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# Designing the new intranet

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## Abstract

Designing the new intranet is about exploiting web technology in an organisational context so that the users can better utilise the intranet from a knowledge management perspective. This means to take advantage of the specific features that characterise web technology, to take advantage of the tangible traces of everyday work activities, and to take advantage of the fact that actions on an intranet are not isolated events. The pervading theme in this thesis is how to design the intranet to activate the users rather than a preoccupation with technology *per se*. The ambition has been to understand why intranets are being under-utilised and to influence the way intranets are understood. Another objective has been to design a new framework for intranet implementations in general and for knowledge creation and knowledge sharing in particular. The research described in this thesis has taken place in an industrial environment and in close collaboration with the members of the organisation under study. The results apply to and are relevant to large and/or geographically disperse organisations, where the members do not know or know of each other and the organisation as a whole does not know what it knows. Further, leveraging the knowledge of the employees becomes increasingly important in the post-industrial society, where organisations depend on networks, co-operation, and openness to achieve a competitive edge. This thesis consists of five papers and a framing introduction. Papers 1, 2, and 3 deal with enacted knowledge and competence, whereas papers 4 and 5 are targeted towards innovation and knowledge creation. The introduction places the papers in a context and presents the contributions; (1) the application prototypes, (2) the papers, and (3) the intranet design framework.



**Keywords**
Intranet, knowledge management, information technology, organisations

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Dick Stenmark
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## Part I



## Part II

# Part I

# Research objective

In less than ten year's time, intranets have gone from being perceived as a spelling error to be one of the most widespread organisational technologies. According to a 1996 survey, 40 percent of the North American companies with less than 1000 employees and close to 60 percent of companies with more than 1000 employees had already implemented intranets (Wachter & Gupta, 1997), and Forrester Research estimated that two thirds of the Fortune 1000 companies had intranets in place (Sridhar, 1998). Today, intranets are implemented by most organisations and often hailed as the ultimate solution to many issues, including anything from dissemination of management vision to integration of seemingly incompatible computer systems (Scott, 1998). What caused this tremendous development was the birth of the World-Wide Web (hereafter the web).

The Internet existed quietly for many years without affecting the ordinary man's life. It was not until the advent of the web that the Internet exploded in terms of both users and content. This distributed hypermedia system was initially developed to be "a pool of human knowledge, which would allow collaborators in remote sites to share their ideas…" (Berners-Lee *et al*., 1994, p. 76), and as such, it was designed to facilitate publishing and sharing of information by everyone. The ability to seamlessly connect users from different computing environments, regardless of topologies or operating systems, opened for a dynamic, vivid, creative, and border-crossing environment, where a multitude of file formats, topics, and contents were mixed. Whatever you needed, it would be out there somewhere.

Internet solutions were soon to be brought inside the organisations, and separated from the rest of the Internet by firewalls, these corporate-internal webs became known as intranets. The possibility to be able to connect every employee via a unifying and single client promised to make the intranets ideal arenas for corporate members to meet and share knowledge quickly and efficiently. However, although the dissemination of intranets has been successful and the access to the technology is high, actual usage seems to be limited. This fact is mainly due to the

employees' difficulties finding relevant information; a problem blamed on the lack of coherent design and structure, inconsistent vocabulary, and unclear ownership. Instead of users actively sharing knowledge on a peer-to-peer level, the intranets have become one-way communications channels for corporate information.

My ambition has been to understand why intranets are being under-utilised, to change the way intranets are understood and implemented, and to design prototype intranet applications that take advantage of the specific characteristics of the intranet and support the organisational members in their daily work. *The objective has been to understand how an organisation could design their intranet to better support everyday knowledge creation and sharing*.

This ambition is particularly relevant to large and/or geographically disperse organisations, where the organisational members do not know or know of each other, and the organisation as a whole does not know what it knows. Benefiting from the knowledge of the individual employees becomes increasingly important in what I refer to as *innovative* organisations, i.e., organisations depending on networks, co-operation, and openness to achieve a competitive edge in an unpredictable business environment. Leveraging the intranet from a knowledge management perspective means that the individual employees, and therefore the organisation as a whole, are able to make better use of their knowledge. To study such interactions meant that my research had to be carried out from *within* the organisation. Being an industrial PhD student, i.e., working in the industry whilst completing a doctoral thesis, I have not only studied the organisation but also been a member of it. This situation carries with it particular considerations.

In my position as an insider, I have had field access in ways not always open to fulltime academic scholars, and this has provided me with a contextual understanding useful for my studies. Even more importantly, as an industrial PhD student I have had the opportunity not only to observe organisational phenomena but also to affect the processes and intervene in the human interactions under study. This has been a necessary component of my research methodology. As an organisational member, I have personal and practical experiences of the intranet context from working with it on a daily basis, using it as a

platform for everyday activities, and developing production systems or applications to run on it. My position has thus allowed me to design and implement various IT artefacts in a real industrial environment. However, intervening in an organisation's daily activities and observing the outcome is *per se* not enough to produce solid scientific results. The collected data must be analysed more deeply to become generally applicable knowledge. This is typically a problem for practitioners, who seldom have the theoretical depth or the analytic distance required for such analysis. The academic training I have received during these years of study has provided me with the required tools and helped me elevate my observations, interview data, and experiences to a scientific level. Although I have applied a mix of elements from different approaches, some dominating elements remain consistent throughout my work. These can be traced back to *interpretative case studies* (cf. Walsham, 1995) and *action research* (cf. Avison *et al*., 1999). However, when applying research theories in the field, the borders between them are seldom as clear-cut as they appear in the textbooks, and Braa and Vidgen (1999) hold that the "ideal type" approaches to research are not attainable in practice. Hence, my approach can be seen as a hybrid research method.

Given the nature of my research, it is almost inevitable that some sort of interventions take place. In my case, an important part of this has been to design and add intranet application prototypes. The introduction of new IT artefacts normally bring about a certain amount of disruption that forces the organisational members to a more explicit sense-making than otherwise necessary (cf., Zuboff, 1988; Schultze, 2000). The web application prototypes I have devised have thus been instrumental in provoking my fellow employees to reflect upon and question their assumptions. Leveraging and making the intranet more useful is partly a question of implementing and designing the required tools but also related to social issues such as incentives, attitudes, and values. By designing web application prototypes and introducing them in an unexpected situation or with an unanticipated twist, I have tried to address both these perspectives. The applications have played a role that transcends a pure design/evaluate purpose: they should be seen as catalysts for organisational change, concept development, and theory generation.

The VIP prototype (described in *Paper 2* and *Paper 3*), and to some extent its predecessor Watson (*Paper 1*), were introduced to make the organisational members aware of the importance of personal interests. In the VIP prototype, I included a "Find Competence" feature that 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 organisational members to reflect upon what constitutes competence and how this relates to interests. The Mindpool prototype (see *Paper 4* and *Paper 5*) was an attempt to introduce electronic brainstorming in the realm of traditional suggestion systems, and by encouraging the organisational members to share their ideas, challenge the organisation to think and act differently.

In the next section, I describe the background for my studies. I first elaborate on the industrial heritage that has shaped our understanding of information systems and explain how this affects today's intranets. Secondly, I describe the intranet and its technical characteristics in more depth. Thirdly, I present other KM related work on intranets and discuss how information and knowledge are related and intertwined. I also question much of the previous intranet research and explain how I have taken a new approach to the field. In Section 3, I return to the research topic and derive two more precise research questions. Here, I also outline the five papers that constitute the main research results. The research method used is accounted for in more detail in Section 4. The results are presented in Section 5, where I first describe the two intranet application prototypes used in this research, and thereafter describe the papers and their contributions. Section 6 contains a discussion in which I introduce my design framework and present the new intranet. The introduction finishes with a one-page conclusion in section 7.

# Background

To set the scene for my research I shall in the three following subsections account for the industrial heritage that has shaped our understanding of information systems, explain what an intranet is and what makes it unique, and position my work in relation to previous knowledge management efforts involving intranets.

## *The industrial heritage*

As noticed by Dahlbom and Mathiassen (1993), the mechanistic world-view has since long influenced the way we organise – in the corporate world as well as in society at large. According to this view, which is based on the assumption that the world is ordered and stable, organisations know what to do and how to do it. In organisations, the roots of this mechanistic view can be traced back to Taylor's scientific management (1911), and notions such as bureaucracy (Weber, 1947) and mechanistic organisation (Burns & Stalker, 1961) are but two of the labels used to describe the same phenomenon. In my work, I refer to these organisations as *rationalistic organisations* (see *Paper 2* and *Paper 3*). As explained in *Paper 2*, the rationalistic organisation nurtures a perspective on organisations as closed and stable systems. The work performed in the rationalistic organisation can be described as knowledge-routinised in the sense that it has well-established recurrent activities characterised by repetitive tasks and known problems. The level of uncertainty is low and the ambition is to optimise performance and eliminate redundancy. In the rare occasions when rules do not apply, problems are escalated through layers of bureaucracy and decisions are made by management who is separated from the actual work.

Some would argue that rationalistic organisations do not exist any longer. Maybe not in the pure stereotypical form, but having grown out of a mechanistic understanding, the industry of today is still rooted in rationalistic thinking. Like the machines it produces, the industry is most comfortable when there is stability, order, and control. However, when uncertainty increases and the environment changes, the rationalistic organisation is in trouble. Even though commentators such as Marx,

Nietzsche, and Freud already in the nineteenth century pointed out that our world is not stable, well-ordered, rational, or based on mutual interests and agreements (Dahlbom & Mathiassen, 1993), this fact became even more obvious when the industrial era started to give way to the information age (cf., Drucker, 1988). In the information age, business models are marked not by incremental but fundamental and radical changes (Malhotra, 2000). Businesses should no longer rely on long-term and in beforehand decided plans but foster an open attitude towards changes and create preparedness for the unexpected (Weinberg, 1997). To operate effectively in a dynamic environment, we need an organic structure that tries to seize the opportunities as they emerge, communicate laterally, and empower the workers at the frontline to make decisions, instead of looking in the rear mirror, relying on formalism and rules, and enforcing hierarchies. Such an organisation cannot be a closed stand-alone system but must interact with its environment and acknowledge the economic and social changes in a larger context (Fenton & Pettigrew, 2000). This organisational form is also known under many different names, e.g., the organismic type (Burns & Stalker, 1961) or the network organisation (Miles & Snow, 1986). In my work (cf. *Paper* 2 and *Paper 3*), I refer to this form as the *innovative organisation*, and it is for such organisations my research is targeted.

Information plays a decisive role not only in the post-industrial society, but also in rationalistic organisations of the late twentieth century. However, in the rationalistic organisation information is a control instrument whereas in the innovative organisation it is a communication vehicle (Sveiby, 1997). In both cases, though, managing organisations also means managing information. Managers in rationalistic organisations are highly influenced by Tayloristic ideals and engineering practice. This is not at all surprising, since promotions in these environments are made largely based on technical knowledge (Carlson, 1999). When engineers are promoted into managers, they bring along their traditions of measure and control.

On the continuum between full management control and no management control, four models of information governance have been identified: monarchy, federalism, feudalism, and anarchy (Davenport, 1997). These are illustrated in figure 1. *Information monarchy* is when

one central individual or function controls most of an organisation's information. *Information federalism* means that a central agency is responsible for some organisation-wide information policies but that the local actors have more autonomy. In *information feudalism*, there is no central governance. Instead, local lords define their own information policies without any integration or co-ordination between themselves. *Information anarchy*, finally, is not really a model, but a situation that emerges when centralised attempts to manage information have broken down. Although acknowledging that information anarchy has the merit of being driven by information needs firmly grounded in practice and thereby depicting real user concerns, Davenport describes it as a poor and counter-productive reflection of the chaos found on the Internet, and he argues that the shortcomings of information anarchy are easily identified (p. 75). Davenport's point is that when individuals maintains their own information silos, create their own structures, use their own formats, and share and access information as they see fit, the overall picture is lost and information quickly diverge.

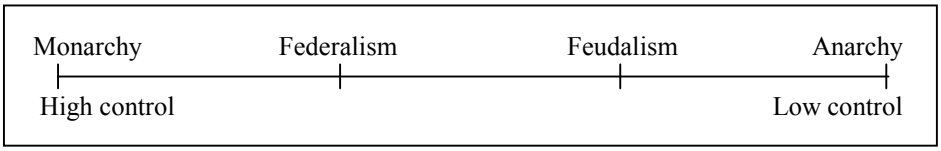


Figure 1. The four overlapping models of information governance and their position relative one another (Davenport, 1997).

We can also examine the different sorts of information that are being managed. One way to categorise information is to distinguish between the structured and the unstructured. Another approach is to make a separation between digitalised and non-digitalised information. Combining these two dichotomies, we receive the 2x2 matrix depicted in figure 2 below. Most information is in fact unstructured. Conversations, emails, free text messages, and other similar media that we deal with in an office environment contain information with very little structure. In addition, until very recently almost all information was non-digital and came to us acoustically or on paper. Hence, it seems plausible that the bulk of information would be found in the lower left quadrant of figure 2. In contrast, the most commonly used information management approach is to have computers handle structured information (Davenport, 1997), which puts the focus on the upper right quadrant in

figure 2. This preference is a result of the rationalistic organisation's desire to organise its world. Information managers often embrace the library model of information management, where the assets are categorised and organised into neat rows of shelves according to a model never grounded in real user needs. While such an approach fit the Tayloristic ideals, it is ill suited for today's more rapidly changing environment (Davenport, 1997).

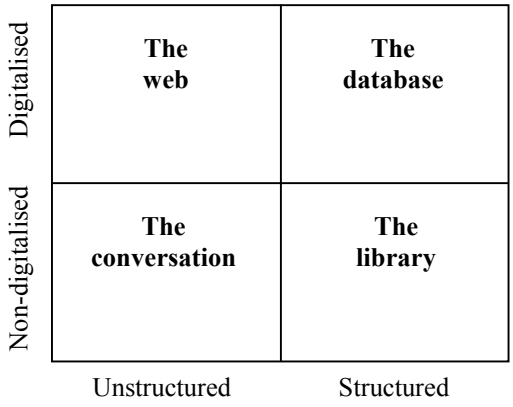


Figure 2. Four arenas of information management with examples.

The information systems designed and built for and by the rationalistic organisation rest on the assumptions dominating that tradition. In the early days of computing, the computing world consisted of dumb terminals hooked up to mainframes. At the users' end of the system, there was no computing power; CPU capacity, memory, and disk storage were located and managed centrally. The introduction of the PC in the early 80s decentralised some of the computing power and placed it on the users' desktops. However, it was not until graphical user interfaces and better networking capabilities came along that the PCs started to become productive, as desktop computers were connected both with each other and with mainframes in networks. Suddenly, the entire organisation, even if large and disperse, could be interconnected. These networks helped save money by letting the organisational members share expensive equipment such as printers and storage devices (Bernard, 1997). Then came the Client/Server architecture, which not only enabled the sharing of hardware but also software and data (Wen, 1998), and out of this architecture emerged the Internet, which can be

seen as collaborative client/server computing on a global scale (Bernard, 1997).

Although there has been a decentralisation of computing power, the managing power remains centralised. When the corporate internal computer networks, which were typically based on vendor-specific client/server technologies, migrated to standards and protocols such as TCP/IP, they could all be agglomerated to form the Internet (Bernard, 1997). Organisations can choose to shield off a part of the network from the rest of the Internet by using one or several firewalls. These devises allow authorised employees to access the Internet whilst preventing those outside the organisation from getting in (Curry & Stancich, 2000). The resulting private networks that reside inside the firewall, use TCP/IP as the transport protocol, and have the web browser as the client interface are referred to as *intranets* (Bidgoli, 1999). From this definition, it should be obvious that an intranet is not just a collection of static web pages, which many organisations seem to think. Databases, legacy systems, and other applications and services accessible from the users' browsers are equally part of the corporate intranet. Since the intranet is a central part of this thesis, we shall discuss web technology in more detail.

## *Web technology and intranets*

The foundation for the Internet is a suite of networking protocols known as TCP/IP. However, what transformed the Internet from a rather narrow environment to the widely used media we today recognise it as, were the two novel innovations that enabled the birth of the web: the HyperText Transfer Protocol (HTTP) and the HyperText Markup Language (HTML). HTTP is a stateless protocol intended for the retrieval of text and images in an unbounded and extensible set of formats, which is achieved by a unique ability to negotiate formats. HTML is a common language for the interchange of hypertext, designed to be sufficiently simple to use but still adhere to SGML (Structured General Markup Language) standards (Berners-Lee *et al*., 1994). The openness provided by the web makes it a bottom-up technology since it enables development of add-ons, which in turn guarantees adaptiveness and access to formats and types not yet existing. Therefore, a web page does not restrict the type or the amount of information presented. In a sense,

the underlying standards (TCP/IP, HTTP, and HTML) can be said to constitute the minimal federal laws of information management Davenport advocates. However, Davenport's critique of information anarchy does not apply to the web, where there are no isolated information silos. Everything is connected *despite* having different structures, formats, and purposes. The lesson here is to leave the standards on the protocol level, to keep them open, and to make them transparent to the users.

The principles underpinning the web are different from those used in traditional client/server architectures, distinguishing the web from the information systems that reigned prior to 1990. In particular, the web is not a "given" technology created for a specific and static purpose. Instead, web technology should be understood as multi-purpose and highly dynamic (Lyytinen *et al*., 1998; Damsgaard & Scheepers, 1999; Damsgaard & Scheepers, 2001). Equally significant is the fact that the web is also very different from previous Internet services. Email, news groups, file transfer, and telnet, for example, all required client programs – *different* client programs – to be installed on the users' machines. These clients all required you to log in using different userids and passwords, and created a connection to the host that had to remain open during the entire session. In contrast, the web makes it possible to send and receive email, read news, transfer files, and browse documents via one common multi-purpose client – the browser. The users do not need to know that different servers or services are invoked, and this unobtrusiveness has raised the convenience factor to levels never before seen in computer systems (Bernard, 1997). Finally, what propelled the web from a mere document repository to a multi-purpose technology was the common gateway interface (CGI) (Wen, 1998). This programming interface enabled the web server to interact with legacy systems residing in other servers and on other platforms and made web technology a "middleware" (Lyytinen *et al*., 1998).

In other words, and from a technological point of view, the web has three unique features that distinguish it from other IS/IT environments, and there is a fourth aspect in which the intranet differs from the Internet. This gives the intranet four distinctive characteristics:

1. *The intranet is hyperlinked*. The web was initially invented to allow scientists and researchers to communicate, collaborate, and exchange information in a transparent way. Much of this transparency is due to the hyperlink concept. The ability to create hyperlinks to other resources is perhaps the most significant feature of the web and something that allows it to transcend printed media. The hyperlink feature provides the users with extremely easy access to a huge amount of information, available at their fingertips. This superconnectivity aspect enables single individuals as well as large organisations to distribute information equally easy (Turoff & Hiltz, 1998). The hyperlink feature also makes the web inherently pull-oriented and entirely user-driven (Damsgaard & Scheepers, 1999). Using the hyperlink feature, the user requests information from the server; the server never sends information pro-actively.

2. *The intranet is networked*. The web obviously is highly networked in the sense that it is distributed both physically and in authority. The client/server architecture and the Uniform Resource Locator (URL) allow information to be placed anywhere in the network, making the physical whereabouts of the data transparent to the user. Further, the web revolts against the library model with its centrally located administrators that organise and grant access. On the web, there is no central management or predefined hierarchy structure, which means that anyone can publish anything. Web users are therefore not restricted to be simply information consumers, which seems to be the tacit understanding amongst most organisational information departments, but can almost as easily be information providers.

3. *The intranet is open*. The web is a bottom-up technology based entirely on open and accessible standards. The access mechanism of the HTTP protocol allows also proprietary formats to be used without having to standardise. A web page does not restrict the type or the amount of information presented. The openness also guarantees adaptiveness and access to formats and types not yet available, which facilitates information richness. In contrast to most other client/server models, the web does not require the installation of any proprietary products or protocols. A standard web browser

and a TCP/IP connection are all that are needed. Information can then be displayed independently of network or server topology.

4. *The intranet is organisationally bounded*. In addition to the above characteristics, which intranets share with the Internet, intranets contain only users from within the own organisation or company. This is an important factor from a KM perspective since it enables the organisation to share more freely information not intended for competitors. Intranet users belonging to the same organisation can be presumed to share certain objectives and subscribe to the same set of values and beliefs. Intranet users differ in this aspect from Internet citizens, and the intranet can be seen as providing a level of coherence that is absent on the web as a whole.

## *Knowledge Management*

To help organisational members share knowledge by making more active use of their intranet, which is my objective, is indeed a knowledge management-related activity. KM has received enormous attention from academia and industry alike in the last few years. Despite (or perhaps due to) this broad interest, no clear definition of KM has emerged. Instead, the literature is cluttered with different, albeit similar, versions as shown in table 1.

Table 1. Definitions of knowledge management

| ***Knowledge management…*** | | | |
|---|---|---|---|
| …addresses the generation, representation, storage, transfer, transformation, application, embedding, and protecting of organisational knowledge (Hedlund, 1994). | …is about generating, accessing, transferring, representing, embedding, and facilitating knowledge and knowledge processes by developing a culture that values, shares, and uses knowledge (Marshall *et al.*, 1996). | …is the process of increasing the efficiency of knowledge markets by generating, codifying, coordinating, and transferring knowledge (Davenport & Prusak, 1998). | …is about harnessing the intellectual and social capital of individuals in order to improve organisational learning capabilities (Swan *et al*., 1999). |

KM is largely regarded as an organisational process consisting of a number of various activities, but both the number and the labels of these activities differ between authors (Alavi & Leidner, 2001). Alavi and Leidner conclude that a minimum of four basic KM processes can be identified: creating, storing/retrieving, transferring, and applying knowledge. My aim has not been to exhaustively define KM but to design IT to support it in practice. To do so I need only a working understanding of KM and I have found it sufficient to think of KM as any organisational effort aimed at helping individuals to make better use of the knowledge held by themselves or their peers.

### *Data, information, and knowledge*

Sharing the opinion of Galliers and Newell (2001) that computers never can hold knowledge, one may wonder how I can continue to develop IT-tools for knowledge management and argue in favour of the intranet as a KM environment. To understand my position, we must discuss the relationship between information and knowledge. However, we do it not from a philosophical perspective but from a IT perspective. As observed by Alavi and Leidner (2001), the knowledge-based theory of the firm was never built on a universal truth of what knowledge really is but on a pragmatic interest in being able to manage organisational knowledge.

