), Weick (1979, p. 35-42) provides an illuminating account on the inevitable tradeoffs that are associated with theory use and development. Accuracy, generality, and simplicity are desired qualities of a good theory, Weick asserts, but they can never be achieved simultaneously. It is

inevitable that one of these qualities will be downplayed when theorists try to maximize the other two qualities. Following this line of reasoning, it can be argued that Jones' (2000) criticism of AST is an example of a heavy orientation towards the accuracy quality of theories. Jones (1999, p. 124) claims that "…it should be clear that AST bears little resemblance to Giddens's ideas," suggesting that the theory is less accurate in predicting the specifics of structurational processes in which IT is involved. Clearly, Jones' (1999) criticism of AST is valid in terms of how faithful the theory is to Giddens's original ideas, but it tends to overlook the way this "failure" brings with it important gains in applicability. As Rose and Lewis (2001) suggest, social theories such as structuration theory have to be adapted to the realm of information systems practice and this is especially relevant in intense researcher-practitioner collaborations like the ones described in this paper. In action research settings, the simplicity quality is more relevant than the accuracy quality. Our use of AST should be seen as an attempt to apply a social theory for achieving generality and simplicity, at the expense of accuracy.

Looking at action research studies conducted in the field of information systems, one can note that most theoretical frameworks used have been developed originally as both theories and research methodologies. Checkland's (Checkland, 1981; Checkland and Scholes, 1990) work on Soft systems methodology (SSM) and Argyris and Schön's (1996) work on organizational learning represent theoretical frameworks that have a conceptual and epistemological basis suited and designed for action research. As an example, the development of systems development methodologies such as Multiview (Avison and Wood-Harper, 1990) is an example of applying SSM and practical action research to improving systems development theory and practice. In this paper, we apply a complex social theory to competence systems adoption, where the main emphasis has been on how to inform the correction of pragmatic problems experienced by practitioners. In doing this, we have the moral obligation to be faithful to the practitioners we work with although sometimes at the expense of the original tenets of a social theory. Rose and Lewis (2001) provide a nice illustration of how this can be done in the context of intranet development in a

university department. In order to avoid what Kling (1991) refers to as convenient fiction in social theory application, it is thus important for action researchers in the information systems field to incorporate dimensions relevant to information systems practice in theories originally designed for explaining the social only.

6.3 Implications of our action research study

With its origins in systems theory (Checkland, 1981; Checkland and Scholes, 1990; Susman and Evered, 1978), the mainstream action research study is designed and conducted to serve a rather clearly defined client. In our case, the main client can be identified as practitioners who struggle with applying and developing competence in knowledge work. First of all, our research is designed to serve practitioners in non-managerial positions. These individuals often have a rather clearly defined field of expertise such as particular programming languages or local network technologies and, therefore, they easily become subject to categorization according to formalized competence classification schemes. As outlined in our study, this categorization often leads to unwanted consequences in that people find it necessary to by-pass the competence systems to secure short-term assignment preferences and enable long-term career paths (cf., reproduction bias and competence direction inattention). Moreover, the study shows how the competence descriptions of existing competence systems are often too shallow to provide sufficient richness for the practice of competence application. To overcome these problems, our study demonstrates how a competence system should be designed to be transparent rather than espousive, interest-driven rather than reproductive, and media-rich rather than isolative. Such a design, complemented with features making competence analyses flexible rather than rigid, would also be valuable for managerial duties such as manning client projects and designing competence development activities. In sum, our action research study provides a direction for the design and application of useful competence systems in knowledge work practice.

As a concrete result of our research efforts, some of the design principles outlined in this paper have been applied and further developed by Guide and Volvo IT. Based on the experiences from the Competence visualizer system, Guide has improved the Competence marketplace's design. The main objectives for this design improvement were primarily to strengthen their internal competence management activities but also to be able to offer a better competence system to their customers. Currently, Volvo IT in Gothenburg is continuing a project that aims at improving the organization's competence management worldwide. On the basis of the lessons learned from TP/HR and the VIP system, it has been decided that personal interest profiles should be an integral part of the organization's competence descriptions.

Apart from the practitioner implications outlined above, however, our action research study provides implications for a number of other clients related to the typical action research project. First, our study provides insights into action research initiators in that it illustrates how joint collaborations between academia and practice can be designed to increase the relevance for academic as well as industry participants. Many of the reported case and action research studies in the field of information systems include one or a few researchers working with one or a few organizations. While much insight has been gained by such studies, we subscribe to Mathiassen's (2000) view on collaborative practice research in which research is seen as collaborative undertakings involving many researchers and several organizations. In our study, six organizations were part of the overall research project on competence systems. In addition to the theorizing and the direct learning that occurred at each research site, the participants benefited from the indirect learning occasioned by people meeting and interacting at workshops, seminars, and focus group studies. This means that the learning was not restricted to the researcher-practitioner collaborations, but also included practitioner-practitioner collaborations that would not emerge if it had not been for the action research project. As illustrated by this study, these types of collaborations can be productive even in cases where the participating organizations are competitors. Second, our study provides a potential role model for