It has often been pointed out that data, information, and knowledge are not the same, but despite efforts to define them, many IS/IT researchers use the terms very casually. In particular, the terms knowledge and information are often used interchangeably even though the two concepts are far from identical. To give an example from the literature, Kogut and Zander define information as "knowledge which can be transmitted without loss of integrity" (1992, p.20), thus implying that information is a form of knowledge. This was typical of early texts on KM, which did not sufficiently separate information from knowledge. Nonaka, who is widely quoted in the KM discourse, has also been criticised for such carelessness (cf. Baumard, 1996/1999, p.133-134). Many other commentators also define knowledge in terms of information, which in turn is defined as a form of data. I think this is unwise – data, information, and knowledge are interwoven and interrelated in more complicated ways than such a simple model suggests. Both data and information require knowledge in order to be

interpretable, but at the same time, data and information are useful building blocks when constructing new knowledge (Stenmark, 2002). Old knowledge is used to reflect upon data and information and when the data or information has been made sense of, a new state of knowledge is formed in the mind of the interpreter. Knowledge thus requires a knower. As I have previously explained (cf. Stenmark, 2002), I see no sharp distinction between data and information; they are only two different stages on a continuum. We sometimes need to focus our attention on certain aspects of knowledge, thereby making it focal. The focal knowledge can, sometimes and partially, be articulated and expressed in words. I call this information. If the information becomes too decontextualised, i.e., too distant from the knowledge required to interpret it, I call it data. The information itself is not sufficient to exhaustively describe the knowledge to which it refers, and to interpret and fully comprehend the implications of the information, the reader's tacit knowledge must be compatible with that of the writer.

The notion of tacit knowledge was introduced by Polanyi (1958/1962), a philosopher made known to a larger audience by being quoted in the writings of Kuhn (1962) and who since has had a renaissance due to the writing of Nonaka (1994) and Nonaka and Takeuchi (1995). As Polanyi observed, "we can know more than we can tell" (Polanyi, 1966/1997, p.136). Unfortunately, Nonaka uses Polanyi's term somewhat differently from Polanyi himself. Due to the strong influence of Nonaka's writings on the KM discourse, this misconception has been widely adopted. While Polanyi speaks of tacit knowing as a backdrop against which all actions are understood, Nonaka uses the term tacit knowledge to denote particular knowledge that is difficult to express. Although referring to and building on the arguments of Polanyi, authors come to contradictory conclusions regarding the nature of tacit knowledge. Cook and Brown argue, in what they claim is in agreement with Polanyi, that "explicit and tacit are two distinct forms of knowledge (i.e., neither is a variant of the other) […], and that one form cannot be made out of or changed into the other" (1999, p. 384). In contrast, Tsoukas, also building on Polanyi, claims that tacit and explicit knowledge are mutually constituted and should not be viewed as two separate types. In a critique of Nonaka, Tsoukas further argues that tacit knowledge is not explicit knowledge internalised. In fact, tacit

knowledge is inseparable from explicit knowledge since "[t]acit knowledge is the necessary component of *all* knowledge" (1996, p. 14). All articulated knowledge is based on an unarticulated and tacitly accepted background of social practices. We come to know the unarticulated background by being socialised into a practice and thereby internalising an understanding that is not only cognitive but also embodied (Tsoukas, 1996). In my work, I see all knowledge as tacit while things that can be put on paper or stored in computers are information. However, amongst people who share a tacit understanding, the exchange of information can be seen as a form of knowledge transfer, since the information when interpreted extends the reader's knowledge. Under such circumstances, e.g., in *communities of practice* (Brown & Duguid, 1991), IT can thus be instrumental in KM processes (cf. Stenmark, 2002).

Informed, and hence with an updated state of knowledge, we are enabled to perform new actions. Actions are the only way through which knowledge can manifest itself and Sveiby (1997) defines knowledge as the ability to act. This does not mean that knowledge *must* result in action in order to exist. However, as long as the knowledge remains inactive, it is of limited organisational value. Work-related and enacted knowledge can be referred to as expertise or competence, and these two highly interrelated concepts are also used somewhat interchangeably in the literature. However, whilst expertise is often understood as an individual aspect, competence is typically discussed on an organisational level. The practise-oriented knowledge in which I am interested works well with the notion of competence. Competence is concerned not with knowledge and skills *per se*, but with the knowledge and skills required to perform a specific task, and the notion of competence thus depicts a relationship between humans and work tasks (McClelland, 1973). This is discussed in more detail in *Paper 2*. Competence is also related to professional interest. Interests provide motivation and hence an incentive for actions. As argued in *Paper 2*, pursuing a professional interest in a corporate setting eventually leads to competence within that area. I therefore argue that it seems plausible that interests can be a means for identifying applied knowledge.

### *Knowledge management and intranet research*

Alavi and Leidner (2001) define knowledge management systems (KMSs) as IT-based systems that are applied to managing organisational knowledge. My work has focused solely on designing *intranet-based* KMSs, and I shall therefore limit this section to a review of other attempts to pair intranets and KM. I relate these research efforts to the four KM processes identified by Alavi and Leidner: *i)* intranets for knowledge creation, *ii)* intranets for knowledge storage/retrieval, *iii)* intranets for knowledge sharing, and *iv)* intranets for knowledge use.

*Intranets for knowledge creation* examines intranets as a facilitator of innovation. It is argued that innovation cannot be "engineered", i.e., planned and controlled in the traditional sense, but should instead be "cultivated" and treated as garden work. The pull-based access mechanism of the intranet is well suited for this management mode, which has partly been attributed to the strengthening of internal communication that the intranets supposedly foster (cf. Roffe, 1999; Yen & Chou, 2001). However, intranet efforts are noticed to be successful only when accompanied by relevant "people management" and organisational practises, and research efforts are made to be able to predict under what circumstances intranets can assist and when they can hinder innovation and knowledge creation. Knowledge depends more on networking than on networks, and to support innovations, care must be taken to ensure that intranets support social networking (Swan *et al*., 1999). Similar thought can be traced in some of the latter work of Damsgaard and Scheepers (2001). To support knowledge creation, they argue, publishing must be paired with other intranet use modes to match the four knowledge-creating processes suggested by Nonaka's SECI model (Nonaka, 1994).

*Intranets for knowledge storage/retrieval* has developed along two different tracks. The intranet is described either as an unstructured knowledge base (cf. Telleen, 1997) or as a media for free flow and exchange of information (Bennett & Gabriel, 1999). The discussion in this discourse has parallels to the commodity vs. community perspectives on knowledge described by Swan *et al*. (1999). On the knowledge base side, researchers deal with basic concepts of and conceptual frameworks for KM and how these relate to intranet

technology (cf. Scott, 1998). From the information flow perspective, intranets are being investigated from a information dissemination and collaboration point of view (cf. Lai & Mahapatra, 1998). However, both sides make little difference between information and knowledge. Regardless of whether you see knowledge as static or dynamic, the intranet can be seen as an infrastructure for knowledge work (Choo *et al*., 2000) or as a general knowledge system. However, some claim the intranet's full potential to leverage organisational knowledge depends on appropriate user interfaces that can provide the organisational members with alternative views of the stored information (cf. Standing & Benson, 2000).

*Intranets for knowledge sharing* acknowledges that the competitive edge of today's organisations lies in their ability to transfer knowledge between their members (cf. Offsey, 1997). Since organisations typically already have a number of separate "knowledge silos", i.e., non-interconnected repositories of vital information, an overarching KM system must be implemented in order to make these silos useful from a KM perspective. Such a KM system should preserve the functionality of each sub-system whilst enabling universal access to their content (Offsey, 1997). The intranet, which has dramatically lowered the barriers between such silos, is the natural base for a KM system of this sort, and the intranet's ability to achieve such transfer in a both user-friendly and cost-effective way has been highlighted (cf. Cantoni *et al*., 2001). For example, one way of transferring organisational knowledge is via intranet-based online communities (cf. Davis *et al*., 1998; Cothrel & Williams, 1999). However, though intranets can be useful to overcome localisation it does not necessarily solve cultural problems (Cantoni *et al*., 2001; Ruppel & Harrington, 2001). Recognising that knowledge transfer depends not solely on technology but on social practices, research is also aimed at management practices, reward systems, and cultural initiatives for the development of intranets that stimulate active sharing (cf. Stoddart, 2001; Cantoni *et al*., 2001).

*Intranets for knowledge use* is concerned with how the organisation interact over the intranet to utilise the knowledge of its employees. This area is the one closest related to my research. Particularly interesting is the study of how organisational members make use of their knowledge on an intranet carried out by Choo and his doctoral students (Choo *et al*.,

1998; Choo *et al*., 2000), who have monitored the information seeking behaviour of intranet users. The way in which the organisational actors search, create, and use information is to Choo and his colleagues central to how intranets that facilitate the re-use of knowledge should be designed. They suggest that intranets are to be understood as "socio-technical systems in which information seeking and use take place, rather than as systems that merely support the retrieval of information" (Choo *et al*., 2000, p. 103). Based on behavioural-ecological theories, they argue in favour of an intranet design that supports communication and collaboration. My work relates to their research but my approach differs from theirs is several aspects. Unlike Choo, Detlor, and Turnbull, who are full time scholars, I am employed by the organisation I study, and have a stronger urge to act as a change agent rather than an objective observer. Further, Choo and colleagues do not explicitly examine the characteristics of the intranet the way I do, and they do not design or implement any applications.

### *An alternative approach*

Much of the research conducted on intranets has been informed by a mechanistic and rationalistic understanding of organisations, information, and management. Many researchers tacitly, and sometimes also explicitly, adhere to the library model of information managing, acknowledge the need for rigid structures and clear policies, and subscribe to a view of information needs being stable and predictable. Even more worrying is their tendency to consider information needs from the providers' view only. For example, when Lai (2001) reports from his study of the largest 500 organisations in Hong Kong, he finds that the human resource departments with a +80 per cent adoption rate were the primary beneficiaries of intranets. This, Lai concludes, is because these departments have much corporate information that need to be published and distributed. The question never asked is "*who* needs the information?" Lai does not examine whether the information is ever requested by the users. As with the library, the focus is on the information itself and how to organise it: whether or not the public is interested in borrowing any books is left unconsidered. I argue that the user must be included and that we need more initiatives in line with those at Xerox, where 1,500 employees were surveyed to understand

how they prioritised and used information prior to designing the intranet (Hildebrand, 1997).

It seems plausible that the information needed for an organisational member to carry out the daily tasks should come from multiple sources, and not just from the human resource department, the information department, or from whomever "owns" the intranet. In order to encourage debate and avoid one-sidedness, *all* users should be allowed to publish – even if this results in overlapping or even contradictory information. Indeed, co-ordination of intranet activities should not be based on centralisation of control or prescription of web development, but rather on ensuring that the employees are clear on the direction of the intranet efforts (cf. Wachter & Gupta, 1997). Nonaka and Takeuchi (1995) acknowledged the importance of "requisite variety" in relation to KM and although some intranet-related authors recognise the benefit of the diversity in information provided by the web, the majority of the commentators conceive redundancy as one of the main enemies that should be fought with all means. When Wachter and Gupta (1997) report that one firm they studied had nearly 40 sites of which many had redundant information, it is evident from their way of writing that they saw this as an unwanted situation. I see no support for such a conclusion.

One way to avoid redundant information often prescribed is to be restrictive with publication rights and tightly police those who gain permission, and numerous reports about management concerns for the intranet not being sufficiently controlled or managed are available (cf. Scheepers & Damsgaard, 1997). However, the commentators seldom critically question the correctness of these utterances. Just because an interviewed manager believes that more control would improve intranet usage does not mean this is indeed the case. If we consider the Internet, which has no governing authority, we see that it has continued to grow at an almost exponential rate in terms of both content and users since its beginning. Organisational members, who show little or no interest in their intranet, can spend hours updating their Internet pages. I argue there is a lesson here for those who care to question the superficial. Unfortunately, not many authors do. Instead, they go along with the prevailing assumption and prescribe more control and structure (cf. Damsgaard & Scheepers, 2000) and advocate a federal approach to information management where policies and procedures should be

established on corporate level to ensure proper content management (cf. Curry & Stancich, 2000). This conclusion can also be questioned and one might instead argue that increased empowerment and larger degrees of freedom is what the intranet needs, since such policies would more likely propel end-user participation.

In sum, my research diverges from much of the previous intranet research in four ways. *Firstly*, much of the previous work is non-technical, whereas I show how to exploit the specific properties of web technology. The intranet is not just any other IT environment – it has, as I have described above, distinguishable characteristics that makes it unique. When interested in understanding the intranet and how to improve its use, one should explore and exploit these features. I try to do that in my research. *Secondly*, the previous research that actually has a technocratic approach is typically interested in information processing. In contrast, I argue for a multi-perspective view of the intranet in order to go beyond the prevailing information-centric perspective. It may be so that easy access to a huge amount of information is what most people associate with the web but nevertheless this information access must not be the final goal but the starting point – the information must be there for a purpose. *Thirdly*, I suggest that the platform provided by the intranet and its set of supported protocols must be paired with and complemented by applications designed to include the end users as actors. If the intranet remains nothing but an advanced bulletin board offering only one-way communication, it will generate little added value. The applications should thus be designed to meet the users' information or communication needs in order to provide the incentive required for the users to willingly adopt the technology. *Fourthly*, I seek to address not only information but also tacitly held knowledge by examining what actions the users perform when interacting with the information. Information and knowledge interact and affect one another and the intranet can provide an arena for such interaction if the design takes advantage of the characteristics of the web, is based on a multi-perspective view, and includes the organisational members as actors.

# The thesis

In Section 1, I outlined the objective for my research as to understand how to design the intranet to better support knowledge creation and sharing. This objective was deliberately held rather general. However, having spent the previous chapters explaining the situation in which today's intranets are working, we are now better equipped to appreciate the problems the intranets are facing. Towards an under-standing of intranet usage, my observation is that organisations address the problems outlined in the previous sections by adding more structure and control. As noticed in other domains, when confronted with abundance of material seemingly in need of co-ordination, organisations invent and adopt mechanisms to stipulate order. As the complexity grows, this co-ordinating activity has to be repeated, and for each iteration, the new mechanisms are typically more prescriptive and more rigid than the ones replaced (Carstensen & Sørensen, 1996). In contrast to the Internet, intranets therefore become more and more circumscribed with publishing policies, user roles, content categories, information hierarchies, and design restrains. To publish on the intranet, content quality is no longer enough; a web page must also comply with cosmetic rules, adhere to naming conventions, and be placed in the proper structure. More management is the medicine prescribed by most organisations. I think this is unwise. The Internet is obviously thriving despite the lack of control. Actually, I would say that the Internet is thriving due to the lack of control. Web technology is a bottom-up technology and its hyper-linked, networked and open nature makes it inherently unstructured. Instead of suppressing the creativity that lies latent in the unstructured, the challenge for organisations is to learn how to cope with the wild, and, as in brainstorming, turn the multiplicity into a competitive advantage. Given these technological characteristics, a first question to answer when designing the new intranet is thus:

> *How could intranet applications be designed to take advantage of the specific characteristics of the web?*

The above question addresses the relationship between intranet design and web technology. There is also another important component: the

user. The computers used in the 1970s were information processors and storage devices where the user played only a marginalised role. In those days, the systems should preferably be designed to reduce the users' capabilities and access as much as possible. This mental model also affects today's intranets where a selected few are supposed to provide the rest of the members with relevant information. However, when users today are more empowered and allowed to operate with greater autonomy than thirty years ago, the answer to what is relevant must be decided where the action is, i.e., not at the top of the hierarchy but down in the trenches. The organisational members must therefore be understood as actors and not merely as passive receivers of corporate information. Contributions from all members are important when seen from a knowledge management perspective and intranet applications must therefore be designed so that the technology actively affords user participation. This is a prerequisite for the intranet to function as a KM environment. However, these activities must not be such that they add to the users' workload or oblige them to do things *in addition* to what the tasks at hand require. Grudin's influential work within the field of Computer Supported Collaborative Work (CSCW) shows that situations where one party does the work and someone else receives the benefits, often leads to failure (cf. Grudin, 1987; 1988; 1994). Although the intranet as an organisational-wide technology can be understood as a new form of groupware (cf. Hills, 1997), Grudin's findings seem to be overlooked in the intranet literature. We cannot expect the users to spend time and efforts feeding a "knowledge database" or maintaining a "knowledge system" for the benefit of the organisation, on top of their ordinary responsibilities. Yet, for the intranet to become an environment that supports everyday knowledge use, there must be mechanisms to express or represent the knowledge of the employees in ways that enable the organisation as a whole to use and benefit from it. To exploit the traces that the users' everyday activities leave behind in form of web server log files, published documents, or submitted search engine queries, might be a feasible and unobtrusive solution. A second question for me to answer along the way towards the design of a new and more useful intranet would therefore be:

> *How could intranet applications be designed to take advantage of the user's everyday actions?*

The above questions represent two different perspectives on intranet design that together help us understand how to take advantage of the intranet. The pursuit of the answers to these questions has resulted in a number of articles that have been published at conferences and in journals. The five papers constituting this thesis appear in essence as they were published, except for some minor adjustments regarding reformatting in order to be consistent with the rest of the text in this thesis. Table 2 below provides an overview of the articles, the author(s), and where they were published.

Table 2. The five papers constituting this thesis

| |
|---|
| **Paper 1: Leveraging Tacit Organisational Knowledge**<br>Dick Stenmark<br>*Published in Journal of Management Information Systems, Vol. 17, No. 3, 2001, pp. 9-24. A previous version appeared in Proceedings of the 33rd Hawaiian International Conference on System Science, January 2000.* |
| **Paper 2: Rethinking Competence Systems for Innovative Organisations**<br>Rikard Lindgren, Dick Stenmark, Jan Ljungberg, Magnus Bergquist<br>*Printed in Proceedings of the 10th European Conference on Information Systems, Bled, Slovenia, 2001, pp. 775-786. A revised version is under consideration by the European Journal of Information Systems.* |
| **Paper 3: Designing Competence Systems: Towards Interest-activated Technology**<br>Rikard Lindgren, Dick Stenmark<br>*Accepted for publication in Scandinavian Journal of Information Systems, 2002.* |
| **Paper 4: The Mindpool Hybrid: A New Angle on EBS and Suggestion Systems**<br>Dick Stenmark<br>*Printed in Proceedings of the 34th Hawaiian International Conference on System Science, IEEE Press, Maui, HI., 2001.* |
| **Paper 5: Group Cohesiveness and Extrinsic Motivation in Virtual Groups: Lessons from an Action Case Study of Electronic Brainstorming**<br>Dick Stenmark<br>*The version included in the thesis is the revised paper invited by and submitted to the e-Service Journal special issue on 'e-Groups: Communicating in a Distributed Environment'. A previous version was nominated best paper in the Distributed Group Support Systems mini-track at the 35th Hawaiian International Conference on System Science, IEEE Press, Hawaii, HI., 2002.* |

# Research method

As an organisational member, there have been plenty of opportunities for me to observe how my peers at Volvo interact with the intranet. However, these observations have been more of the general kind and thus been used primarily for background and inspiration. I have not conducted specific and systematic observations of users working with my prototypes or used video to record such activities. Instead, my primary source of data has been interviews (even though other methods have also been engaged, as described in e.g., *Papers 1*, *3*, and *5*). Together with Rikard Lindgren at Viktoria and five master students from the Department of Informatics, I have conducted 51 interviews. As shown in table 3, these have engaged organisational members in a number of different roles.

Table 3: The different categories of respondents interviewed for each paper. Paper 4 is theoretical and not based on any empirical data.

| **Role** | **Paper 1** | **Paper 2** | **Paper 3** | **Paper 5** | **Sum:** |
|---|---|---|---|---|---|
| Systems developer | 3 | 4 | | 8 | 15 |
| Technician | 1 | 2 | | 5 | 8 |
| Systems programmer | | | 3 | 3 | 6 |
| Project manager | | 2 | 3 | | 5 |
| Department Manager | 1 | 2 | 1 | | 4 |
| Human Relation staff | | 2 | 1 | | 3 |
| Analyst | | 1 | 2 | | 3 |
| Information staff | 2 | 1 | | | 3 |
| Educator | | | | 2 | 2 |
| Technology watcher | | 1 | | | 1 |
| Product manager | | 1 | | | 1 |
| **Sum:** | **7** | **16** | **10** | **18** | **51** |

The interviews have typically been semi-structured, meaning there has been a theme around which we have tried to keep the discussions and a prepared handful of general questions to throw in should the conversation run dry. The respondents have thus been allowed to elaborate freely around the central theme. The interviews have lasted between 25 and 70 minutes. In addition to the 51 interviews referred to above, I have conducted individual and group interviews with other

Volvo personnel, moderated discussions and focus groups, and held and participated in workshops. Taken together, this material, of which some has been accounted for in other publications, has provided me with a rich set of contextual data.

Once collected, I have analysed the data in order to elevate the result to a level above a simple collection of quotes. To achieve this goal, many different methods can be applied and a number of various theories may be used to shine light on the findings. In my research, I do not take departure in one specific theory that I try to apply to all my cases. Instead, I have approached the data in an open-minded fashion. In this sense, my approach has similarities to and contains elements from the grounded theory research methodology as suggested by Glaser and Strauss (1967), even though I do not explicitly subscribe to their entire framework. Central to my understanding of how a set of unstructured data becomes scientific conclusions are the notions of interpretation and reflection.

*Interpretation* means going beyond the face value of the data. Statements given by the informants must not be reported as some sort of fact or evidence. There is no such thing as "pure" data and the actor's point of view must not be treated as an explanation – the facts "*never* speak for themselves" (Silverman, 1993, p.36). It would be naïve to believe that user experiences collected through open-ended interviewing would automatically produce useful scientific findings. A feature borrowed from symbolic interactionism that I have applied in my research is the possessing of the "self". This notion means to imply that man can be an object of his own actions, or in other words, that man is able "to perceive himself, have conception of himself, communicate with himself, and act towards himself" (Blumer, 1959, p.62). The self can be described as a little voice inside ones head that says, "Yes, I recognise this" when the researcher does her observations or reads her data, and this mechanism should be engaged when doing the analysis:

> *"This is where the investigator must use the self as an instrument. The investigator must read the interview testimony with a very careful eye both to what is in the data, and what the data "sets off" in the self"* (McCracken, 1988, p.44).

Qualitative-oriented authors argue that it is necessary for the researcher to see the object the same way the observed see them. For me to imagine myself in the respondent's situation has been rather easy. When going through the data, the self, informed by the literature and the contextual understanding, has supported or refuted the tentative explanations I am constructing. Thus, rather than trying to determine whether or not the informant has told the truth, I have asked myself why the statement has been given, and what it reveals about the informant's motives, situation, and worldview. In the process of interpreting the data, my approach has been similar to the open coding technique used in grounded theory (Strauss & Corbin, 1990) in the sense that I have let the data itself suggest categories and concepts rather than imposing an existing scheme.

*Reflection* means that the researcher is being observant of her own observations and interpretations: Why do I interpret as I do? Are there other interpretations? What assumptions am I making? Empirical research characterised by reflection should show a healthy scepticism towards what may appear as an unproblematic picture of how reality works. For me, this has meant that the initial categories and tentative schemas developed have been revised and refined in an iterative process (cf. Orlikowski, 1993). As an insider, the industrial researcher is already familiar with hard to detect aspects such as corporate culture and tacitly agreed upon understandings, which shape the practice under study. Being a true member of the group has given me access to inside knowledge that otherwise would have been out of reach. This familiarity also presents some down sides that the insider must address. One such problem is the danger of contaminated research due to the control the practitioner has over the production of research data. It is all too easy to design the data to support nearly any argumentation (Heiskanen *et al*., 2000). Another problem that I have had to deal with has been to distance myself from the data in order to be able to see the things normally taken for granted. Researchers working in a familiar environment carry with them a large number of assumptions that direct their inquiry and may limit the range of things they see as worthwhile. To avoid this tunnel seeing problem, the researcher should manufacture distance and thereby create a critical awareness. Having spent many years at the site of study, it was impossible for me to over night change perspective and to be able

to see familiar behaviour with fresh eyes. I had to understand what it was I took for granted in my environment and question my own activities. In my attempts to create distance, I found McCracken's advice valuable.

McCracken (1988) suggests four ways to manufacture distance. Firstly, one can leave the familiar milieu for an extended period of time and then return. Though being the classical approach, this method is rather impractical. Secondly, one should pay attention to elements of surprise. Surprise is an indication of expectations that have been violated, and it gives the researcher an opportunity to detect her otherwise hidden assumptions. A third opportunity is humour, which deliberately combines elements from different categories and does thus violate assumptions. By analysing how humour operates, the researcher can create the necessary distance. Fourthly, a thorough literature review provides a set of expectations that the data can defy and thus helps create an analytic distance. In particular, I have applied advice two and four; the elements of surprise and the literature study. When it comes to the element of surprise, also Blumer stresses the importance of what seems "odd" when he recommends "all observations that challenge one's working conceptions as well as any observations that that is odd and interesting even though its relevance is not immediately clear […]" should be carefully recorded (1969, p.42). I have thus more carefully re-examined every unexpected, odd, or surprising answer or comment, and asked myself why I was surprised. What had I expected or assumed? Secondly, being well acquainted with related research means that the researcher is better equipped to detect and recognise the unexpected, and he or she can more easily recognise exceptions. The literature review does in this respect help to manufacture the intellectual distance without which there can be no analytic work. However, cautions must be taken not to create preconceptions, but this risk is smaller that the benefits, especially so if one "exercises a constant scepticism" (McCracken, 1988, p.31) towards the texts.

# Results

The results from my work are presented in the following two subsections. Firstly, I describe the two intranet application prototypes used in my research. Secondly, I account for the contributions from the papers.

## *The prototypes*

The platform that the intranet constitutes through its supported protocols makes it possible to create an information-sharing environment just by installing a web server and adding content. Support for different file formats are provided out of the box. However, to facilitate more sophisticated forms of collaboration than merely reading one another's documents requires the design and implementation of additional applications. My efforts to better utilise the intranet, i.e., to transform the intranet from an information repository to a vivid knowledge environment for people to interact in and with, has involved the design and implementation of various such intranet application prototypes. The guiding design thoughts have been to benefit the unstructured nature of the web and engage people by providing added value and encourage them to be more than merely passive information consumers. The two prototypes described below are *Mindpool*, a tool for brainstorming and idea sharing, and *Volvo Information Portal* (VIP), an environment facilitating awareness of both information and colleagues sharing an interest in that information.

### *Mindpool – A brainstorming tool*

Mindpool (cf. *Paper 4* and *Paper 5*) allows organisational members to submit sketchy ideas and draft proposals to a database accessible via the intranet. These entries may then be browsed by all other employees via their web browsers, and the purpose is, as in a regular brainstorm session, to provide seed for new ideas. When first accessing Mindpool via the web browser, submitted ideas are retrieved from the database and displayed in reversed chronological order. Figure 3 shows a snapshot of Mindpool's main screen. The date and subject of each contribution is

displayed together with the actual suggestion, and the user can casually browse through the suggestions and ideas and collect seeds for new thoughts. The user is *not* supposed to comment on the existing ideas, as in a traditional discussion list, since such comments often only contains negative critique killing the initial idea. Instead, the associations should be used to create new ideas. This complies with Osborn's (1953) original brainstorming rules; encourage wild ideas, elaborate on other's ideas, and refrain from critique during the early stages. Ideas and proposals are entered via email, and the benefit of this approach is that both email and web browsers are available to the entire organisation and the users are familiar with the interfaces.

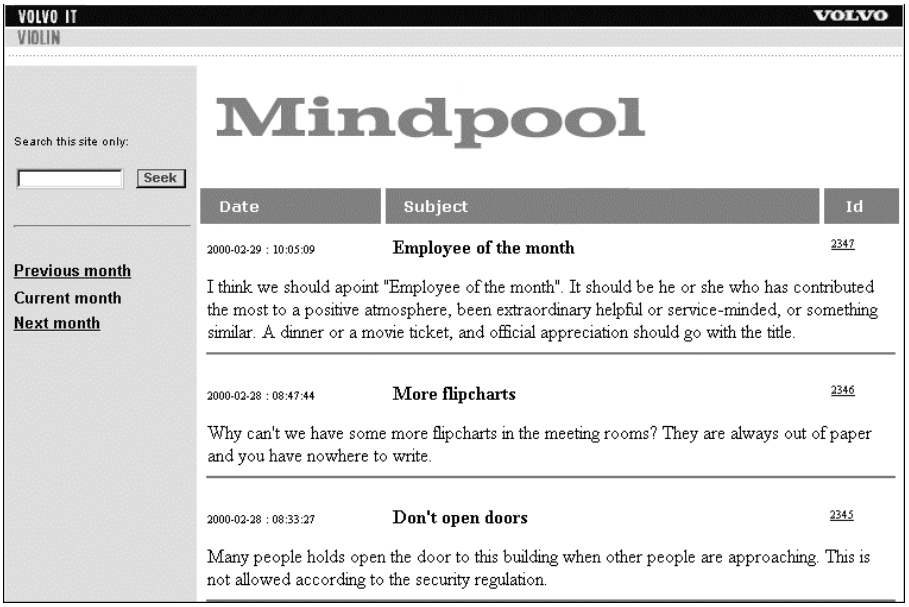


Figure 3. A screenshot of Mindpool's start page with three submitted suggestions.

The identity of the proposer in form of his or her email address is extracted from the email message and recorded in the database but, to avoid evaluation apprehension, not displayed on the web page. However, in order to support direct communication between the organisational members, there is a built-in feature allowing the readers to click on the suggestion ID and send a message to the proposers without knowing who the proposers are. The application acts as a broker and relays the

message to the proposers, who remains anonymous until they choose to voluntarily reveal their identity by replying.

The ideas submitted to Mindpool are not categorised, sorted, or otherwise arranged in any structured way. Such structuring would limit creativity by the formalism imposed by the person responsible for the structure. Instead, by leaving the suggestions unordered, a pluralist view is possible, where the organisational members are free to create their own understanding, do their own associations, and form their own tacit links and combinations. This interaction with and combination of different pieces of information provided by different organisational members can facilitate the creation of new ideas and knowledge.

Approaching the prototype from a technical perspective, Mindpool was implemented on the Windows NT server platform using Microsoft's Windows Distributed interNet Application (DNA) architecture. Windows DNA is a three-tier solution, separating the user layer, the business layer, and the data layer. The three-tier approach has the benefit of scaling well since the developer is able to exchange either the user interface or the database implementation (or both) without changing the central business model. The heart of Windows DNA is the integration of web and client/server application development models through a Component Object Model (COM). COM allows solutions to be assembled from reusable software parts, and acts as the glue that ties Windows DNA Services and the different customised or third party components together.

The User layer, with which the user interacts, was coded using Active Server Pages (ASP) and Visual Basic (VB) scripts. This means that all execution takes place on the server side and that only plain HTML files are transferred to and from the client. The client can thus be any old computer capable of running a Web browser. The ASP code is interpreted by the Internet Information Server (IIS) that acts as web server. As soon as anything beside simple navigation is requested, the ASP code instantiates a Business layer object and invokes its methods, thus transferring control to the business layer.

The Business layer contains a use case oriented class and several object-oriented classes, which are both implemented using the COM support of Microsoft Transaction Server (MTS). The use case class is

built in compliance with the anticipated actions of the typical user. In the prototype described here, the methods needed are only two: *List all ideas* and *Create a comment*. All communication between the User layer and the Business layer goes via the use case class. This single-point access design makes it easy to later hook in monitoring, accounting, and/or authentication capabilities. The object-oriented classes obviously contain the objects referred to in the use case, i.e., ideas and comments. These classes contain methods that instantiate and call classes from the Data layer.

The Data layer, finally, has one class per database table and it controls all access to the physical database, which in my case was an Oracle 8i database. All SQL statements are kept in the Data layer and nowhere else. The three-tier architecture of Mindpool is illustrated in Figure 4.

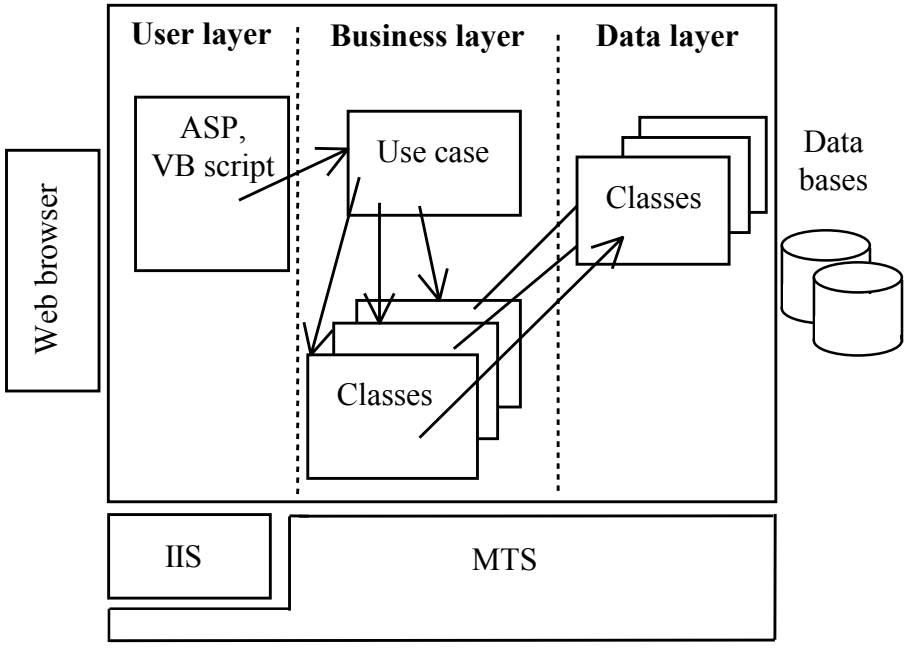


Figure 4. Three-tier implementation of Mindpool using Active Server Pages (ASP) and Visual Basic scripts running on an Internet Information Server (IIS) on top of Microsoft Transaction Server (MTS).

### *Volvo Information Portal*

The Volvo Information Portal (VIP) (cf. *Paper 2* and *Paper 3*) is a prototype recommender system (Resnick & Varian, 1997) where personalised information agents recommend relevant web documents. The underpinning motive for people to register and log in to VIP is thus to receive the information their agents have harvested for them. This incentive for participating is the mechanism that supposedly guarantees that every user maintains an accurate and updated interest profile. In addition to this base functionality, other services have been added, for example the Community feature and the Find Competence feature.

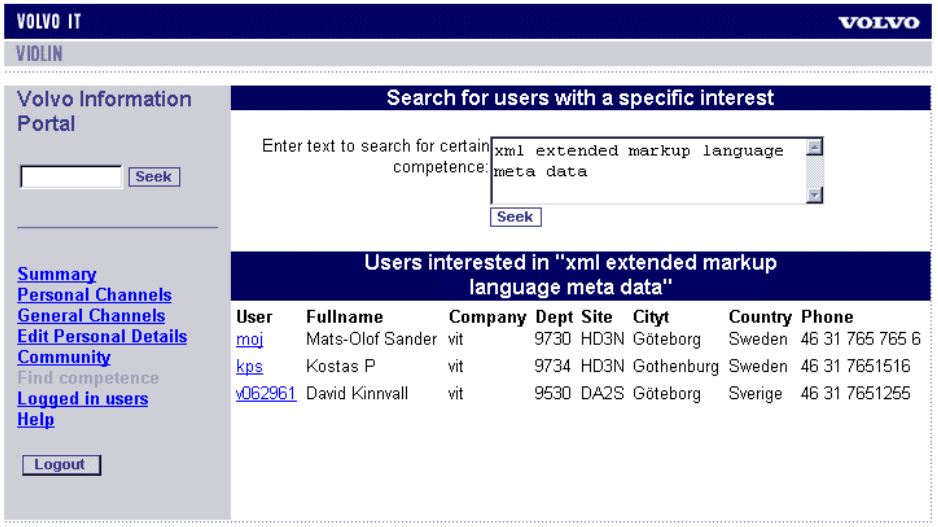


Figure 5. Example of VIP's *Find competence* feature. The text in the input field has matched the interest of three users.

Based on the interest profiles set up and maintained by the users in the form of agents, the Community feature allows the organisational members to become aware of peers interested in similar topics. The click of a hypertext link invokes a mechanism in VIP that compares the user's agent with that of other users, and presents the user with a list of matching organisational members. However, the novelty with the VIP system compared to its predecessor Watson is the ability to search not only for people who *share* you interests but also with people who have *complementary* competencies. The Find competence feature allows users

to enter a natural language sentence, to type a set of descriptive keywords, or to paste in a piece of text from a representative document, and the VIP system returns a list of users who have active agents monitoring such concepts, as is illustrated in figure 5. My results, as described in *Paper 3*, show an interesting relationship between personal interests and competence, and suggest that organisations interested in the future rather than in the past should exploit interest-driven technology when designing their competence managing systems.

Amongst the positive aspects of the VIP system is the fact that it does not require or depend on the information to be structured, categorised, or ordered into hierarchies. When creating an agent, the user is free to define the agent's information-seeking goal by typing keywords, entering natural language phrases or sentences, or pasting in documents that exemplifies the wanted information. Likewise, the agents crawl through the entire information corpus and detect matching information items without requiring the content providers to categorise the information or provide descriptive meta-information. The Find competence feature, too, relies entirely on *de facto* actions of the users and not on predefined competence forms. This means that the users do not have to fill out and complete forms for someone else's benefit, which is often the case in traditional competence systems. Instead, the VIP prototype is powered by action-driven technology.

The base for the VIP prototype is Autonomy's Agentware technology (Autonomy, 2001). Agentware works by analysing text and identifying key concepts by applying a combination of information theory principles, Bayesian probability, and neural networks. Once the key concepts are identified in form of word patterns, they are reduced to a digital signature or fingerprint. The key component in the Agentware system is the Dynamic Reasoning Engine (DRE) that utilises neural network technology to perform four main functions. Firstly, the fingerprint from a text source can be employed to return references to other text sources of varying degrees of similarity. Secondly, arbitrary text is used to create a fingerprint for a Concept Agent that is used to scan other text volumes for matching patterns. Thirdly, the Concept Agents can be altered or retrained by accepting a text and adjusting to the new patterns. Finally, a fourth function is a possibility to take a Boolean term or a natural language query and return a list of documents

ordered by relevance. As with the business layer in Mindpool, the DRE runs as a COM object in the MTS and communication between the user interface and the DRE is accomplished via provided Application Programming Interfaces (APIs). Since Agentware is a proprietary product, it is somewhat of a black box and the internals of the business and data layers are hidden, except for the exported methods. The user layer, however, can be designed freely and implemented in a variety of different programming languages and techniques. For convenience, I chose to implement the VIP prototype on the Windows NT platform, and hence I used ASP and VB scripts, as with Mindpool.

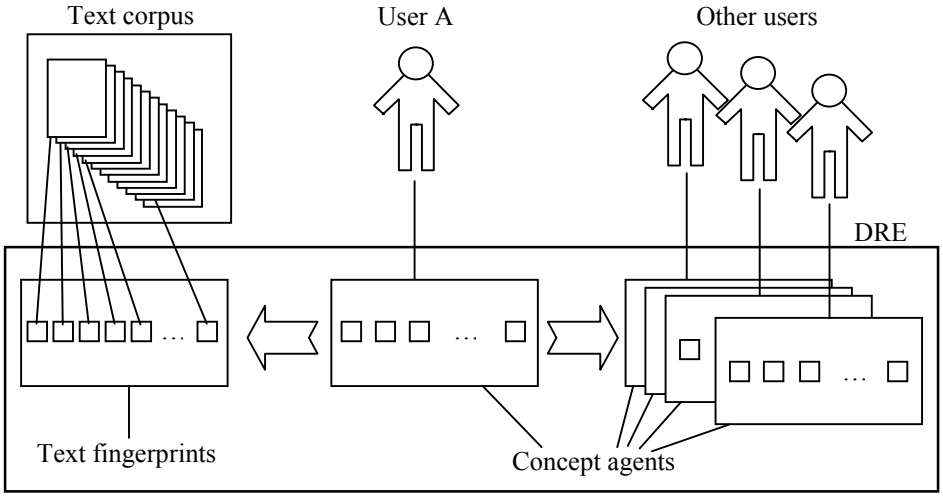


Figure 6. The Agentware architecture. User A can either have his agent find relevant information or use it to locate other users.

By utilising the four functions described above, a user *A* can create one or more agents that scan the fingerprints of a large corpus of text to find matching patterns (the left side of figure 6). This matching process is performed autonomously and does not require any further user intervention. The found documents are gathered on the agent's individual result page where they are sorted and presented in order of relevance, and an optional email notification can be sent to the user. This relieves the user from having to manually monitor the text corpus for new relevant or interesting updates. In addition, the patterns of user *A*'s agents can be matched against the agents of other users to find similarities, thereby indicating which other users share the interests of

user *A* (the right side of figure 6). Since these agents are used to present the user with new and relevant information, it is in the interests of the user to keep the agent current by retraining it whenever the interests shifts or becomes more targeted. The implicit profile that the agent constitutes is thus firmly based in practice and not some politically correct post-rationalisation.

## The papers

*Paper 1* is the result of my work with the Watson prototype, my intranet-based recommender system. My previous research had been occupied with information and information seeking but during the work with Watson, I became aware of the tacit knowledge involved in web activities. Although tacit knowledge constitutes the major part of what we know, it is difficult for organisations to fully benefit from this valuable asset. This is because tacit knowledge is elusive, and in order to capture, store, and disseminate it, which much of the KM literature is all about, it is argued that it first has to be made explicit. However, such a process is difficult, and, as I argue in *Paper 1*, often fails. During the Watson study, I revealed how interest-activated technology could be used to circumvent this problem and make tacit knowledge, in form of our professional interests, available to the organisation as a whole. I show in *Paper 1* how intranet documents, and the actions associated with them, can be used to make tacit knowledge tangible without becoming explicit, suggesting that tacitly expressed entities not necessarily are beyond the reach of information technology.

The study described in *Paper 1* teaches us that not only can intranets store large amounts of information but they can also be used to indicate the whereabouts of tacitly expressed knowledge. Furthermore, this tacitly held and unspoken knowledge that only reveals itself through actions in practice is considered more trustworthy than the espoused theory explicitly presented in manually maintained profiles and records. My work has shown this principle to hold also for actions performed on a corporate intranet. The insight that IT can be used to visualise the whereabouts of knowledge without necessarily having to make the knowledge explicit is a result of my research and a contribution to the KM discourse.

Encouraged by the results from the Watson prototype, I designed and implemented a second prototype – VIP. Building on the insights from *Paper 1*, that interest is an important motivating force, Rikard Lindgren and I wanted to use VIP for competence management. Together with Jan Ljungberg and Magnus Bergquist, we wrote *Paper 2*, where we claim that today's IT support for managing competence is based on an outdated Tayloristic view of competence. In the dynamic settings of the innovative organisation, the interest-informed actions that capture the emergent competencies of tomorrow require new types of IT support. In *Paper 2*, we theorise about these two separate forms of organisations and use them as a means to interpret and classify the empirical findings from the VIP study. The interviews show that competence is perceived as complex and multifaceted and three perspectives emerge: competence as a formal merit; interest as a complementary aspect of competence; and interest as something that transcends competence. The findings in *Paper 2* offer an empirical platform for rethinking competence systems for innovative organisations and a new design rationale promoting systems that are able to detect, visualise, and leverage interests of organisational members is suggested.

Things we are interested in occupy our minds both consciously and subconsciously. Sometimes we can put a name on our interest but perhaps more often our interests are only tacitly known to us as vague gut feelings. Yet, we have no problem determining whether or not a given situation, topic, or document is interesting. When we pursuit an interest we often probe into the unknown and learn new things as we go along. The competence gained during the process can often only be correctly labelled in retrospect – there might not even be a proper phrase for the phenomenon when the interest starts. Interests are thus indicators of future competence, and this finding is a novel insight.

At the time of our research, Volvo IT were in the process of evaluating a traditional competence management tool named Tieto Persona/Human Resource (TP/HR) and Rikard and I used this opportunity to study and compare these to different systems (VIP and TP/HR) and intervene in the evaluation. The resulting *Paper 3* thus extends the results presented in *Paper 2* by presenting an 18-month action case study of the design, implementation, and evaluation of two different competence systems. Our results increase and enrich the

existing body of competence systems research in two ways: Firstly, we show how problematic aspects of a hierarchically structured competence system negatively affect the adoption and use of such a system. Secondly, we show how a prototype recommender system can be utilised to support competence management. With these research results as a basis, we contribute to the general design of competence systems that support organisations striving to activate their members' competence by offering novel design implications. We conclude that such systems should provide features to facilitate search for action-based competence, awareness of communities of interests, high degree of personal data, formal descriptions of competence, and aggregation of competence information.

Parallel to my work with recommendation systems and competence management, I have also been interest in suggestions systems and idea generating environments. Traditional suggestion systems, despite certain shortcomings, have been used to promote creativity in industry for over a century, and have existed at Volvo for many years. Alongside this institutionalised approach, brainstorming has been practiced within Volvo as an informal method to increase idea generation. However, the two have never met. In *Paper 4*, which is an argumentative paper, I suggest that by adding computer support and applying lessons from the realm of electronic brainstorming (EBS) to traditional suggestion systems, useful improvements can be achieved. I therefore devised a hybrid intranet prototype that mimics the attributes of an EBS system and at the same time serves as a complement to the suggestion system. Mindpool combines the process gains of an EBS system with the few process losses of traditional brainstorming. The implications from my theoretical evaluation suggest novel ideas for both suggestion systems and EBS research, and it contributes to our understanding of the intranet as an unobtrusive and far-reaching organisational technology, and thus useful for supporting KM initiative.