research sponsors in the process of designing research project expectations and collaborations in applied research programs where both academia and industry are involved. Because applied research in general, and perhaps action research in particular, can confront role dilemmas (cf., Rapaport, 1970) in terms of the roles that each party should take on in the ongoing project, the research sponsor can play an important role in outlining the terms for each party's participation. In the action research reported here, the main research sponsor, Vinnova, required that each party joining the project signed an agreement specifying resource allocations and regulations for potential commercial utilization of the results produced in the project. Looking at our project, it is our conviction that this agreement was necessary to foster a working environment where opportunism, unproductive to learning, was downplayed. In this context, it might be noted that companies such as Guide and Frontec were willing to contribute to the project with internal and customer project experiences, despite the fact that they were rival competitors on the same market. The lessons learned here is that the research sponsor can play an important role in bypassing some of the barriers to industry participation in cutting-edge research collaborations. Third, our study benefits information systems students in that it presents rigorous research on information systems adoption in an accessible way. Sections four and five of this paper can be read and used as a teaching case in undergraduate and graduate information systems education. These sections provide rich material on a range of systems development, implementation, and use aspects and can therefore work as a basis for general educational purposes. Undergraduate classes often use textbooks or management journal papers rather than the lessons published in peer-reviewed journals, suggesting a need for more accessible examples of solid research (see Benbasat and Zmud (1999) for a similar suggestion). On a general level, we suggest that action research, and especially the structure that the action research cycle provides, works well for teaching purposes while it also provides a useful approach to writing up systematic research in a way that is in line with our mundane problem-solving.

7. Conclusion

The literature on institutions (DiMaggio and Powell, 1991; Scott 1995), information infrastructures (Ciborra et al., 2000), information systems failures (Lyytinen and Hirschheim, 1987; Myers, 1994; Sauer, 1993) illustrates the difficulties associated with purposefully changing social systems embedded in surrounding and interrelated networks of information technologies, institutions, power relations, technical standards, and so on. Research on implementations of communication technologies (Henfridsson and Söderholm, 2000), groupware (Orlikowski, 1996a), and health patient records (Hanseth and Monteiro, 1997), for instance, have identified a series of different types of barriers to successful information systems adoption. Indeed, the lessons learned regarding how information systems fail to achieve their intended effects paint a rather discouraging picture of the possibilities of purposeful intervention.

In spite of the difficulties involved in information systems change, however, we must note that information technology, as the most important subset of our object of study, seems to be a running target. New technologies are developed at a surprisingly steady pace and many of them are likely to influence the future of both organizational and social life. While society is changing, however, the information systems research published in our most prestigious publication outlets seems to have little impact on its direction. In this regard, it seems important that the information systems community seriously consider the usefulness of the mainstream strategies and methods used for conducting research. In the recent call for more relevant information systems research, it is suggested that information systems researchers should take a more active part in changing the practices of information systems (see e.g., Benbasat and Zmud, 1999). We suggest that action research is one useful strategy to do that. Rather than merely providing careful analysis of information systems phenomena in a descriptive or explanatory manner, action research enables researchers to produce insights by actively implementing change in practical settings. This encouragement is indeed a challenging one in that the simultaneous contribution to knowledge and practical

problem solving requires re-considerations of how we should produce, implement, and evaluate information systems research.

As exemplified in this paper, one such re-consideration can concern theory use and development. The paper applies a complex theory of information systems adoption, AST, to inform the process of developing a new competence systems agenda. To this end, the underlying complexity of structuration processes have been reduced at the expense of faithfulness to Giddens's (1979, 1984) original formulation of structuration theory. This cost is incurred for increasing the practical relevance for both information systems research and the practitioners involved in the study. We argue that it is more important to be faithful to the practitioners and their problems than to the social theory used when conducting action research. Given that generality and simplicity can be accepted (at the expense of accuracy) as important pillars for evaluating research in the information systems community, our paper provides a comprehensive illustration of action research as a promising research methodology to produce consumable research. In short, the paper examines and demonstrates how competence systems can be re-designed to facilitate their adoption in knowledge work. Our examination shows how existing competence systems fail to cater for the competence application and development problems that practitioners perceive in their everyday practice. On the basis of what we learned from this examination, we co-formulated a new competence systems agenda with the involved practitioners. This agenda is designed to overcome the identified problems and was tested through the implementation of two competence systems prototypes in the competence practice of two case organizations. Contrary to existing competence systems, our research results indicate that such systems need to activate both existing competencies and competence interests that people have in order to be useful in practice. The prototypes are two attempts representing a significant re-orientation of the design principles that underlie the current design of competence systems and might be one step towards the establishment of a new agenda for applying and developing competence in organizations.

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