Although the theoretical evaluation described in *Paper 4* showed the feasibility of combining a suggestion systems and an EBS tool, the devised prototype application failed to live up to these expectations when put to practice, as described in *Paper 5*. To understand and explain these negative results, I returned to the EBS literature. EBS as a form of group support system has received the attention from much cross-

disciplinary research and while it is generally held that group cohesiveness is lower in virtual settings that in face-to-face interactions, it has also been argued that this does not matter in cognitive work such as idea generation. However, most work on EBS has been carried out in academic settings, and though such environments provide more control, they are obviously insufficient to capture all nuances of on-going office work. As a useful contrast, *Paper 5* is an account of an action case study in a real organisational setting. Having analysed the cause of the failure, I claim that IT environments for virtual groupwork need to maintain and make salient a clear group identity. The analysis suggests that virtual groups engaged in cognitive work in competitive environments may need to maintain a group identity, counter to what is previously suggested. The conclusion is that it is not the reward system *per se* but the combination of extrinsic motivation and low group cohesiveness that caused the undesired effect.

*Papers 4* and *5* show that technology such as the intranet by itself does not guarantee the sharing of ideas that Berners-Lee and his colleagues opted for. To facilitate knowledge sharing, the technology must be paired with managerial efforts to reach its full potential as a KM environment. If such a culture can be fostered and the users actively contribute to the organisation's corpus of documentation by explicitly sharing experiences, ideas, and comments, a pool of useful organisational information can indeed be created. When the employees read, reflect, become inspired or upset, or otherwise react, new experiences are gained and new ideas are born, which in turn can be added to the pool. For this process to work, the access to and the adding of information must be as effortless as possible and not perceived as an added burden. Computer environments based on traditional means of input and output are unfortunately seldom effortless. However, although being equally restricted in terms of input devices, the web has better than any previous IT environment managed to hide the complexity of the technology from the user and can therefore offer less obtrusive ways of interacting with a large and disperse audience. It is important, though, to point out that the information corpus alone is not sufficient. What makes the intranet attractive is the interaction between the people who use the information. This has previously been marginalised and a result of my work is the highlighting of the user in the context of intranets.

The key factor for action-based KM to work is the existence of active users. Without active users, there can be no action and hence no transfer or creation of knowledge. It is also important that the users are acting in their own interests. When the action is restricted to brokers and gatekeepers, who perform actions on other's behalf, no real image of the organisational activities can emerge. Two things are thus required: incentive and possibility. There must exist an incentive to participate, and as I argue in *Papers 1*, *2*, and *3*, interests are important motivators that provide the required encouragement for individuals to engage in various activities on the intranet, such as information seeking and collaboration. There must also exist opportunities for the organisational members to personally pursuit their interests. This can be achieved by empowering them to act without gatekeepers and providing suitable end-user tools. However, as seen in *Papers 4* and *5*, people also want recognition. One way to motivate and reward employees is thus to acknowledge their efforts. This can be done on an intranet where actions can be made salient and community members who contribute can be announced in public. Although anonymity has been shown to have positive effects on certain types of on-line work in terms of more equal participation, there are also situations where not being able to identify or recognise the contributor is detrimental to the willingness to participate. Using the intranet to find, identify, and acknowledge organisational members and groups who constructively contribute to the organisational knowledge by sharing experiences and information can thus increase awareness and promote such behaviour. Activities and mechanisms that highlight the users and not merely the information are therefore necessary and should be integrated in the intranet design.

# Discussion

Although the rationalistic organisation still employs the majority of the work force, a different organisational form has emerged in the post-industrial society. I have called this new form the *innovative organisation* (see *Paper 2*) and it is for this organisation my work is targeted. In the post-industrial society, the requirements of tomorrow cannot easily be foreseen. Organisations trying to be more innovative acknowledge this by replacing standards, convergence, prediction, and structure with openness, divergence, preparedness, and a willingness to accept the unstructured. The problem at hand is not that of recurrence and redundancy, but to create a surplus of innovative ideas that can guide knowledge workers when developing new solutions. The production flow is less sequential and machine-driven and more chaotic and idea-driven (Sveiby, 1997), and the objective is not only to solve a problem but often also to create new business opportunities. However, unlike problems, which are obvious to everyone who encounters them, opportunities do not signal themselves. Instead, new opportunities open when taking lateral leaps and combining cross-functional insights rather than when extrapolating old solutions, and this rationale is what propelled the work described in *Paper 4* and *5*.

When information flows follow organisational hierarchies in the rationalistic organisation they instead go via collegial networks in the innovative organisation (Sveiby, 1997). The idea of a small group of centrally located information brokers that can control the flow and provide the rest of the organisation with relevant information is well suited for a bureaucracy, but less useful in more organic settings. Instead of having gatekeepers, information is reachable directly by those who need it. However, the strong focus on information that we now witness has itself its caveats. In libraries, the attention is on the information. Information managers and information systems developers, too, concentrate on the information. This focus, however, tend to make organisations forget *why* there is information. The information itself – how it is structured, stored, and disseminated – overshadows the people that are supposed to use the information to some ends. As a result, human aspects are neglected or marginalised. Brown and Duguid warn

against such an oversimplification. In organisational work, people interact with information and through information. When the social interactions that people engage in are neglected, there is an obvious risk that the information-centric view isolates informational aspects and makes us blind to other forces that govern our daily activities. Information is pivotal but one should therefore not try to squeeze everything into an information perspective or address people solely as information processors (Brown & Duguid, 2000). Instead of only concentrating on the information artefacts *per se*, my work has been to examine how people *make use* of these artefacts, in order to change and improve that use. By monitoring the actions and interactions the organisational members engage in whilst dealing with information, we can learn where certain kinds of knowledge reside and thereby leveraging the tacit knowledge of the organisational members.

Table 4. Consequence of the paradigm shift from Rationalistic to Innovative organisations (adapted from Malhotra, 2000)

| | **The rationalistic organisation** | **The innovative organisation** |
|---|---|---|
| **Strategy** | Prediction | Anticipation of surprise |
| **Management** | Compliance | Self-control |
| **Technology** | Convergence | Divergence |
| **Knowledge** | Utilisation | Creation and renewal |
| **Assets** | Tangibles | Intangibles |
| **Organisation** | Structure | Edge of chaos |

The fundamental differences between the two organisational forms that I have described are summarised in Table 4. However, I want to make clear that when I refer to these two stereotypical forms I do not imply that they necessarily have to be mutually exclusive. As argued in *Paper 2*, we often find both models in the same organisation – maybe in different geographical areas, in different departments, or on different layers in the establishment (cf. Nonaka, 1994). For example, Volvo as a whole can largely be considered a rationalistic organisation, whereas at department level there are many examples of highly innovative units. The clear-cut separation made here is for clarity and analytical reasons only.

## *The new intranet*

The web is obviously an artefact of the information age. However, when the Internet, which itself was instrumental in transforming society from industrialism to post-modernity, was brought inside the organisation, the resulting intranet came to suffer from the outdated mindset that reigned in the rationalistic organisation. Afraid of anarchy and lack of control, information monarchy or information federalism was quickly proposed as the governing model. By providing prescriptive guidelines and imperative rules regulating intranet usage, management sought to ensure consistency and control and thereby stifle the tendency of chaos otherwise associated with the web. In other words, information managers tried to squeeze the intranets into the organised/digitalised information arena as described in section 2. Subjected to the library model, the intranets were not able to preserve the creativity and diversity that characterise the Internet.

This standardisation urge goes counter to the emergent new economy where high-volume production is replaced by high-*value* production, and where a move from standardised to customised is evident (cf. Reich, 1991; 2002). To be more innovative, organisations need a new view of the intranet and an updated information management model. In contrast to the rationalistic organisation, the innovative organisation must support intra- and cross-organisational communication and actively network in order to shortcut the decision loops. There is no time to escalate requests up through the hierarchies, have management turn it into strategies, and then communicate down the ranks again. By the time it reaches the front-line workers, the business opportunity is long gone (cf. Stenmark, 2000). Customer relations are no longer handled by the market department only, but interactively via personal networks (Sveiby, 1997). Horizontal communication and collaboration are thus key activities in the innovative organisation, and the intranet can be instrumental in the establishing of such cross-functional interactions.

Not only can the intranet speed up the information flow. Perhaps even more importantly, when organisational members interact with and over the intranet, new and unforeseen combinations of information and knowledge arise due to the networked, hyperlinked, and open character of the web. These serendipitous combinations result in new creative

ideas and new business opportunities. Such interactions can be systematised and promoted, but not by imposing structures, standards, and processes. The often-seen phrase "the right information to the right people at the right time" is an expression of the mindset that ruled the rationalistic organisation. Trapped in this thinking, US West formulated their KM strategy in similar terms: "What's important is to find useful knowledge, bottle it, and pass it around" (Stewart & Kaufman, 1995). The innovative organisation is instead characterised by relative lack of structure, few rules, and large degrees of freedom. In contrast to US West, Pfizer outlined a strategy more suitable for the information age. Their director of pharmaceutical systems Rich Lynn explained: "There's this great river of data out there. Rather than building dams to try and bottle it all up into discrete little entities, we just give people canoes and compasses" (Dragoon, 1995).

## *A design framework*

Today's intranets are populated by a small number of information providers, who publish official corporate material and general information. However, much of the information available in today's intranet is not used by the organisation's members, who instead need *specific* information. Leveraging the intranet means including the users and having them add content more closely related to the every day activities they perform. I have argued in this thesis that allowing not only a narrow group of information professionals but the entire employee-base to publish also has a positive effect on organisational knowledge creation. There are thus good reasons for encouraging participation on a broad front. To take advantage of the unstructured nature of the web, the intranet must be designed to meet the information needs of the users and the information base must be broadened and rooted in practice.

Intranets should therefore not merely be seen as a collection of information but as an arena for organisational activities, thereby including the users as actors. Since work is becoming increasingly collaborative and team-oriented, information technology must support not only individuals in isolation but more importantly interactions between users and between groups of users. As an organisational-wide technology, the intranet should invite and inspire people to actively

participate in dialogue. To support such a scenario we need applications able to include the users as actors. The relationship between the information on the intranet and the knowledgeable organisational members making sense of it is that the information serves as a sort of scaffolding or building block that helps the employees reflect upon their assumptions, their interests, their knowledge, and their competence. Information artefacts, both by their content and by the actions associated with them, bridge the gap between the tacit personal knowledge of two individuals sharing a common context. To support and facilitate the sharing and making sense of knowledge, an intranet design must thus encompass more than just the information perspective. Towards such a design, I have suggested a model where the intranet as a KM environment is seen from three different perspectives: the information perspective, the awareness perspective, and the communication perspective (Stenmark, 2002). This is illustrated in figure 7.

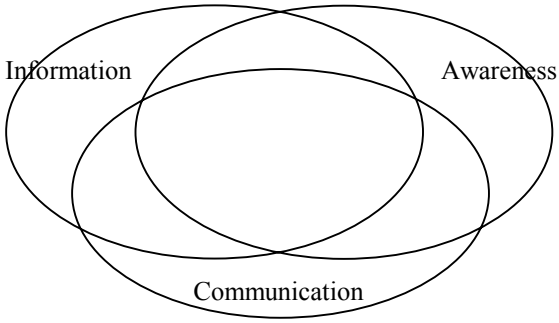


Figure 7. Three perspectives on the intranet. By simultaneously providing information, awareness, and communication, the intranet can better support the knowledge worker.

*The information perspective* is the most obvious view of the intranet, since information provision is a built-in feature of the technology. Even so, the prevailing approach to intranet information must be reconsidered. When users say they cannot find the information they need, the standard assumption seems to be that it is due to the intranet's poor structure. I think this is only partly true. Another and in my experience more plausible explanation is that it is because the information is not there. Until every employee is empowered and encouraged to participate by adding unique information to the intranet, we cannot hope to have an intranet that fully supports us in our daily work.

Seen from the information perspective, the intranet can provide the organisational members access to both structured and unstructured information in form of databases and documents. Access to rich and diverse sets of information is important for organisational knowledge creation since it provides rich stimuli and the requisite variety, creative chaos, and redundancy needed for knowledge creation (Nonaka & Takeuchi, 1995). The intranet thus affects the interaction between information and knowledge in today's organisations by increasing the consumers access to information and the opportunities for producers to reach a larger audience. To be able to handle this often huge and inherently chaotic information corpus, the organisational members must be given information technology that does not require the information (or the users) to be structured or standardised on a corporate level.

However, to merely read the information is not enough to gain knowledge. The reader must also reflect upon her assumptions, her actions, her experiences, and what consequences changing the rules will have on her future actions. Reflection therefore enables us to learn how to learn. Information plays an important role as a catalyst for reflection and IT is thus highly relevant for work that requires knowledge. The information infrastructure the intranet provides therefore needs applications that complement the information perspective by providing awareness and facilitating communication to allow the organisational members to find each other and engage in dialogue.

*The awareness perspective* exploits not only explicit links but also tacitly expressed connections to hook up organisational members with information and people they might otherwise have missed. The large amount of information available can result in information overload, and to avoid such a situation and maintain the awareness perspective, tools to assist the organisational member by prompting when new and relevant information is added must be developed. By making users aware of peers who not only share an official job description but also *de facto* have accessed the same information or authored similar documents, the awareness perspective can help establishing communities of practice, which increases the likelihood for successful communication and collaboration. This is illustrated with both the Watson prototype (*Paper 1*) and the subsequent VIP prototype (*Paper 2* and *Paper 3*). The shared environment provided by Mindpool (*Papers 4* and *5*) also increases the

organisational members' awareness of ongoing activities as the prototype reflects what ideas are occupying the employees' minds.

*The communication perspective*, finally, enables the organisational members to collectively interpret the available information by supporting various forms of channels for conversations and negotiations. The intranet communication perspective promotes reflection by making salient different interpretations and viewpoints. This is partly exploited in the Mindpool prototype (see *Paper 4* and *Paper 5*). By offering workflows and co-ordinating routines as well as support for more informal collaboration such as shared whiteboards, project areas, and chat rooms, the intranet provides means for organisational members to work together and engage in dialogue. When engaged in collaborative work with peers that share your objectives and understand your vocabulary, the common context necessary for knowledge sharing exists. From a communication perspective, we can act upon our new understanding, thereby transforming our knowledge to organisational benefit. A major objective for the intranet must therefore be to enable people to actively work together based on the information available to them, and facilitate the documentation of their experiences. The intranet would thereby help the organisation to take advantage of the knowledge of its members. The communication perspective must not be isolated from the information and the awareness perspectives. Only when designed as a holistic whole are the potentials for successful knowledge management fully utilised.

# Conclusions

Designing the new intranet means to include intranet applications that take advantage of the specific features that characterise web technology; openness, linking, and networking. The users should not be required to structure their material according to predefined categories or add descriptive keywords from a finite set of approved topics. Such imperatives discourage participation. Neither should the users have to know the exact whereabouts of the information nor rely on gatekeepers to retrieve the information needed. Instead, the intranet should employ sophisticated applications based on e.g. agent technology to navigate through unstructured information and find patterns between previously unlinked sources. By maintaining a rich supply of information and communication sources, the intranet will attract actors of all sorts.

Designing the new intranet means to take advantage of the tangible traces of everyday work activities left behind in form of published documents and server log entries. By exploiting the user's everyday actions in an unobtrusively manner, the intranet activities the user is already engaged in during an ordinary workday can be turned into an organisational benefit. Designing the new intranet also means to take advantage of the fact that actions on an intranet are not isolated events but interrelated activities performed by members of the same organisation. The activities that spontaneously occur on an intranet should be aggregated and exploited to reveal otherwise invisible patterns. An intranet application such as a search engine could therefore be able to detect if two users were interested in similar things, and use this insight to increase organisational awareness.

For today's organisational members to be able to create and share knowledge on a daily basis, the intranet should rest on an *information perspective* grounded in real user needs and based on actual user activities. From an *awareness perspective*, the intranet design should alert the users both of relevant information and of other knowledgeable users. The intranet should facilitate collaboration by applying a *communication perspective* that allows both ad hoc and well-defined groups and communities of practice do engage in dialogue.

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# Part II

# Paper 1

## Leveraging Tacit Organisational Knowledge

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## Abstract

Although tacit knowledge constitutes the major part of what we know, it is difficult for organisations to fully benefit from this valuable asset. This is because tacit knowledge is inherently elusive, and in order to capture, store, and disseminate it, it is argued that it first has to be made explicit. However, such a process is difficult, and often fails due to three reasons: (1) we are not necessarily aware of our tacit knowledge, (2) on a personal level we do not need to make it explicit in order to use it, and (3) we may not want to give up a valuable competitive advantage. During an empirical study of recommender system usage, it was noticed how such technology could be used to circumvent these problems, and make tacit knowledge, in form of our professional interests, available to the organisation as a whole. Using Polanyi's theories it will be showed how intranet documents can be used to make tacit knowledge tangible without becoming explicit, suggesting that tacitly expressed entities not necessarily are beyond the reach of information technology.

# 1. Introduction: A pluralistic epistemology

Ever since man first shared the knowledge of how to make fire with his fellow human beings, the managing of knowledge has been employed by masters training their apprentices and by parents teaching their children. In recent years, however, the importance of knowledge in business and industry has risen dramatically, and shifted from being one resource amongst many to becoming the *primary* resource. Being able to effectively manage this resource has thus received the attention of many chief executives and Knowledge Management (KM) as a concept has become a hotly debated topic.

Without going too deeply into the philosophical debate of what exactly knowledge is, we may notice that most voices in the KM discourse have abandoned the positivistic view of knowledge as an objectified and monistic absolute truth. Instead, the KM community has adopted a pluralistic epistemology, acknowledging that there are many forms or types of human knowledge (Spender, 1998). For example, Nonaka and Takeuchi (1995, chapter 3) distinguish between tacit and explicit knowledge. Choo (1998, p.111), based on Boisot's (1995, p.145-147) typology, suggests a differentiation between tacit, explicit, and cultural knowledge, and Spender (1996) suggests, in addition to tacit and explicit knowledge, individual and collective knowing. Blackler (1995), elaborating on Collins (1993), speaks of embodied, embedded, embrained, encultured, and encoded knowledge.

Though several other ways to classify knowledge exist and have been suggested, they all, more or less, build on the influential work of Polanyi (1966/1998) and his notion of tacit knowledge. Interestingly, the commonly used tacit-explicit distinction is not directly derived from Polanyi's work. Most commentators see explicit knowledge as knowledge that has been captured and codified into manuals, procedures, and rules, and is easy to disseminate. Tacit knowledge, on the other hand, is then knowledge that cannot be easily articulated and thus only exists in people's hands and minds, and manifests itself through their actions. In contrast, Polanyi does not make such a distinction. Instead, he envisions tacit knowledge as the backdrop against which all understanding is distinguished. Tacit knowledge is thus a cultural, emotional, and cognitive background, of which we are only

marginally aware. This tacitness is a precondition for *focal* knowledge (Prosch, 1986; Tuomi, 2000). Polanyi's view has sometimes been criticised for being overly concerned with the tacit aspects and thus becoming almost monistic. On the other hand, Polanyi's opinion that the tacit and the explicit are mutually constituted and should thus not be treated as two separate types of knowledge is supported by e.g. Tsoukas (1996), who argues that trying to split these two inseparably related entities is to "miss the point". While acknowledging the many nuances that exists between these two stances, the author shall use the terms "explicit" and "tacit" as normally understood. Polanyi's theories are however still useful for this paper since the purpose is to examine the tacit side of knowledge.

Organisational researchers have argued that research on KM has thus far been dominated by an IS/IT perspective, resulting in an overemphasis on codification of *explicit* knowledge, suitable for databases an other traditional IS solutions (Swan *et al*., 1999). If all knowledge could easily be codified and stored, there would be no need for a new paradigm – good old-fashioned data and information management would have done the job. However, it is widely acknowledged that many things are tacitly expressed and understood. It can thus be argued that it is the very *inability* of the information systems to handle knowledge that has brought about much of the current interest in knowledge management. With this discussion in mind, the author suggests that instead of trying to identify, capture, and make explicit tacit knowledge we should design IT solutions that will help us locate and communicate with knowledgeable people. Expertise is a quality highly dependent on tacit knowledge, and it can often only be observed and recognised through its resulting actions. We should not look on technology alone as the solution to our problem with finding and sharing knowledge but, at best, as a facilitator that helps us initiate and sustain social interactions.

Having argued that there is tacitly expressed knowledge in organisations and that this knowledge is important and worth pursuing, the author shall in this paper apply Polanyi's (1966/1998) theory of tacit knowledge to interpret the findings from an empirical case study of recommender system usage. Three conclusions can be derived: Firstly, our interests as experts and professionals is an example of part of our

tacit knowledge, secondly, web documents may be used to visualise and communicate this knowledge, and thirdly, information retrieval systems such as recommender systems can be used to exploit such tacit knowledge on an organisational level, without making it explicit. The result also shows that IT may be used to address knowledge that has not been made explicit.

However, the studying of (tacit) knowledge must be made with caution, since it is a valuable asset and often related to power. This ambiguity of tacit knowledge is discussed in the next sections, before explaining the relationship between knowledge and professional interests. Section four accounts for the authors approach to information retrieval technology, while section five describes the research site and the research methodology used. The prototype is explained in section six, followed by the field results and the discussion. The conclusions in section nine finish the paper.

## 2. The ambiguity of tacit knowledge

An interesting but also troublesome property of tacit knowledge is the inherent tension between its value on the one hand and its elusiveness on the other hand. The high value stems from the fact that most of our body of knowledge is made up of things we know but are unable to express. With Polanyi's words: "*We can know more than we can tell*" (Polanyi, 1966/1998, p.136). Leonard and Sensiper go even further by stating that "*we can often know more than we realise*" (Leonard and Sensiper, 1998, p.114).

Unfortunately, tacit knowledge is difficult for organisations to exploit. Since it only resides inside people, it cannot easily be sought for electronically. The problem of knowing who knows what grows with the size of the organisation. Tacit knowledge not being available in an explicit form makes it difficult if not impossible to quickly spread or share it within the organisation. This circumstance presents problems for today's organisations. In their widespread model of knowledge creation, Nonaka and Takeuchi (1995) suggest that tacit knowledge becomes explicit through the process of *externalisation*, i.e., by sharing metaphors and analogies during social interaction. However, such a process is both difficult and costly, and the fact that the tacit knowledge must be

externalised before it can be exploited limits its usefulness. It may even be questionable whether it is at all desirable to try to make (certain) knowledge explicit (Hansen *et al*., 1999).

The troublesome aspect of tacit knowledge is its elusiveness, which derives from at least three reasons: we are ourselves not fully aware of it, there is no personal need to make it explicit on the individual level, and there is a potential risk of losing power and competitive advantage by making it explicit.

Firstly, Davenport and Prusak observe that tacit knowledge "*incorporates so much accrued and embedded learning that its rules may be impossible to separate from how an individual acts*" (Davenport & Prusak, 1997, p.70). A baseball hitter just knows how to hit but he cannot describe it explicitly enough for someone else to learn. Such knowledge cannot be represented outside the human body. Choo takes a similar stand and writes that "*tacit knowledge is distributed in the totality of the individual's action experience*" and that tacit knowledge is "*relying on tactile cues registered by the human body interacting with its environment*" (Choo, 1998, p.117). In other words, our daily activities are informed by our tacit knowledge, without us thinking of it as, or recognising it as, knowledge. We know how to ride a bike without having to think. The knowledge resides within us, but we can neither document it in a manual, nor explain it in word to others. In fact, such knowledge would be useless to all who had not themselves experienced the activity. Tacit knowledge requires involvement of the knowing object, and to transfer such skills, the master and the apprentice must during periods of internship share experiences through actions.

Secondly, there is really no need for externalisation from the individual's point of view. Since we are able to use our tacit knowledge without thinking, we do not need to document it. Should we have to express our tacit knowledge in words, not only would it be a difficult and laborious task, but also a labour from which we would not directly benefit. It would be for the benefit of someone else in our organisation or for the good of our community. Grudin (1997) has argued convincingly that situations where one is forced to do the work and someone else gets the benefit very often result in failure.

A third, and final, reason for the evasiveness of tacit knowledge is brought up by Leonard and Sensiper (1998), who argue that making knowledge explicit is not always beneficial at the individual level. If the tacit knowledge provides an important competitive advantage, there is little reason to share it with the rest of the organisation, they argue. Extensive knowledge sharing by externalisation may create a situation where an organisational member has "automated away" the reason for his or her existence in the organisation. This is however not only restricted to tacit knowledge. For example, it has been indicated that lack of a proper reward mechanism on the individual level may effectively hinder sharing of ideas despite potential organisational benefits (Stenmark, 1999b). This suggests that Leonard and Sensiper's argument holds for knowledge in general.

# 3. Professional interests and tacit knowledge

As noted above, tacit knowledge is closely related to actions, and a particular type of action of interest to organisations is *work*. There may be a significant discrepancy between the espoused image of organisational work and the actual reality. In his ethnographic study of how work is conducted at Xerox, Orr (1996) describes how an organisation's view of how work is carried out contrasts sharply to what it really takes to get a job done. Though we have our formal job descriptions, these are seldom enough to account for the actions we perform during a working day. Instead, our interests as professional experts often make us elaborate within, and often even outside, our role definitions. Much of our daily office activity is thus governed by professional interests that dictate which reports we read and which documents we write.

The concept of interest is useful because it gives a motive and hence an incentive for actions. However, interest is too general a term to be useful in this discussion unless we narrow its scope to that of a corporate setting. Suchman (1987) observes that tacit knowledge enables us to take actions that are situated in particular social and physical circumstances, and that tacit knowledge thus is contextually bound. In an office setting such as the one examined in this research, our interests, and the actions they give rise to, are limited to a professional context. If we could

capture some of those activities and derive our underlying interests, we might be able to communicate part of our tacit knowledge. Such a possibility would be useful to an organisation, as it would enable this valuable resource to be shared, and help us find people who hold relevant knowledge.

Our (professional) interests are instances of tacit knowledge. Though we may be unable to produce an exhaustive definition of our interests, we usually have no problem in determining whether or not a given document is interesting. This ability is, like all tacit knowledge, highly situated. We may one week dismiss a document as uninteresting only to find that it has become very interesting a week later. Interests are typically ephemeral and what documents we are interested in is influenced by many factors beside sheer content, such as e.g., familiarity, novelty, importance, or urgency (Foltz & Dumais, 1992). However, it is generally assumed that *professional interests* are more stable over time (Foltz & Dumais, 1992; 20).

The reason why we intuitively know what we are interested in when we see it may be explained by applying Polanyi's (1966/1998) theories. Polanyi claims that tacit knowledge has two distinct properties, which he names its *proximal* and *distal* terms. The proximal term is the part that is closer to us, while the distal part is further away. In Polanyi's example, he describes how the police help a witness who is unable to describe a suspect to create a photo-fit picture by selecting images from a large selection of human features such as eyes, noses and hair. By attending *from* the first, closer image that resides within, *to* the second, more distant picture collection, the witness is able to communicate her awareness of the face.

Similarly, Polanyi refers to an experiment where a person was presented with a large number of written nonsense syllables and after certain syllables, the person was given an electric shock. The person was able to anticipate the shock at the sight of the shock syllables but on questioning remained unable to identify them. Again, by attending to the distal term - the shock - the test person became aware of the proximal term - the shock association. Tacit knowledge is, argues Polanyi, the understanding of the unity that this proximal/distal pair together

constitutes. We become aware of the proximal term only in the presence of the distal term but remain unable to communicate the former.

Applying Polanyi's notion of the proximal and distal terms, we see that when attending *from* our interests – the proximal term – and attending *to* the document – the distal term – we are able to recognise and express our interests. Through interesting documents, tacit knowledge may be communicated, despite the fact that it is not easily expressible in words. The fact that language alone is not enough does thus not stop tacit knowledge from being communicated (Spender, 1996). Choo (1998, p.117) suggests that rich modes of discourse including analogies, stories, and metaphors, should be used to reveal tacit knowledge. What we need now is an instrument to help us attend to this other, richer form.

## 4.An alternative perspective on retrieval systems

Recommender systems may be seen as performing what Foltz and Dumais (1992) refer to as personalised information delivery. Such systems are able to anticipate what items a user is likely to be interested in and can thus, in a hopefully intelligent way, recommend such items. How this "anticipating intelligence" is implemented varies from product to product and is not relevant to the discussion in this paper. Academic research, as well as the success of commercial products, has shown that such systems do work and we may safely assume this to be true in this particular case. For references to research on recommender systems, see e.g., (Resnick & Varian, 1997).

While implementing and studying the usage of an agent-based web retrieval prototype the author observed unexpected but interesting user behaviour which led him to do further investigations. Based on these studies it is claimed that recommender systems can provide the mechanism that allows us to address the three problems mentioned previously; (a) it helps communicate tacit knowledge; (b) it presents a natural incentive to do so, and; (c) it does not involve externalising away the competitive advantage. By identifying certain documents as interesting, the user could tell an agent-based retrieval system to maintain a dynamic profile that represents a certain limited perspective on the user's tacit knowledge without requiring explicitly defined

keywords or manually updated records. Since this profile is used to provide the user with information that is more accurate and search results that are more precise, a natural incentive exists for the user to give feedback and thus cultivate the profile. Finally, without being made available in explicit form, the resulting profile represents part of the user's tacit knowledge, which thereby becomes useable to the organisation as a whole.

Cohen *et al*. (1998) take a similar but reversed approach in their Expert Browser, when they note that experts read web documents and that this is an indication that the document in question is relevant within a certain field. Others may follow the path of the expert to find useful information. A prerequisite is that the expert (or a group of possible experts) is *known*. In contrast, the approach suggested here is to instead *follow the interest* that the documents represent to find the otherwise unknown expert.

Research concerning agent-based retrieval systems has mainly focused on user-to-object or user-to-information objectives, but has sometimes also addressed the user-to-user considerations. No one, however, has approached agent-based retrieval systems from a knowledge management perspective; i.e., discussed what knowledge governs the individual activities and how *tacit* knowledge may be put to use in the community. This work contributes to our understanding by proposing an interpretation that explains how tacit knowledge is activated, and how it may be made tangible in an organisational setting. The research described herein is thus not about recommender systems *per se*. The author has studied people *using* technology rather than the technology itself. However, the way in which the recommender system prototype was implemented helps to explain the findings, and some of the main features in the tool used will thus be briefly described. The choice of tool was however not significant for the research and will not be further discussed.

The aim of the initial research project was to examine how agent-based retrieval technology could be used in a new and innovative way and to speed up the development process existing software tools were used. While examining the commercial tools available at the time, the author came to realise that there were two different perspectives on how

content was handled and what role the user or customer played. These two views may be labelled Push and Pull respectively.

Push-oriented products focus on the content providers and how the site owners can best deliver added value to the customers. Though being able to adapt to user behaviour and learn to recognise user preferences, this is primarily done in order to help the content provider. Since every server wanting to have this feature must have the appropriate software installed, this solution works best when a single web server is used. For example, when Amazon uses push-based technology to recommend books or music, it only recommends books and music from the Amazon site. It does not provide references to competitors. However, for an intranet, this approach is less useful.

A pull-oriented product, on the other hand, starts with the user's needs and pulls whatever information it can find that matches the user's interests, from any web server in the net, and delivers it to the user's browser. No modification to or restructuring of existing data is needed and no additional software has to be installed on the web servers. Given the objectives of this research, the pull-oriented technology was considered more suitable.

# 5. Research site and method

The project described above took place at Volvo Information Technology during the autumn of 1998. The author spent four months implementing an agent-based recommender system and studying its usage at Volvo IT, which is an IT service company within the Volvo Group. At the time, Volvo's intranet consisted of some 450 web servers and had approximately 400,000 documents. Most of the content was official or semi-official information, such as department presentations, project reports, Frequently-Asked-Questions (FAQ's), and online help material.

Approximately 80 users were invited, of which 48 agreed to participate in the study, which ran from August to November 1998. The incentive to participate came from the assumption that the prototype being tested would be able to provide them with more targeted information for a lower user effort. The interested users were invited to a

2-hour introduction meeting, where the author explained the purpose of the research, the concept of agent-based systems, the design of the application and how to operate it, how to register and login, and how to set up and run individual agents. The participants were also asked to keep informal records of particular incidents that they considered worth noting, and informed that they were going to be contacted during or after the test to collect their viewpoints. Seven users were unable to attend either of the three introduction meetings, and did instead receive the above information via email. Most, but not all, of the 48 users who registered and participated in the test were Volvo IT employees and their job descriptions varied from technicians and system developers to content providers and administrators. All were experienced computer users with access to personal intranet-connected PCs.

The author subscribes to a grounded theory-inspired approach, meaning that instead of starting by forming hypothesis that may later be tested, the field is approached in an exploratory way letting the empirical findings form the hypothesis on which the analysis is built. This is an iterative process during which the empirical findings are re-interpreted until a theory that comprises all observed cases has been formed. Although approaching the field with an open mind, the author does not claim to be free of theory. On the contrary, *without a theory, there is nothing to research* (Silverman, 1993, p.1). Sometimes existing theories may prove useful in accounting for the observed results, while on other occasions, the findings cannot be adequately explained by existing theory and the researcher must discover the theory hidden in the empirical findings. In this particular case, the theory "discovered" was that of and Polanyi (1966/1998) and Argyris and Schön (1974), and the findings were interpreted using their frameworks to construct an understanding of the observed phenomena. This approach is thereby very similar to what Klein and Myers calls "interpretative case study" (Klein & Myers, 1999).

User experiences as well as hard data have been collected in several ways including interviewing, questionnaires, and web server log file analysis. First, all users were invited to a group interview but only eight showed up. Certain emerging patterns could however be noticed and a first tentative theory was formed. The remaining 40 users were then sent an email questionnaire, which again only some (12) answered. After re-

looping the analytic phase, based on the so far received answers and the application log files, seven semi-structured qualitative interviews were conducted, which shaped the final conclusions reported herein. The interviews were open-ended and lasted between 28 and 66 minutes.

# 6. Prototype features and design decisions

The prototype application used in this research, described in more detail elsewhere (Stenmark, 1999a), was based on a commercially available agent-technology tool that used neural networks and advanced pattern-matching techniques to identify text patterns in profiles and to look for similar patterns in other profiles or web documents. The system spidered Volvo's intranet each night and synthesised each found web document to a 0.5K digital representation. This "fingerprint" contains the characteristics of the document. Once the fingerprint signature was created, the reasoning part of the system could perform concept matching (e.g., finding documents relevant to each other), agent creation (e.g., setting up agents that can find relevant documents), and agent retraining (e.g., adapt the agent to a set of relevant documents). Please see the vendor's white paper for details (Autonomy, 2000).

New users were supposed to create a user profile in which they were to describe their job role or work responsibilities in a free text fashion. If a user already had a CV stored elsewhere, it could be copied into this field. The profile, once saved and stored, was then converted to a digital signature. The system provided a Community feature that was intended to enable users to locate colleagues with similar assignments and organisational roles by matching these signatures. A list of users with matching profiles was displayed and the user could now display the email address or the profile of any found user by clicking the corresponding hyperlink, and had the opportunity to contact him or her. The intention with this feature was to make the users aware of each other's presence and thus facilitate the emergence of online communities.

The prototype system offered individual agents that could be set to find intranet documents based on what Rich define as an implicit profile (Oard, 1997), i.e., a richer representation of an interest than merely a keyword-based query. To achieve personalisation, the users were

required to identify themselves by logging in. Once given access, the users could create agents, name the agents, and assign them tasks. A task corresponded to a search engine query, but was expressed in natural language and the best results were achieved when the users cut and pasted (a large chunk of text from) a relevant document and asked the agents to find more similar documents.

For each agent the users had four options; delete it, edit it, find similar agents, or check the result. The search results from the agents were displayed in a simple list, similar to those generated by most search engines, and by clicking on the associated hyperlinks the documents were retrieved. When the user had read and verified that one or more of the returned documents were 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 agent signature, replacing the previous one.

The Similar Agents feature was a rather late idea added more or less because it was easy to implement. The initial plan was to let the users be able to search for and find similar agents to have them cloned by copying them to their own private area. In this way, new and inexperienced users would receive help to get their agents to a decent quality level more quickly. However, this functionality was not implemented in time for the study and the only feature offered to the users during the test was the option to find other users with similar agents.

# 7. Field results

The week immediately following the initial 2-hour introduction, at which all participating users were provided with user-id, password, and the URL of the prototype, the usage was high. During the following two weeks, usage declined slightly before settling on a stable level. This level was then maintained throughout the rest of the test. The users typically used the application frequently, sometimes heavily, during a couple of days and then stayed away from it for a while before returning for the next session. Since the test site used Dynamic Host Configuration Protocol (DHCP), by which each user receives a dynamically generated

ip-address at each logon, the number of unique addresses in the log file was higher than the number of actually registered users. It was therefore not possible to determine exactly how many individuals had accessed the prototype on any given day. However, the pattern described above was easily identified.

### *7.1 Creating and maintaining agents*

Overall, the user reactions were positive. All 27 responding users claimed the prototype to be useful or at least potentially useful. However, eight users did not consider the prototype useful in its *current state*, but they believed that a future version would probably be able to deliver. The respondents said they believed in this technology and considered it to be "an extremely important asset" with a "great potential". One user put it this way:

> *"It's not exactly perfect you know, but I think it has potential… We will eventually be forced to have something to help us, I mean, in the future we're gonna be bombarded with even more info and this may be the only way to stay ahead".*

By automatically monitoring the search index, the agent could detect relevant intranet updates and thus off-load the user from manual searching. This was an appreciated feature since it "saved time not having to search". Besides the time-saving aspect, the most frequently reported reason for these beliefs were that it was easier to construct queries. Seven users explicitly expressed their appreciation of not having to come up with descriptive keywords, since they considered selecting keywords problematic. One of the respondents explained:

> *"Like, if I use a word, there's no guarantee the author used the same word. And if he didn't, I find nothing. Or worse – I get a lot of crap. So trying to be clever, figuring out the best keywords is usually just a waste of time since they do never fully contain the meaning you have in mind any way".*

The process of retraining the agents was conceived as non-trivial and despite the general claims that these sorts of retrieval agents were welcomed and appreciated, many users had experienced mainly negative actual results. A majority of the users (15 of 27) reported what they

referred to as “strange” or “unexpected” document matches, as indicated by the following quote:

> *“You don’t know what triggers a match, and sometimes you get suggestions that really makes you wonder. They seem totally off track… And that makes it hard to get something useful out of it. After retraining it with relevant documents it comes up with nothing”.*

However, some users tended to blame these bad results on their own inability rather than on the application. One user having received very little useful information said:

> *“I don’t know, maybe it’s me. I’m not at all sure what I’m supposed to write here. I don’t think it’s obvious. That’s a problem. The rather shallow results may depend on me not using the right words. Otherwise, I like the idea. Keep improving!”*

### *7.2 Facilitating networked communities*

The Community feature was intended to enable users with similar job profiles to learn of each other’s existence. However, not many users exploited the Community feature. The reasons given were that the users already knew enough people doing similar jobs or that most users with similar profiles worked at the same department as the respondents. The respondents were not too interested in finding like-minded colleagues. As one user put it:

> *“What’s the use of hooking up with people doing the same stuff I do? If I want to talk to those guys, I go talk to them. They sit over there. But take, eh… databases – SQL server or something – where I don’t have a clue. I wouldn’t know where to start. It would probably be better to team up with those who know stuff I don’t know.”*

Those who actually did try the Community feature used it only once or, in one case, twice. All interviewees but one considered the Community feature to be working, or to use their words; it delivered what it was supposed to. One user, however, claimed to have been connected to people with whom he had nothing in common. This was not what he had expected and his reaction to it was rather negative. “*This was clearly a bug*” were his words.

### *7.3 Finding similar agents*

The Similar Agent feature was implemented using the same mechanisms as in the Community feature, and although the Similar Agents feature generated exact the same output as did the Community feature, the Similar Agents feature was much more frequently used, and received much more interest. One user commented:

> *"Sometimes you think you're alone and then you find out you're not. And it's not… I mean, it's all kinds of different people. It's really interesting to see who else is searching for these sorts of things".*

Six respondents reported that they were surprised to find certain people sharing their interests, and another four said that the Similar Agents feature returned users whom they had not expected to be interested in a particular topic. However, these comments were not uttered in a negative way, as was the case with the remarks on the Community feature. On the contrary, the users regarded these un-expected results as useful new insights and no one questioned the correctness of the results.

## 8. Discussion

Rather than having to invent clever keywords to describe their interests, the users preferred to provide examples by pointing to relevant web documents. This is because the act of recognising an interesting document utilises tacit knowledge while the task of selecting descriptive keywords requires a (non-trivial) translation to explicit knowledge. However, to many organisational members the use of keywords is the established way of searching and they have difficulties trying to re-think. Despite the instructions to use entire documents as query input they continue to type in (a few) keywords. This suggests that the system should more actively encourage and facilitate the use of documents rather than keywords - possibly by letting the user enter a URL instead of text. This would prevent the user from entering keywords only.

By drawing a parallel to Polanyi's account of the face description and the shock association, we can see that our interests constitute the proximal term of our tacit knowledge. In the presence of the distal term - here represented by the document as previously the picture cards and the

syllables - we are able to attend to the proximal term; our interests. Polanyi explains: "*This is how we come to know these particulars, without becoming able to identify them*" (Polanyi, 1966/1998, p.138). The documents on an intranet can thus be used to communicate the tacit knowledge of our interests.

### *8.1 Espoused theory*

This distinction between tacit and explicit knowledge is parallel to the differences between Similar Agents and the Community features, and explains why the Community feature, which is based on explicit knowledge, was not used much whereas the Similar Agent feature, which relies on tacit knowledge, was more deeply explored.

People are often viewed as performing their jobs according to their formal job descriptions though everyday practice provides evidence of the opposite, as shown by Brown (1998). Browns account is consistent with the findings of Argyris and Schön (1974) who refer to the worldview and values that people believe their behaviour is based on as "espoused theory" as opposed to "theory-in-use". The organisational structure and the department descriptions, that are not only already known to the members but also experienced as fictitious, depict the espoused theory of work. The Community feature was built on static profiles provided by the users themselves to mirror the official responsibilities placed upon them by the organisation. The users rightly or wrongly assume that they already know the explicit knowledge that the Community feature will return and they dismiss it as of little interest. Baumard (1999, p.57) suggests that organisational members are unaware of this behaviour due to the cognitive gap that exists between the explicit knowledge we believe we use when making decisions and the tacit knowledge that we really employ. In our post-rationalisation we instead explain our behaviour using completely different knowledge from that which we initially used.

### *8.2 The relevance of practice*

The Similar Agents feature is different from the above in that it does not rely on static profiles provided to describe an official role. Instead, Similar Agents relies on the tacit knowledge of our interests, made

tangible through dynamically retrained agents created with a totally different purpose than the static profiles. If the prompt "Enter your profile" connotes a question equivalent to "what is your official job description?" the agents are instead created for personal benefit only and no official considerations are taken into account. True and real interests govern the choice of topics, which makes these search profiles more "believable" than the previous job describing ones. The most notable observations from the interviews are that when comparing job profiles, which are built on explicit knowledge and espoused theory of work, the user being linked to colleagues not expected referred to the result as "strange", in the negative sense of the word. At the same time, the users matching agents that built on tacit knowledge and practice commented similar results as "interesting", in the positive sense of the word. The tacit theory-in-use is obviously regarded as more trustworthy.

### *8.3 Avoiding the explicit*

Nonaka and Takeuchi's (1995) model of knowledge creation and sharing largely ignores the fact that knowledge is a competitive resource not only on the organisational level but also on the individual level. People do not share knowledge without a strong personal motivation, and they would certainly not give it away without concern for what they may gain or lose by doing so. This problematic circumstance may be avoided by the approach suggested in this work, where knowledge does not have to be externalised.

Instead, the *whereabouts* of the knowledge may be identified and made known within the organisation. In this way the users' value will increase, both for themselves - as they are identified as having certain knowledge - and for the organisation - which can use the knowledge. When the users no longer risk having their knowledge tapped and replaced by a database, their reluctance to contribute is reduced. Davenport *et al*. (1992) reason along these lines when they suggest the introduction of information politics: that collective knowledge of the organisation is worth managing, but not necessarily worth capturing. Hansen *et al*. (1999) take a similar stance when they conclude that the management strategies for knowledge should be informed by the nature of the business. When mainly tacit knowledge is used to solve problems, the face-to-face approach to communicate knowledge should be used,

rather than any attempt to store it. Trying to externalise tacit knowledge can lead to serious problems since the nuances and details that are exchanged in physical interactions are lost.

To be able to find this sort of knowledge is, however, only a first step; it only helps identifying experts within the organisation - it does not prevent these people from leaving the organisation nor guaranteeing that they will have time or willingness to share their knowledge on request. Davenport and Prusak observe that "*mapping who knows what in an organisation creates an essential knowledge inventory, but does not guarantee the ongoing availability of knowledge*" (Davenport & Prusak, 1997, p.81). To foster an environment that appreciates, encourages and rewards active knowledge sharing, other measures that fall outside the scope of this text must be deployed.

## *8.4 Limitations*

However, the approach suggested here has certain shortcomings that need to be addressed. McDonald and Ackerman (1998) point out that many recommender systems do not distinguish between different levels of knowledge. There is no way of telling whether a user with an interest is an experienced expert or just a curious novice. Indeed, the approach suggested in this paper suffers from this weakness. Further, interests are in themselves rather elusive. Interests may shift over time but that does not imply that the knowledge is gone. A senior C++ programmer with a corresponding interest may develop an interest in Java programming, and eventually focus entirely on this new field. Since the agent would evolve with the programmer's shifting interest, it would then not be possible to identify this user as a C++ expert.

Although the author had pre-knowledge of the working conditions at the studied site, no systematic usefulness or usability measures were taken. For example, Davis' Technology Acceptance Model (Davis, 1989) could have been used to ensure the implementation of the features most likely to be perceived as useful. Such an analysis might have resulted in the removal of the some feature and the addition of others.

Finally, the fact that the participants were volunteers might have biased the outcome. These interested individuals may be somehow different from the rest of the employees, thereby generating a result

different from what had been obtained with a randomly selected test group. We remain ignorant of whatever hidden agendas impelled these individuals to participate. The difficulties the author experienced trying to gather the post-study responses can be an indication of motives other than the objectives of the study.

# 9. Conclusions

Most of the research done in the KM arena has an IS/IT background, and despite the fact that making tacit knowledge explicit is difficult, costly, and not always desired, this is the prevailing approach. The work described above suggests a novel attempt to utilise IT in order to exploit tacit knowledge, but without making it explicit and thereby rationalise away the people in whom the knowledge resides.

The author has argued that the professional interests of users in a corporate setting are examples of tacit knowledge, and that this knowledge governs many of their daily activities. Focusing on a subset of the organisational environment – the intranet – it has been shown that web documents and information retrieval technology can act as a facilitator in the knowledge managing process by leveraging tacit knowledge on an intra-organisational web. On the whole, the approach has three benefits: Firstly, the otherwise hard to solve problem of being able to produce an exhaustive definition of one's interests is replaced with the much simpler task of determining whether or not a given document is interesting. Secondly, since a good profile results in more accurate information, a natural incentive to maintain the profile by giving feedback exists. Thirdly, the knowledge is not externalised but allowed to reside within the users, and therefore no loss of competitive advantage is experienced. The main point made here is that though some things in organisations are tacitly experienced it does not imply that they are outside the reach of information technology support.

Apart from these system-specific implications, we can also deduce a more general conclusion that may influence the design of future KM systems. The discrepancy between the espoused theory and the explicit knowledge that we like to think we use and the tacit knowledge that we really employ in practice has been demonstrated by the empirical evidence and explained. From this it can be concluded that *profiles*

*based on tacit knowledge that are identified by practice are considered more trustworthy than the espoused theory-based job descriptions.*

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# Paper 2

## Rethinking Competence Systems for Innovative Organisations

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## Abstract

Information technology (IT) support for managing competence is based on a rationalistic view of competence. While these competence systems might work in rationalistic organisations, we argue that in more dynamic settings, such as in innovative organisations, the interest-informed actions that capture the emergent competencies of tomorrow require different types of IT support. We theorise about these two separate forms of organisations and use them as a means to interpret and classify empirical findings from an action case study of an implemented interest-activated recommender system prototype. The interviews show that competence is perceived as complex and multifaceted and three categories emerge: competence as a formal merit; interest as a complementary aspect of competence; and interest as something that transcends competence. The findings offer an empirical platform for rethinking competence systems for innovative organisations. We suggest a new design rationale promoting systems that are able to detect, visualise and leverage interests of organisational members.

# 1. Introduction

Much work on knowledge management (KM) systems has focused on handling knowledge (in a general and unspecified sense) or on expertise, i.e., individually held work-related knowledge (see e.g., Ruggles, 1997; McDonald & Ackerman, 2000). Relatively little attention has been paid to IT support for managing competence, i.e., organisationally managed work-related knowledge (see (Lindgren and Wallström, 2000) for an exception). Furthermore, most competence systems have adopted an over-simplified rationalistic perspective on competence rooted in early 20th century management thinking. Needless to say, the adoption of such systems has been problematic in terms of conceptualisation, function, and user acceptance. Competence systems are typically used for personnel administration by human resource departments (Lindgren & Wallström, 2000). Systems that passively store formalised competence descriptions related to well-defined tasks might work in organisations characterised by perfunctory activities acting in a stable environment. As we shall argue, organisations distinguished by changing conditions, unforeseen requirements and a constant need for innovations need a richer interpretation of competence. A more dynamic view should include the form of competence-in-action that is primarily driven by individual interest. This in term requires competence systems that are emergent, dynamic, and based on interest-driven actions that depict real-time status. We show this by reporting from an action case study of an implemented interest-activated recommender system prototype at Volvo Information Technology AB in Göteborg, Sweden. By analysing how people used this prototype to find information they were interested in, we were able to understand how personal interests resulted in observable actions. This enabled us to both inquire into how organisational members perceived the relationship between interest and competence, and elaborate on what IT support competence management in innovative organisations would require.

This paper is organised as follows. The next section discusses the related research, and is followed by a section on the concept of competence. Thereafter, we relate competence to the notions of rationalistic and innovative organisations in section four. In section five, we present our research approach before reporting the empirical results

in section six. Section seven contains a discussion of interest versus competence, and in section eight, we discuss implications for future competence systems. Our conclusions in section nine finish the paper.

## 2. Related research

Over the past several years, the management of knowledge and competence has been promoted as a critical factor for organisational survival and maintenance of competitive advantage (see e.g., Nelson & Winter, 1982; Drucker, 1993; Nonaka, 1994). A number of researchers have suggested that individuals' knowledge, expertise and ability to learn are at the heart of today's competency-based organisations (see e.g., Senge, 1990; Leonard-Barton, 1992; Lawler, 1994). The notions of knowledge, expertise and competence are closely related, and historically these have been discussed in a variety of ways (see e.g., Prahalad & Hamel, 1990; Walsh and Ungson, 1991; Amit and Shoemaker, 1993). In this paper, both expertise and competence are seen as enacted and work-related knowledge. These two concepts are highly interrelated and used somewhat interchangingly in the literature. The difference, however, is that expertise is often understood as an individual aspect, while competence usually is discussed on an organisational level. Our ambition is to adhere to this notion.

How organisations manage their knowledge and expertise, e.g., as narratives (Orr, 1990), through knowledge mapping (Zack, 1999), or via gatekeeping (Schultze & Boland, 2000), has been studied frequently. Moreover, there have been many studies focusing on KM systems for knowledge and expertise, e.g., intranets for sharing knowledge (Scott, 1998), database technologies for handling organisational knowledge (Maier & 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 & Ackerman, 2000). Finally, empirical studies have been conducted in order to point out implications for design of KM systems, e.g., by analysing work conducted in a telephone hotline group (Ackerman & Halverson, 1998), and expertise location in a software development company (McDonald & Ackerman, 1998).

Comparatively little research on how organisations handle their competence has been reported in the KM 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 contains 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, not much attention was given to the role of IT in these processes. In Lindgren and Wallström (2000), results from a multiple-case study of competence systems in practical use are reported. The main characteristic that the competence systems, included in their study, has in common, is that they store organisational members' competencies in hierarchical tree structures. The competence systems use a grading scale to indicate the level of skill for a certain competence. With competence data as point of departure, it is possible to search for a specific competence, overview the status of competencies, and measure the difference between existing and wanted competencies. The investigated systems are particularly designed to support the organisations in managing their competence in a structured and efficient way, i.e., to have the right competence at the right place and the right time. According to the authors, this is not achieved, though. Their results highlight general problem areas related to conceptualisation, function, and user acceptance. Competence systems are reduced to tools for creating passive inventories of formalised competencies, instead of being seen as vehicles for making competence active as wished by the organisations (cf. (Bannon & Kuutti, 1996) for an analogous argument concerning organisational memory). We have used the results from Lindgren and Wallström's study as a starting point for the research reported in this paper.

# 3. Competence

While knowledge is a broad and abstract concept discussed by philosophers for ages, competence is a more specific concept firmly established in scientific management of the early 20th century (Taylor, 1911), and more frequently used in human resource management in the 70's and 80's (McClelland, 1973; Boyatzis, 1982). Competence is understood as the relation between humans and work tasks, i.e., the concern is not about knowledge and skills in itself, but which knowledge

and skills are required to perform a specific task in an efficient way (McClelland, 1973).

Early management thinkers addressing competence criticised the *ad hoc* and unstructured way in which competence was managed. In 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 casually related to […] superior performance in a job or situation" (Spencer & Spencer, 1993:9). A plethora of methods and espoused theories used by practitioners is based on varying sets of such characteristics, including attributes such as knowledge, skill, ability, experience, attitude, willingness, and personality (see e.g., Veres III *et al*., 1990; Sandberg, 1994; von Krogh & Ross, 1996). Organisational activities such as competence mapping and competence gap analyses are based on the same rationalistic view of competence, which suffers from several limitations: Firstly, descriptions of competence are fragmentary and atomistic; Secondly, competence is categorised beforehand in an *ad hoc* way with weak connections to both empirical data and theory, which rather confirm the model of competence itself than the workers' competence; Thirdly, regardless of the number of categories, competence profiles are static, indirect, and general descriptions concerning human competence. Competence profiles do not demonstrate whether workers actually use the competence in accomplishing work, i.e., the competence profiles are not rooted in work practice (Sandberg, 1994).

Despite this critique, organisational approaches to competence as well as accompanying IT support still rely heavily on a rationalistic view of competence (cf. Lindgren and Wallström, 2000). In order to understand why using such competence systems is problematic, competence must be understood in relation to the organisational forms in which the systems are implemented. Therefore, we have to be aware of how organisational frameworks create different demands for competence management.

# 4. Rationalistic and innovative organisations

On an organisational level, we shall separate the rationalistic from the innovative organisation (cf. Hedlund, 1994). This separation is based on a dichotomy that relates to the extensive literature describing typologies of organisational forms. The two main strands in this discourse are the goal-oriented rationalistic form suitable for a stable and predictable environment, and the organic form appropriate for changing conditions, fresh problems, and unforeseen requirements for action. However, it is important to note that rationalistic and innovative organisations do not necessarily have to be mutually exclusive. We often find both models in the same organisation, in different areas, departments, or layers in the establishment (cf. Nonaka, 1994).

The rationalistic organisation includes characteristics from scientific management (Taylor, 1911), bureaucracy (Weber, 1947), mechanistic systems (Burns & Stalker, 1961), goal-directed rationalistic organisations (Pfeffer, 1982), and a perspective on organisations as closed and stable systems (Thompson, 1967). The rationalistic organisation is knowledge-routinised or expert-dependent. It has well-established recurrent activities characterised by repetitive tasks and known problems, and is driven by an ambition to optimise performance and eliminate redundancy (Blackler, 1995). Competence is therefore defined either as the knowledge and experience of technologies, the rules and procedures required to perform the repetitive tasks, or as levels of expertise for more qualified tasks. Making competence visible and retrievable, and thereby available to the organisation as a whole, is thought of as a way to enhance performance as well as a way to avoid reinventing the wheel. Since future tasks and problems are presumed to be known, competence is defined and categorised beforehand.

The innovative organisation, in contrast, depends on a different sort of rationality that includes characteristics of organic organisations (Burns & Stalker, 1961), emergent, almost-random organisations (Pfeffer, 1982), and a perspective on organisations as open and dynamic systems (Burns & Stalker, 1961). The innovative organisation has little or no prior knowledge regarding the requirements of tomorrow. The problem at hand is not that of recurrence and redundancy, but to create a surplus of innovative ideas that can guide knowledge workers when

developing new solutions. In the innovative organisation, competence has to be associated with processes of change. Competence must be seen as dynamic, emergent, and situated in constantly changing practice, and is therefore hard to define precisely and beforehand. Communication and collaboration are key processes, and the ability to master symbolic manipulations is vital (Blackler, 1995). Making the organisation more efficient by rationalisations is not an issue. Instead, people's commitment and motivation become crucial assets alongside technology's role of enabling new possibilities and connections (Nonaka, 1994).

As stated previously, most IT support for managing competence is designed based on a rationalistic perspective on competence (cf. Lindgren & Wallström, 2000). This way of handling competence might work in a rationalistic organisation, but does not support an innovative organisation. Consequently, there is a lack of contributions that deal with competence systems for innovative organisations. Therefore, we argue that the innovative organisation needs systems based on a richer understanding of competence that includes an interest-driven working practice. Computer mediated communication platforms such as email have been used to connect organisational members with similar interests (Finholt & Sproull, 1990). While it might be difficult to exhaustively and explicitly articulate what constitutes an interesting text, we often have no problem determining whether any given document is interesting or not. Elaborating on this fact, Stenmark (2001) uses Polanyi's theories to show how interests are instances of tacit knowledge, and how professional interests, because they provide a natural incentive for actions, are useful from an organisational perspective. Professional interest dictate which reports we read and which documents we write, and thus govern much of the daily office activities. The actions that we focus on in this particular case are those related to information seeking on a corporate intranet. In such a context, where all material is work-related, the underlying interest can be assumed relevant to the organisation. The challenge is to somehow capture these actions and identify the motivating interest. The approach suggested by Stenmark (2001) is that information retrieval systems could be used to reveal part of our tacit knowledge by making salient our search patterns. Building on Stenmark, 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, and opens for new ideas about how to design competence systems for innovative organisations. To be able to study the relationship between interest and competence, we implemented a recommender system prototype at Volvo IT.

## 5. Research approach

During the spring of 2000, the recommender system prototype was implemented at Volvo Information Technology AB, which is the competence centre for IT services within the Volvo Group. Though the corporate group was in many aspects more of a rationalistic type of organisation with an evident industrial legacy, Volvo IT had to be more innovative. This was because the IT company was not the only provider of IT services since they had to compete with external firms. The recommender system prototype operated on the corporate intranet, which had been implemented in 1995. The intranet consisted of more than 700 web servers and contained both official information, and semi- or unofficial material. While the official information was maintained via coherent structures and relied on meta-information to improve search capabilities, the major part of the intranet structure, although containing much valuable information, seemed *ad hoc* and haphazard. This motivated the employees to engage information agents to find relevant information.

The primary objective of the implemented recommender system prototype was to provide the organisational members with relevant and targeted information retrieved from the corporate intranet. The prototype used in this research was a development of a previous prototype (Stenmark, 2001) based on Autonomy's AgentWare, which is a commercially available tool that uses neural networks and advanced pattern-matching techniques to identify text patterns in profiles. The system spiders the intranet, and retrieves and synthesises every web document into a 0.5K digital representation. Using this representation, the system allows the users to define their areas of interest by creating

one or more information agents, which search the created index for documents matching the user's interest. An interest is 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 creates a digital representation. Each user can define several agents, and the search results from each agent are displayed in a simple list. When the user has read and identified one or more of the returned documents as relevant, the user can provide the agent with explicit feedback by marking the best document(s) and clicking a retrain button. The digital signature of the agent is then merged with the signature(s) of the selected document(s), and the result becomes the new signature replacing the previous one. This mechanism makes it easy to update the agent profile to reflect one's actual interest.

A novel addition to the standard recommender system function was the Find competence feature, which allowed the user to enter a free-text description of any desired competence, e.g., "database administration on an oracle system". In sharp contrast to traditional competence systems, our prototype did not answer such a query with a set of formalised database records, but presented lists of employees who, at this very moment in time, had agents actively searching for information similar to the content of the query. Hence, the Find competence feature facilitated the active and up-to-date information that is otherwise so difficult to maintain in a traditional competence system.

Unrelated to the intranet, the company had in late 1999 initiated a pilot installation of Tieto Persona/Human Resource (TP/HR), which is a traditional system for managing competence, designed to support mapping, categorisation, and visualisation of an organisation'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 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 organisational 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.

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 an action case study (Vidgen & Braa, 1997). 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 case study data consists of 16 semi-structured interviews with organisational members using the prototype recommender system. 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 organisation, ranging from non-technicians such as HR staff members and financial controllers to technology watchers and systems programmers. All interviews were recorded and transcribed, and the empirical results 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

Concerning the prototype's Find competence feature, it was evident that many users were uncertain of what this function 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:

> *"Well, Find competence [in the prototype 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 C++ for example 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 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 […] I am still puzzled when I look at it."*

According to this software developer, competence is normally something that is formalised and refers to specific roles and work tasks within the organisation. Further, some respondents discussed competence as something transcending what can be formalised, but also enacted and emerging from practice. One HR staff member saw potential in the prototype, since it could be a complement to the formalised way of mapping competencies supported by the TP/HR system:

*"TP/HR is a lot more about order… order and being in control of the situation. And 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 use their skills for. It is sort of the next step."*

This HR staff member's view was that the prototype displays what people actually do, rather than merely displaying a historic description of the employees' competencies. The quotation further illustrates a perspective on competence where formalised descriptions as well as competence applied in practice are important and complement each other. In addition, there were interviewees who not only regarded the prototype as a complement to the formalised competence systems, but also saw it as a tool that could support the activity of keeping the TP/HR's role categorisation up to date. Manually updated work descriptions are problematic since people change work tasks continually, and therefore systems that contain such profiles are hard to keep up to date. This perspective on the prototype indicates an action-oriented view of competence. In line with this, a project manager discussed the need for information that makes salient people's actions. Interests in similar areas mean working with comparable problems, which in turn indicates

related competence. However, one of the interviewed system programmers took this discussion an additional step further by arguing that lack of interests reveals missing competencies within the organisation:

*"Yes, of course 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. Yes, then you could find areas that are neglected or where you are weak…"*

The idea of using the prototype as an instrument in order 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 to use the prototype for managing competence within the organisation:

*"A personal agent speaks about an element that people want. Then maybe you realise that, through analysing personal agents, you can discover that there is a competence gap in comparison with what the organisation 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 represents a perspective in which interest is considered as means for managing the organisation's competence. This respondent also meant that interest is so important for competence that they should be taken into account when configuring new projects. Other interviewees 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, because I do not really 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. It does not have to take days. 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. However, this is not a problem, rather our main point. Identifying the driving forces among the employees is essential for the organisation. 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, and one technology watcher elaborated on using the prototype for this purpose:

> *"The most powerful thing I see is a possibility to visualise. If one can use this tool in a proper way then there is a possibility to visualise [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 visualising the status regarding interests over time on an aggregated level, it is possible for the organisation to partly trace the historical development of the employees' interests, and partly discover emerging new initiatives with a potential strategic impact.

# 7. The relation between interest and competence

In this section, the different personal views concerning the relationship between interest and competence, illustrated in the previous section, will be condensed into three themes: competence as formalised description; interest as competence; and interest beyond competence. These themes will be discussed in relation to the rationalistic and the innovative organisations as well as to existing IT support for managing competence.

A considerable part of the interviewees discussed the prototype in relation to TP/HR, which is a system that embodies and expresses the rationalistic view of competence. Interests, in this context, were ignored by these respondents, who implicitly perceived competence as primarily constituted of attributes such as knowledge, skills and ability that can be represented in formalised descriptions (cf. Veres III *et al*., 1990; Sandberg, 1994). The TP/HR system is based on formal descriptions of competencies in form of skills and thereby reflects the idea of the rationalistic organisation. The system can be described as a traditional tool for managing competence since it is designed to match an activity,

based on standard procedures and constituted of well-defined tasks with available competencies. Thus, 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 certain problem (cf. Blackler, 1995). Further, the competence resides somewhere in the organisation, 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. Existing competence systems are designed with this rationalistic perspective on competence as a basis (Lindgren & Wallström, 2000).

Some interviewees recognised interests as essential because it says something about work-practices (cf. Argyris & Schön, 1974; Suchman, 1995). 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 organisations' competencies, and were seen by some respondents as equally important as the rationalistic way of understanding competence. Consequently, in this perspective formalised descriptions and competence applied in practice are both important and complement each other. For example, the respondents discussed the possibility to have the prototype update the content of the TP/HR system. Though this perspective regarding the relationship between interest and competence also has its roots in the rationalistic idea of the organisation, the importance of interest as an addition to the formalised view of competence was acknowledged. Embryos to systems supporting this perspective on competence can be seen in the form of functions 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 visualise interest and ambitions (cf. Lindgren & Wallström, 2000).

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 (cf. Levitt & March, 1988). It is the intrinsic

motivation that comes from personal interests that sets the limits for the organisation'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 organisational forms, it became obvious to them that innovative work requires other ways of organising as well as a new understanding of competence. The view of interest as something that goes beyond competence belongs to the innovative organisation, 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 innovative organisation business relies more on identifying individuals with the ability to learn as they go along than on finding employees matching predefined competence profiles. IT support for detecting emerging interest with the potentials of becoming new competence areas is difficult to realise since much of the input required is only tacitly expressed. However, this does not mean that such support is entirely out of reach, as shall be discussed next.

# 8. Competence systems

In situations when real-time and action-based status is expected, it is crucial that the systems are up to date. If only historical records are available, the systems are useless to the innovative organisation regardless of whether interests or formal competencies are stored. There is a strong resemblance to the problem of the common good discussed extensively in the groupware literature. It has been concluded that such problems, e.g., keeping electronic calendars current, can be attributed to the fact that the person doing the job is not the one benefiting (Grudin, 1987). To avoid this situation, a possible approach would be to design systems to primarily solve another problem, or perform a different task on the user's behalf, and update the competence profile as a spin-off. To do this as unobtrusively as possible, the primary activity must be such that it delivers an added value to the user that motivates her to go through the process. Such activities should therefore activate the user's true interests rather than some espoused or politically correct theory. One such activity, exploited in this paper, is information seeking, and the

challenge for future information systems researchers is to come up with more such activities.

As shown in this paper, the implemented recommender system prototype opens up for a variety of different possibilities, ranging from complement to formalised competence systems to a tool for visualising and managing shifting interests. Traditional IS/IT solutions support merely the rationalistic perspective on competence. To support and facilitate also the other two perspectives presented in this paper, we need systems that are able to detect, visualise, and leverage interest on an organisational level. Future competence systems for the innovative organisation should therefore be able to capture the actual interests and actions, rather than "static" records of past achievements. It has been suggested that though some organisational processes are only tacitly understood they may nevertheless be supported by IT (Stenmark, 2001), and we have showed that analogous arrangements could be employed to support competence management in the innovative organisation. As is evident from the testimonies of the interviewees reported in this paper, interest-driven competence systems have implications on both systems design and managerial attitudes. Below, we shall briefly hint at some of these implications.

Since organisational 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. While interests satisfy the need for up-to-date indications of competence, it 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 organisational 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 & 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 as traditional competence systems have. Instead, interests must be derived unobtrusively from the users actions while pursuing other tasks (Stenmark, 2001). Therefore, 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 organisation's competence status. By aggregating interests, we thus elevate ourselves from the individual to the organisational level.

For the enriched interpretation of competence, which also includes personal interest, in effect to become useful, it must be paired with a corresponding change of management mindset. The innovative organisation cannot be managed with the rationalistic "measure and control" attitude that has characterised twentieth century industry. Instead, it has been argued that innovation must be managed through a "coach and facilitate" approach. Such a management style should consider redundancy, autonomy, intrinsic motivation, and recognition of creative initiatives (Nonaka, 1994; Stenmark, 2000). When deadlines and budgets are cut so tight that the employees barely manage to do what is expected, their opportunities to pursuit personal interest are limited. Therefore, management must allow at least a minimum amount of redundancy. In addition, it takes time for new trends and emerging interests to reach top executive level, be converted to official corporate strategy, and be implemented in traditional competence systems, and by the time they are communicated back to the employees the interest and the business opportunity may be long gone. By empowering employees to act autonomously and follow their interests, new unplanned 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. Finally, management should show that risk-taking and occasional failure is not only acceptable, but also necessary. All entrepreneurial activities involve an element of risk and not all interests end up as profitable core competencies (cf. Prahalad & Hamel, 1990). The element

of risk lies in that it cannot be determined in beforehand what the winning interest is (Stenmark, 2000).

# 9. Conclusions

With an implemented interest-activated recommender systems prototype in a real organisational setting as a starting point in this research, we have empirically evaluated the relationship between interest and competence. Three different perspectives are derived; competence as formalised description, interest as competence, and interest beyond competence. Traditional IT support for managing competence merely handles one of these views, namely the formalised perspective on competence as applied in the rationalistic organisation. Since today's competence systems are designed to function as competence silos hoarding old information, they cannot support the view of competence as something evolving. As organisations become more and more knowledge-intensive and innovative, the importance of the other two perspectives on competence will increase. Our results have implications for the design of competence systems for innovative organisations, since the systems need the potential to detect, visualise and leverage interests. Competence in innovative organisations cannot be categorised beforehand, and IT support thus has to be emergent, dynamic, and based on interest-driven actions that depict real time status. Finally, in this paper we have argued in favour of a new design rationale for competence systems that is based not on a stable history, but on an active interest. Moreover, for the innovative organisation to be successful, management must abandon the rationalistic view of competence and embrace interest and intrinsic motivation of organisational members as the primary drivers. Competence, we claim, consists of components that are emergent, dynamic, and situated, and not only based on experiences and past achievements.

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# Paper 3

## Designing Competence Systems: Towards Interest-Activated Technology

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## Abstract

Despite the considerable research interest shown in various types of knowledge management (KM) systems, not much 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 Göteborg, Sweden. In addition, to upset prevailing assumptions and provoke reflection among the organisational 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.

# 1. Introduction

Although a great deal has been written about the design, implementation, and evaluation of KM systems (e.g., Ackerman, 1994; Ackerman & McDonald, 1996; Hahn & Subramani, 2000; McDonald & Ackerman, 2000; Schultze & Boland, 2000; Alavi & 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., organisationally 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 organisations in their competence management processes by providing information about competence status and competence development needs of organisational members. Our studies to date have largely considered competence systems that store and categorise 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 & Henfridsson, forthcoming; Lindgren *et al*., forthcoming). In Lindgren *et al.* (2001), however, these types of competence systems are problematised. 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, visualise, and leverage interests of organisational 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 organisational 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 organisational 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 organised as follows; Section two outlines existing competence systems research. Then follows a presentation of the research method. Section four 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. In section six, we discuss the research results and present 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. Expertise and competence can both be defined as knowledge applied and enacted in work practice (cf., Allee, 1997). However, there is a difference between the two. While expertise is typically considered an individual aspect, competence is usually discussed on an organisational level. In the KM literature, there are many studies focusing on IT support for knowledge and expertise (see e.g., Karduck, 1994; McDonald & Ackerman, 1998; Smith & 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 organisations 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 organisation. For a thorough presentation of competence systems features, see Lindgren and Henfridsson (forthcoming). Apart from our own work, studies that explicitly focus on competence systems are rare. Accordingly, we shall below account for and summarise 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.* (2001). 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 organisations, Lindgren and Henfridsson (forthcoming) 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 organisations. On the basis of the identified adoption barriers, it is argued that the competence systems can be characterised as traditional personnel administration systems with features that passively archive formalised competence descriptions. The authors' main argument is that competence systems need to communicate a technology spirit in line with knowledge work practice in organisations.

With a field research study of a knowledge-intensive, fast-growing, and dynamic organisation as a point of departure, Lindgren *et al.* (forthcoming) illustrates how evolution, which refers to the process in which organisations and information systems change over time, can result in competence systems failures. Of particular interest to competence systems research, the authors show how organisational 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 (forthcoming) are addressed. More specifically, this paper describes and evaluates the design of Competence Visualizer, which is a competence system generating competence patterns of organisational 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 organisational issues.

In Lindgren *et al.* (2001), 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 rationalistic organisations, competence management in innovative organisations requires different types of IT support. With these two organisation 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 formalised 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 formalised view of competence as applied in the rationalistic organisation. Since organisations 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, visualise, and leverage interests of organisational members.

While our previous paper (Lindgren *et al.*, 2001) 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 organisations 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 organisation under study, there was also a desire to use this understanding to change the way the organisation comprehended competence and improve their IT support for competence management. While not adhering explicitly 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 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 & Vidgen, 1999). Much design-oriented work on computer systems has applied what can be categorised 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 organisation 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 organisation 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 organisational members aware of and appreciative of a broader understanding of competence (see Lindgren *et al.*, 2001) 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 organisational 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 been claiming that interview data is not a suitable foundation for design (cf., Fagrell, 2000). In addition to semi-structured interviews, we have therefore 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 organisation-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 organisational 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 organisation. These interviewees were selected to represent different organisational 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 organisation, 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 last six months from June to December 2000 were spent compiling, analysing, verifying, and writing-up the research results. During this phase, we engaged the organisational members in eight focus group meetings. These meetings, where the organisational 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 coloured 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 organisations, as in Orlikowski's work, we studied two different systems within the same organisation. The initial theories, which were based on our previous work (Lindgren *et al.*, 2001; Lindgren, 2002; Lindgren & Henfridsson, forthcoming), 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 & Corbin, 1990). The TP/HR data were re-interpreted, re-coded, and re-categorised 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 to focus more on

generic themes that were more likely to be generalisable. For example, we dropped integration of free-text and formalised 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-analyse. 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-labelling 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 organisational 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 synthesised 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 Göteborg, 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 Site*

This research was carried out from June 1999 to December 2000 at the Göteborg 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 organised 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 organisations, Volvo IT had recognised the major problem regarding knowing who knows what. Accordingly, large investments were being made in both organisational 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 prioritised 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 organisations with industrial connections it was rather hierarchically organised. A high degree of standardisation was hailed as the optimal situation and its centralised 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 standardised mainframe environment, Volvo had a large and rather decentralised intranet. The intranet, consisting of over 700 web servers and approximately 750,000 web pages, was characterised 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 decentralised 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 organisation 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 organisational structure can be described as hierarchical and this was reflected in TP/HR's closed system structure. While managers

were authorised to see competence information about all their subordinates, employees in other positions could only see their own competence profiles.

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.

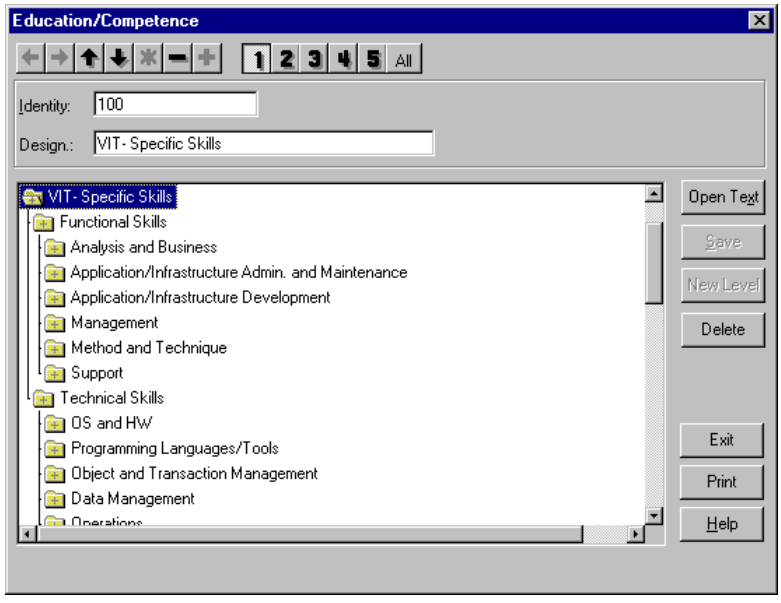


Figure 1. Portion of the competence tree structure in TP/HR

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 organisational 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 organisational 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.

### Competence mapping

Volvo IT tried to implement a competence structure that was common to and accepted by the entire organisation. 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 organisation. 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 organisation had varying demands on what competencies should constitute the structure.

### 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 organisation 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 organisation 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.

### 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 in order 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.

### 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."*

Organisational position determines how an employee can use the TP/HR system. Managers were authorised to see every subordinate's competence profile, while organisational members in other positions could only see their own profiles. 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 organisation realised the potential danger of the TP/HR system becoming an archive that would passively store increasingly inaccurate competence profiles. 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 formalised representations, contrasted the basic tenet of TP/HR.

## 5. The recommender system approach

The rationale behind recommender systems (RS) (Resnick & 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 & 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 minimising bias. The focus on connecting people with objects, e.g., books, films, music, or web pages, which characterised 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 & Kim, 1998; Claypool *et al.*, 2000) and one alternative could be to engage personalised 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 organisations (McDonald & 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 utilising 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 since a well-defined agent rewards the user with high precision search results. 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 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 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, 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 organisational 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 organisational members.

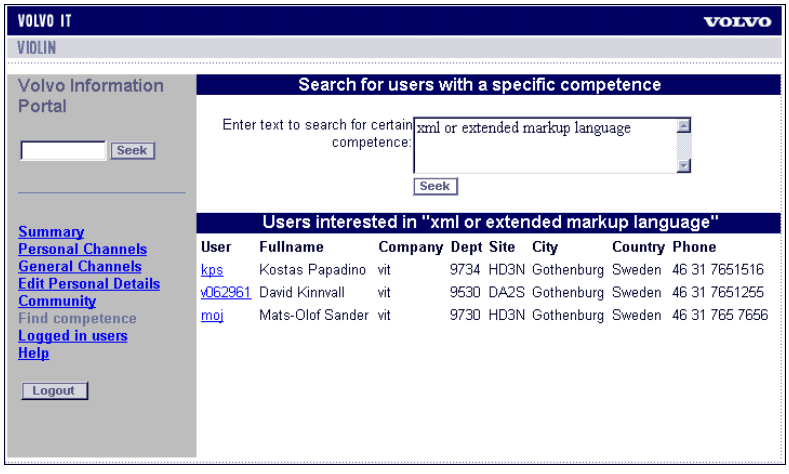


Figure 2: Output from the Find Competence feature.

## *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 existing of usage areas or as thoughts regarding possible future enhancements of the system. Below, we shall report our findings grouped according to these categories.

### 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 organisational 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 organisation. The respondents considered the building of such informal networks important since they are a prerequisite for cooperation. However, the organisational 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 utilise 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 organisation 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 organisation's competencies. In addition, one technology watcher highlighted the possibility to use VIP to visualise 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.

### 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 organisational members the possibility to find out more about other individuals within the organisation, e.g., name, organisational 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 cut across traditional organisational 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 organisational 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 organisational 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 looks 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 organisation'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 organisation's past as well as present competence status, and therefore features to store and handle historic information are important.

# 6. Discussion

Today's organisations 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 organisational 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 organisations (cf., Lindgren & Henfridsson, forthcoming). 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. Firstly, 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 do not necessarily express their ambitions for today or tomorrow (cf., McDonald & 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

organisation 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).

Secondly, we have also shown that a bottom-up approach to competence mapping, which starts with the actions of individual organisational members, can be used as alternative to a predefined top-down categorisation. 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 organisational 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 organisational level (cf., Greif, 1998). Researchers within the IS field, on the other hand, discuss theories and applications from an organisational point of view, but tend to neglect or marginalise that organisations consist of individuals and that success on the organisational 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 organisational 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.*, 2001). 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.

| | |
|---|---|
| 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, book-marking, or searching for documents and web pages, sending, printing, or replying to emails, querying data-bases, 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 organisation, 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 organisation, employees' work tasks or roles often vary from one project to another, again making it difficult to keep an explicit record up to date. |
| 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 organisational activities are not supported by today's competence systems, where employees in non-managerial positions typically only can see their own profiles (cf., Lindgren & Henfridsson, forthcoming). 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. |

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 organisation. 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 organisational members to contact each other for information exchange, competence sharing, and building of communities (cf., Davenport & Prusak, 1998). Another important aspect would be to make available more information about the signalling artefacts themselves. By making details such as the updating or visiting frequency available, the users would be able to derive the owners' level of engagement.

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.

Implication 5 *Aggregation of competence data*. Future competence systems should be able to aggregate and visualise 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 organisational 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 analysing the employees' information-seeking activities, management can become aware of which competence areas attract the attention of the organisation'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 organisation. The difficulty is that the information now has to be compiled and aggregated manually. Mechanisms should therefore be provided to retrieve, aggregate, and visualise this information automatically. This process would give management a tool for a quick and flexible overview of the organisation's status and direction. Such features would help facilitate continuous competence development in order to avoid competence traps (cf., Levitt & March, 1988). Aggregation of interest profiles not only increases the strategic value of the information, but also helps preserve integrity by de-individualising 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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# Paper 4

## The Mindpool Hybrid: Theorising a New Angle on EBS and Suggestion Systems

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## Abstract

Traditional suggestion systems, despite their shortcomings, have been used to promote creativity in industry for over a century. As a parallel track, brainstorming has been applied for almost fifty years as a method to also increase idea generation. However, the two have never met. In this argumentative paper, it is theorised that by adding computer support and applying lessons from the realm of electronic brainstorming (EBS) to traditional suggestion systems, useful improvements may be achieved. A hybrid intranet prototype mimicking the attributes of an EBS system and at the same time serving as a complement to the suggestion system was therefore devised and evaluated using a theoretical framework. The implications suggest novel ideas for both suggestion systems and EBS research.

# 1. Corporate creativity

It has always been important for organisations to improve and develop the way they conduct their businesses, although this need has been further accentuated in the post-industrial society. Two important vehicles for organisational creativity that both have been used in industry for many decades are suggestion systems and brainstorming.

## *1.1 Traditional suggestion systems*

The first suggestion system recorded in literature was implemented at the Scottish shipbuilder William Denny & Brothers in 1880 (Robinson & Stern, 1997). Although more than a century has past, many of today's suggestion system still consists of a box on the wall, and submitted proposals are typically handled by local Proposal-Handling Committees (PHCs), where committee members manually review the ideas. Good suggestions are rewarded in some way, while not so good proposals are rejected. However, while studying creativity and the usage and impacts of a large multi-national company's suggestion system, a few but serious shortcomings with this traditional way of handling suggestions have been noticed (Robinson & Stern, 1997; Stenmark, 2000).

Firstly, there is a communication problem. Submitted suggestions are seldom communicated sufficiently within the organisation and good ideas may be implemented locally but remain unheard of in other parts of the organisation. Other ideas may be prematurely rejected due to the PHC's limited cognitive capacity, the proposer's poor communication skills, bad timing, or being proposed in the wrong context. These ideas, good and bad, could have started other creative ideas elsewhere in the organisation, had they only been made public.

Secondly, many ideas are never proposed at all. One generally acknowledged reason for this is the fear of being made a fool of by one's peers. As we are reluctant to present ideas if we risk losing face in front of our colleagues, we instead keep our potentially revolutionary ideas to ourselves, missing an opportunity for organisational benefit. Another reason for not participating is the threshold an official suggestion system constitutes. We may lack the self-confidence, the ability, or the

motivation to write-up our proposal in the form required for a suggestion to be accepted.

### *1.2 The brainstorming approach*

A parallel, but totally separate, approach to creativity is brainstorming (Osborn, 1953), which since its introduction in 1953, has been widely used in industry and business as a technique for idea generation and problem solving. The fundamental aspects of brainstorming as posited by Osborn are quantity over quality, elaboration on others' ideas, and absence of criticism. This means that brainstorming, in contrast to the traditional suggestion system described above, presupposes that all ideas are visible to the other participants and thereby function as stimuli for their creativity.

However, in contrast to the popularity of brain-storming stands the result of several independent studies showing that nominal brainstorming, i.e., the aggregated work of individuals working simultaneously but without contact with each other, outperform group brainstorming. There are three main reasons for this. Firstly, there is evaluation apprehension, which refers to a situation when the group members are reluctant to express their perhaps unpopular or politically incorrect suggestions or poorly developed ideas in fear of being judged by others. Secondly, social loafing occurs when group members intentionally limit their contributions and rely on other group members to do the job. This often happens when the responsibilities are unclear, when individuals do not feel accountable for producing, or when individual believe that their contribution cannot be identified and thus not fully appreciated. Thirdly, and finally, production blocking is the result of group members having to wait for others to finish before they can offer their own ideas. While waiting, ideas may become obsolete or forgotten, or, in order not to forget, people concentrate on and rehears their own ideas instead of participating and generating more and new ideas. All these three factors have previously been discussed in numerous works (cf. Brown *et al*., 1998; Diehl & Stroebe, 1987; Diehl & Stroebe, 1991; Offner *et al*., 1996; Pinsonneault *et al*., 1999a; Shepherd *et al*., 1995; Sutton & Hargadon, 1996).

In an attempt to address these three problems, electronic brainstorming (EBS) was introduced. With EBS, the participants initially used a special room equipped with networked computers used to enter and share ideas within the group. Although distributed solutions now exist, especially so in industry, the specially equipped rooms still seem to dominate the research literature.

By allowing anonymous idea entry the evaluation apprehension problem is avoided. At the same time, the logging capability of computer software helps reduce the social loafing, since information on the relative performance of each individual may be made salient. However, caution must be taken here not to upset the balance between the demand for anonymity and the need for social recognition. Finally, since participants are using individual computer terminals, idea entry and sharing may be performed by all users simultaneously, thus eliminating much of the production blocking observed in face-to-face brainstorming.

Though it seems indisputable that EBS outperforms face-to-face group brainstorming, it remains somewhat unclear whether or not EBS is superior to nominal groups. However promising and convincing the theoretical reasoning above may sound, the literature shows mixed results; some claim that EBS performs significantly better than nominal groups (Dennis & Valacich, 1993; Dennis *et al*., 1996); some report weak evidence at best (Roy *et al*., 1996); other still have found EBS to perform worse than nominal groups (Pinsonneault *et al*., 1999a). It has been debated whether the size of the group has any influence on the expected outcome. Some argue that for groups of more than eight members, EBS outperform nominal groups due to the increased synergy that comes from the larger pool of ideas (Dennis & Valacich, 1999). Others, however, maintain that this synergy is neutralised by increases also in process losses (Pinsonneault *et al*., 1999b).

This lack of consensus suggests that perhaps more efforts should be put into trying to find consistent ways to evaluate or measure the effectiveness of brainstorming technology. Another possible implication is that more work has to be done with large groups, and preferably with very large groups. A scenario such as the one depicted in this article, i.e., where the entire organisation can participate, may then prove useful. A

third and final interpretation could be that a creative process such as idea generation is too situated and context-specific to be evaluated in general terms.

## 2. Research rationale

Although suggestion systems and brainstorming are both used in industry and both used to promote creativity, they have been treated separately. This paper describes a novel attempt to combine these two parallel tracks. By bringing lessons learned from the large body of research done within the EBS community in to the realm of suggestion system, the author hope to be able to address the shortcomings of traditional suggestion systems identified earlier. The objectives with this project are to increase visibility in a suggestion system by posting all submissions on the web, and to engage a larger part of the organisation in the creative process. The latter is obtained by distributing a brainstorming application to all organisational members and simplifying submission by allowing free-text emails.

Although this work relates closely to the large body of existing research on EBS, the approach described herein differs in several aspects from the ones normally seen, and may therefore provide useful new ideas also for EBS researchers. Most fundamentally, the proposed method deviates from the predominant problem-oriented view that has dominated EBS research and tries to address creativity more broadly. As pointed out by Bostrom and Nagasundaram (1998), most EBS research does not explicitly discuss creativity *per se*. The prototype presented here attempts to provide a bridge between suggestion systems and EBS systems and offers novel ideas to both these communities.

The author has not only the desire to observe and understand but also to intervene in and change the process under study. Such an approach can be referred to as action case research (Vidgen & Braa, 1997). Action case should thus be seen as a mix of both understanding and change, designed to balance the trade-offs between being either an observer capable of making interpretations or a researcher involved in creating change in practice. The case described here will thus be conducted live in a real industry setting instead of being artificially tested in a laboratory setting. Although a live study means less control, the

unpredictability instead increases the chance of breakdowns leading to new and unanticipated findings. To provoke such interruptions, the Mindpool hybrid application was implemented at the intranet of a large Swedish corporate group.

# 3. The Mindpool prototype

The Mindpool prototype uses the corporate intranet to utilise the new forms of group interactions that was previously suggested at HICSS-31 (Bostrom & Nagasundaram, 1998). The strength of such tools is that they are less resource intensive than the same-time-same-place labs that has dominated much of the EBS research. EBS is tacitly understood as being designed to support rather small groups. Although research has indicated that EBS might work better in larger groups (Gallupe *et al*., 1992; Dennis & Valacich, 1993; Dennis & Valacich, 1999), facilities to handle groups larger than 30 members are rarely seen (de Vreede *et al*., 2000). Further, despite the fact that it has been shown that diverse stimuli have a positive affect on creativity (Nagasundaram & Dennis, 1993; Amabile, 1983; Amabile *et al*., 1996) and that groups are better equipped to provide the cross-boundary kaleidoscopic thinking (Kanter, 1988) that can boost creativity, not much EBS technology has been designed for very large groups. Knowing that the combinatorial effects of cross-fertilisation increase exponentially with group size calls for more research in this direction. The prototype advocated here, which attempts to engage the entire organisation, is a response to this call.

## *3.1 Design principles*

Most EBS systems are designed to help solve a problem or reach a decision. This means that there is a pronounced purpose of which all attendants are aware. Further, there are also only a limited number of attendees and a limited amount of time available. Consequently, EBS sessions focus on producing as many relevant ideas as possible within the specified timeframe. The objectives and the conditions of a traditional suggestion system are however very different. Firstly, there is no specific problem to be solved or topic to focus on. Any suggestion that in some way improves the current practice is welcomed. Secondly, the improvement process is a continuous event without any start or stop

time. Thirdly, any member of the organisation is welcome to contribute. In those aspects, the two processes are quite different. However, the hypothesis posited in this article is that Osborn's (1953) fundamental aspects around which all brainstorm activities are built would add valuable features to the suggestion system and help eliminate the shortcomings discussed in the introduction.

When conducting a face-to-face brainstorm session, ideas are typically written down on a flip chart or a white board for all participants to see. The ideas are often recorded in the order they emerge, i.e., chronologically, without any links or other visible connections to the previous idea(s) that might have stimulated them. Mindpool is an intranet application that copies this concept and mimics the creative atmosphere often found in brainstorm sessions with the addition of using the intranet instead of a flip chart. The main ideas are easy entry and company-wide exposure of ideas. Unlike most EBS systems, Mindpool supports asynchronous brainstorming, allowing ideas to develop long after the point of introduction. The system further allows the proposer to be anonymous while yet providing a mechanism for letting people contact them. Mindpool is different from most other EBS systems in four ways:

1. Mindpool is an intranet application designed to be run from the organisational members' ordinary places of work; e.g., there is no need for a specially equipped room. This offers three advantages; i) the absence of physical space barriers eliminates the need to restrict the number of participants, ii) large organisations often have geographically distributed employees, who otherwise might be unable to participate, and iii) being in close vicinity to their ordinary work tasks inspires creative that is more beneficial for the organisation (Robinson & Stern, 1997).

2. EBS is typically performed by groups of people. In Mindpool, there is no group concept whatsoever. Some argue that even ordinary EBS groups that are assembled together in a room are not groups in any traditional sense, but rather a collection of individual that interact with each other's ideas (Nagasundaram & Dennis, 1993). In Mindpool, where participants are distributed in both time and space, this reasoning is taken to its extreme.

3. Mindpool has no time constraints. The idea generation process is not limited to x-hour sessions or any other particular timeslot but should instead be seen as a continuous activity that the organisational members attend to from time to time. This absence of time pressure has important implications.

4. When there is no time restriction, there is also no need to limit oneself to any one topic. Mindpool is thus not problem-oriented in the sense that it does not restrict the ideas to any particular problem to solve nor to any specific topic to be exploited. Instead, new possibilities may be addressed and pursued in parallel.

### *3.2 A Mindpool scenario*

To give an understanding of how Mindpool is intended to work, a possible scenario is described and explained below. The numbers in the text refer to the number in figure 1.

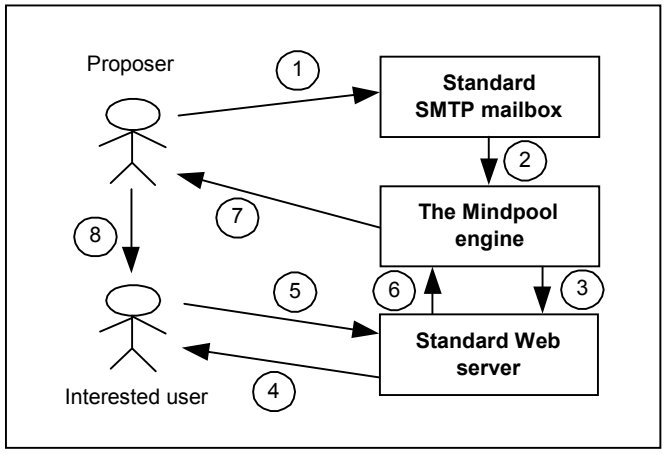


Figure 1. Mindpool workflow and the interactions between Proposer, Mindpool, and other users.

1. *Doris has been at a meeting and is irritated that the flipcharts in the meeting room were – again – out of paper. When returning to her desk she writes a short note about this problem in her email system and sends it off to Mindpool.*

Suggestions, ideas, or simply comments are submitted as emails to Mindpool to be displayed on an intranet web page. These tools – email and web – were chosen because they are widely used amongst most office workers (Bellamy *et al*., 1998).

2. *Mindpool checks the email inbox every sixth minute, downloading any new email, and storing it in its own database.*

When Mindpool receives the email it assigns it a unique ID number and stores it in the Oracle database together with the date, time, and proposer's name and email address. The proprietary email system used at the test site automatically inserts the sender's full name and return address, which might otherwise have been left blank if a web-based form had been used.

3. *When the web page is requested, i.e., when a user accesses the Mindpool server, the web page is dynamically build from the content of the database.*

On the dynamically built web page, all ideas from the current month are retrieved and displayed. The web is used because it is easily accessible from all computer platforms. A web page also adds asynchronicity to the sharing process and users do not have to be active simultaneously, which removes the temporal restriction present in e.g., chat forums. The persistent nature of the web page also allows the idea to linger long enough for it to be found by many different people in different locations and contexts.

4. *The re-constructed web page is sent back to the user, in this case Michael, who is displaying it in his favourite web browser.*

The web page displays the date and time of the suggestions, the subject titles, the suggestions themselves, and the unique idea IDs (see figure 2). The name of the proposer is kept hidden for two reasons; firstly, it eliminates evaluation apprehension and enables users to submit proposals without risking making fools of themselves, and secondly, not revealing the contributors' identity contributes to a more task-oriented and objective evaluation (Kahai & Cooper, 1999), especially so when power differences exist among the participants (Nunamaker *et al*., 1991).

5. *Michael casually browses through the suggestions and happens to notice the note sent by Doris. He decides to contact Doris but since he does not know who sent the suggestion he clicks on idea ID and the associated hypertext link brings up a form allowing Michael to enter a comment, leaving a phone number, email address, or whatever.*

The purpose is not to facilitate a discussion but to provide a pool of stimuli. When Michael browses through the submitted ideas he receives various input for his own thinking process, which supposedly takes place off-line. Ideas are not primarily there to be commented on but to serve as stimuli. The possibility to add comments directly to a proposal, as is the case in threaded discussion lists, is intentionally absent in Mindpool. Not providing this opportunity to provide public comments helps shielding new ideas from public negative critique. Such a filter is important since negative socio-emotional communication has a negative effect on agreement (Kahai & Cooper, 1999).

6. *The entered message is then returned to the Mindpool engine, which uses the unique suggestion ID to resolve the email address associated with the suggestion.*

The web form feature is implemented to allow interested readers to request more information without forcing the system to reveal the identity of the proposer. Michael may, for example, contact Doris to hint about the whiteboards that he heard about that can be connected to a PC and thereby saving the work to a hard disk.

7. *Michael's message is then forwarded to Doris, the original proposer, who remains unknown to all but Mindpool. The comment is not displayed on the web site.*

Since each contributor, i.e., those sending suggestions or ideas to Mindpool, are registered, the aggregated result of each contributor may be made salient once a month or one a year and recognised by corporate officials as a useful contribution to the company's development.

8. *When Doris receives Michael's comment, she may now decide to give up her anonymity and contact Michael for a direct discussion.*

Apart from being viewed by ordinary corporate employees, Mindpool should be regularly monitored by the PHC members, who would treat any useful idea as had it been submitted via the traditional channels.

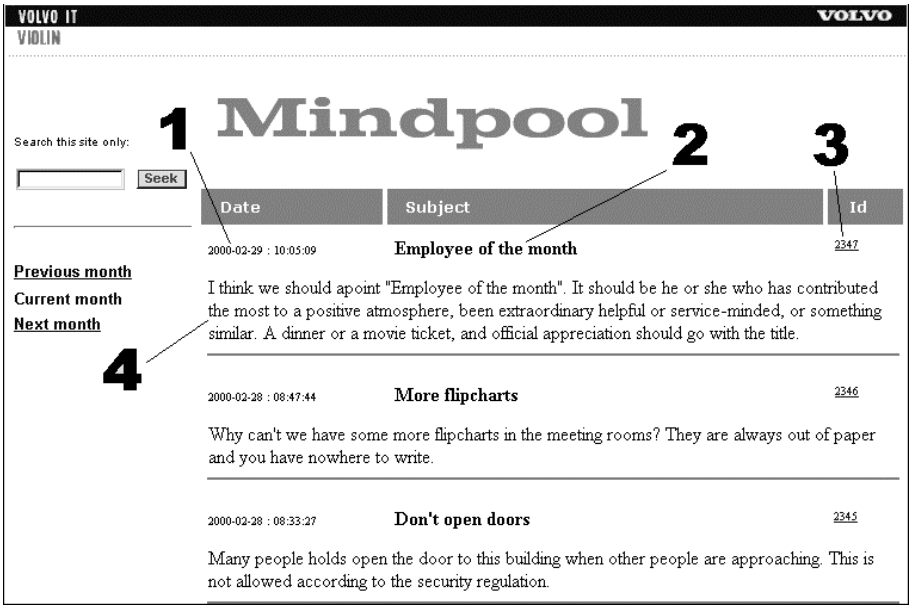


Figure 2. A screen dump showing Submission date (1), Subject title (2), Submission ID (which also holds the link to the comments form) (3), and the actual suggestion or idea text (4).

# 4. A theoretical evaluation

Pinsonneault *et al.* provide us with a schema for assessing the performance of any given brainstorming technology by suggesting that the performance should be calculated as the net sum of the process gains and the process losses (Pinsonneault *et al*., 1999a). Although such a schema is somewhat problematic, implying that qualitative aspects can easily be transformed to quantitative measures, it offers a method to compare the relative strengths of different approaches. Measuring the suggested factors for four different brainstorming technologies; Verbal, Nominal, Anonymous EBS, and Non-anonymous EBS groups respectively, Pinsonneault and colleagues conclude that there is no significant difference between EBS and nominal groups, and that they both outscore verbal brainstorming.

In addition, they identify what they claim to be five previously undetected process losses that EBS seems to introduce. These have been added to table 1 and marked with *i*. Adding also Mindpool (column 5) and examined how it measures, we find that it seems to preserve many of the process gains while being able to eliminate most of the losses. Pinsonneault *et al.* carefully stress that the result of such an assessment must not be seen as a scientific fact but rather as a crude but hopefully useful estimate of the different techniques' relative capacity. With this in mind, we can see from table 1 that Mindpool comes down to a total of +3, thereby outscoring the other four forms of brainstorming. The factors evaluated in the Table 1 are briefly explained in the following sections. For a more detailed discussion, please refer to (Pinsonneault *et al*., 1999a).

Table 1. Comparing process gains and process losses for five brainstorming methods as suggested by Pinsonneault *et al.* (1999a).

| **Process gains** | **Verbal** | **Nominal** | **Anonymous EBS** | **Non-anonymous EBS** | **Mindpool** |
|---|---|---|---|---|---|
| Separation of task | | + | + | + | + |
| Cognitive stimulation | + | | + | + | + |
| Observational learning | + | | | + | |
| Social recognition | + | | | + | + |
| Task orientation | | + | + | + | + |
| Motivational | + | + | + | + | + |
| *Total process gains* | *4* | *3* | *4* | *6* | *5* |
| **Process Losses** | | | | | |
| Production blocking | - | | | | |
| Effort redundancy | | - | | | - |
| Cognitive interference | - | | - | - | |
| Cognitive inertia | | - | | | |
| Evaluation apprehension | - | | | - | |
| Productivity matching | - | | - | - | |
| Cognitive conformity | - | | | - | |
| Personalisation of issues | - | | | - | |
| Social influence | - | | | - | |
| Social loafing | - | | - | | |
| Distraction[i)] | | | - | - | |
| Attentional blocking[i)] | | | - | - | |
| Striving for originality[i)] | | | - | - | |
| Cognitive complexity[i)] | | | - | - | - |
| Cognitive dispersion[i)] | | | - | - | |
| *Total process losses* | *8* | *2* | *8* | *11* | *2* |
| *Net score (gains - losses)* | *-4* | *+1* | *-4* | *-5* | *+3* |

### 4.1 Process gains

*Separation of task* processes and the decomposition of tasks into subtasks have been found to increase productivity. Mindpool addresses no problem in particular and participants may break up their tasks as they see fit.

*Cognitive stimulation/synergy* by receiving verbal or textual cues from peers may elicit new ideas. Mindpool opens the brainstorm context to the entire organisation, leveraging this potential.

*Observational learning* suggests that members can imitate and learn from the best performers and thus increase productivity. The anonymity of Mindpool does not allow this.

*Social recognition* means that individuals want their contributions to be recognised by others. Though Mindpool facilitates anonymous submission, it also provides a mechanism for contacting the submitter. This means that the author of a good ideas or suggestions can be contacted and receive appreciation. The numbers of contributions per individual are also accumulated and frequent submitters may thus periodically receive recognition.

*Task orientation* rather than author orientation and socialisation improves productivity. Being an anonymous on-line application, Mindpool is strictly task oriented.

*Motivational/arousal aspects* come from groups stimulating individuals to perform better. Mindpool is not a group in the true sense, but by providing a forum in the super-group that the company constitutes that shows how other organisational members submit ideas, it should work in a similar way.

### 4.2 Process losses

*Production blocking* means being unable to express ideas as they occur due to social norms. As all other forms of EBS systems, Mindpool should escape this trap.

*Effort redundancy* results from many contributors working on the same or similar ideas. Mindpool publishes all ideas to avoid this. However, the free-text format and the potentially large amount of ideas that may accumulate over time can make it difficult to get an overview of what has previously been suggested.

*Cognitive interference* occurs when others people's ideas interfere with ones own idea generation process. Being entranced by another group member's idea may have a negative effect on one's own ability to generate ideas. However, such concerns stem from the time limitation and since Mindpool usage is not limited to a specific timeslot, this should not be an issue.

*Cognitive inertia* means being too focused or trapped in a single train of thoughts. This is not expected to happen with EBS systems, nor with Mindpool.

*Evaluation apprehension* is when people hesitate to express ideas in fear of what others may think. Being anonymous to the crowd, Mindpool eliminates this risk.

*Negative productivity matching* occurs when group members adjust individual productivity to a (lower) base-line level. Since Mindpool sessions are not performed in a closed group or even with simultaneous users, this risk is small.

*Pressure for cognitive conformity/uniformity* may cause members to remain within certain group norms or values. Mindpool avoids this as do all anonymous EBS system.

*Personalisation of issues* happens when individuals associate the discussed ideas to personal matters. As with other anonymous EBS systems Mindpool should not suffer from this.

*Social influence* from dominant group members can be a problem in non-anonymous settings, but since Mindpool offers anonymity and treats all suggestions equally no individual dominate.

*Social loafing* means deliberately limiting ones efforts, counting on the others to solve the problem, while still sharing the credit. This cannot occur in Mindpool since you either contribute by submitting ideas, and

then you are participating, or you do not submit anything and then your do not receive any credit.

*Distraction* refers to when people become overly engaged in reading other's suggestions instead of generating own ideas. When time is limited, spending too much of it on reading could cause problems. However, from the viewpoint of receiving new stimuli you are supposed to read as many ideas as possible. Mindpool allows such "distraction" by providing an unlimited amount of time.

*Attentional production blocking* may occur in synchronous idea generation groups when members formulating their own ideas are prevented from paying attention to the ideas of others. However, attentional production blocking can only occur when the brainstorming session is limited in time. In contrast, Mindpool is an asynchronous and continuous event where you are supposed to pay intention to others ideas, and where your own idea generation takes place off-line.

*Striving for originality* may cause EBS members to try too hard not to replicate ideas already entered, which hinder them from coming up with original ideas of their own. Eventually, such production blocking will let go and in Mindpool, where there is not time restriction, this should not be an issue.

*Cognitive complexity* is higher in EBS than in nominal brainstorming due to the need to simultaneously read, understand, and interpret other's ideas. Since Mindpool expects its user to read previously entered ideas it can be said to be a more complex environment than a nominal brainstorming session. However, it not required nor intended that all users should read all comments. Users are suppose to browse through the diverse set of stimuli for as long as they like, and the added complexity should be compensated for by the unlimited amount of time given to the users. This, however, has not been tested.

*Cognitive dispersion* is characterised by group members being exposed to ideas along different lines of thoughts, of which some may deviate from the intended topic. This can make it more difficult to successfully elaborate on each individual thread. It should not be a problem in Mindpool, however, since such elaboration may be done off-line.

# 5. Discussion

Judging from the result in table 1, it appears that the benefits of Mindpool are not so much additional process gain as the elimination of process losses. However, one must also ask whether the schema proposed in table 1 is at all applicable to Mindpool, since Mindpool is a hybrid and not an EBS system in the strict sense. It is more of an electronic bulletin board or public forum, intended to increase the organisational members' attention to new stimuli, alternative ideas, and diverse viewpoints. However, as a complement to a traditional suggestion system, the Mindpool prototype presents possibilities as well as limitations that might be of interest for both organisations, trying to improve their suggestion systems, and EBS researchers.

## *5.1 Major differences*

It is clear that the hybrid aspects of Mindpool make it difficult to evaluate it using EBS-specific norms, since the context differs from that of a typical EBS setting.

The fact that a suggestion system, unlike an ordinary brainstorm session, has a continuous timeframe has certain implication on the process loss factors. Cognitive inference and the closely related Distraction both affect group brainstorming negatively since they since they slow down the ideas per minute rate. However, when time is not an issue it seems unmotivated to speak of other's ideas in terms of distractions when the very heart of brainstorming is to elaborate on other people's ideas. Also Attentional production blocking and Cognitive complexity are consequences of a limited amount of time and do not quite apply in the scenario where Mindpool would be used.

Striving for originality is not really time related but still difficult to correctly position within Mindpool. No one is expected to read all suggestions entered in Mindpool and a certain level of redundancy may therefore be expected. However, even if people would spend time trying to avoid replicating proposals already submitted, they would eventually contribute and thereby adding to the pool of ideas.

Social loafing or free-riding is another troublesome aspect to discuss in a Mindpool scenario. In an organisational context, anyone discussing

the latest football result during office hours could be said to be free-riding since they are not contributing to the firm's progress and yet being paid. However, this is not what is usually meant with social loafing in an EBS context. Instead, it denotes a situation where someone gets credit for an achievement to which he or she has not actively contributed. In Mindpool, it is okay to only browse through the suggestions looking for inspiration. If the user gets inspired, fine. If not, it is fine, too. Since only those actually submitting are part of the "group", only those can receive any credit.

Mindpool provides the organisational members with a pool of ideas that may be used to stimulate creativity. However, unlike in brainstorming the idea generation process does not necessarily take place while using the tool but may be performed later. The problem of cognitive dispersion should therefore only be present while browsing through and reading the suggestions posted in Mindpool. In the thinking process, which presumably occurs off-line where people work individually and independently as in nominal brainstorming, the users are free to uninterruptedly pursuit any particular line of thoughts.

### *5.2 Contributions*

Two distinct contributions with the suggested Mindpool approach can be identified. Firstly, there is the novel blurring of boundaries between EBS and nominal groups – people are exposed to each other's ideas (as in an EBS session) but remain distributed and without physical contacts (as in nominal brainstorming). Although many good ideas occur when doing things totally unrelated to work task, such as shaving or driving to work (Nagasundaram & Dennis, 1993), it has been claimed that people are most creative when conducting their ordinary work (Robinson & Stern, 1997). If this is the case, forcing them to leave their workplaces and gather in a predefined and specially equipped room may thus in itself be counter-productive. Since it in addition cannot be decided in advance, who would be creative or when creativity would strike, it seems that selecting whom to invite to a brainstorming session must be an unsolvable problem. Mindpool evades this dilemma by making its environment accessible from the employees' office desks.

Secondly, Mindpool allows continuous company-wide brainstorming. Facilities sufficiently large to host all employees of even a rather small company are difficult to find for ordinary EBS sessions, and should the number of employees exceed, say, a couple of hundred, they are probably impossible to find. Having observed this limitation, de Vreede *et al.* propose a Relay-mode of EBS where the company is divided into sub-groups, each performing sequentially and handing over to the next sub-group like runners in a relay race (de Vreede *et al.,* 2000). However, though circumventing the problem of hosting very large groups, their approach still suffers from having to relocate people and limit the session duration.

It has been suggested that EBS has more process gain than have nominal groups. The schema compiled by Pinsonneault *et al.* (1999a) (and re-constructed here as table 1) shows that it also has more process losses. What is interesting about the Mindpool approach is that while maintaining the process gains traditionally associated with EBS, Mindpool also seems to eliminate many of the process losses. By offering anonymity and at the same time allowing for people to contact (and for the administrator to identify) the proposer, Mindpool avoid several usually seen problems. By also providing asynchronicity, Mindpool offers the participants an unlimited amount of time. It has been argued that the uninterrupted time participants have prior to a group discussion enables them to process and integrate information, but that this is not possible during the brainstorming, at least not at the pace required (Hilmer & Dennis, 2000). Since Mindpool is a continuous and asynchronous environment without time constrains, organisational members have this opportunity for information integration also after receiving the stimuli.

Computer networks allow geographically distributed people to conceivably work together as a group electronically without ever interacting physically. This stretches the definition of what constitutes a group far enough for us to ask if it at all is feasible to speak of groups in the traditional sense. Nagasundaram and Dennis (1993) have suggested that group idea generation is fundamentally a cognitive and not a social phenomenon, and that an EBS "group" is therefore not to be seen as a group in the first place. Instead, EBS participants are just a bunch of individuals interacting with an evolving set of ideas. This means that it

should be possible to extend the EBS concept to include an entire organisation without the having to worry about the loss of group identity otherwise afflicted with such scaling-up (McKinlay *et al*., 1999).

### *5.3 Limitations*

A limitation with the approach proposed in this paper is the assumption that every employee has access to computer in close proximity to his or her workplace. Obviously, this is not true for many categories of workers. Mindpool is thus aimed at supporting creativity in an office setting.

Practical experiences and empirical evaluations of Mindpool are thus far limited. However, the preliminary results available are consistent with the findings from the previous prototype (Stenmark, 1999), and some indications that have been noticed shall therefore be discussed. Early comments from the organisational members indicate a concern for not being appreciated for their contributions if using Mindpool. This concern can be attributed to the use of a suggestion system based on extrinsic motivation (Stenmark, 2000). Convincing evidence exists showing that the reliance on extrinsic motivation in suggestion systems limits participation to typically 10-15 percent of the employees, as opposed to 70-80 percent when no reward systems is used, or when recognition is kept to a symbolic level (Robinson & Stern, 1997). Statistics from the suggestion system in use comply with these earlier findings. This suggests that the employees keep their ideas to themselves rather than sharing them with their organisation, and that motivational aspects as outlined by Amabile (Amabile, 1983; Amabile *et al*., 1996) need to be more thoroughly understood, although being largely ignored in the EBS literature.

It is assumed that the organisational members have unlimited amount of time at their disposal and a positive attitude towards sharing. Obviously, this need not be true. Just because the tool itself does not imply any temporal restrictions, it does not follow that the users will have time to engage in speculative brainstorming. Nor is it guaranteed that the organisational culture promotes sharing. It remains to be seen to what extent the current implementation will actually be used.

Finally, there is a problem with exposure. Being available on the intranet does not guarantee that the ideas are noticed. Organisational members would have to actively surf through the content to get inspired. It can be questioned whether such a scenario is plausible, since it requires more effort on the participants part (Hilmer & Dennis, 2000). In addition to the web page, we are considering projecting the ideas on hallway walls, e.g., outside the cafeteria, for a more unobtrusive exposure, as previously done successfully in other experiments, e.g., (Bellamy *et al*., 1998) and (Redström *et al*., 2000).

### *5.4 Remaining uncertainties*

Orlikowski's work has taught us that both structural elements such as work policies and reward systems, and cognitive aspects such as mental models about the technology and its use, have significant implications for the adoption and early use of new technology (Orlikowski, 1992). Currently, we remain ignorant of what mental frameworks the organisational members hold.

Tentative empirical results however indicate potential problems when extrinsic motivation in form of the reward system is in place, which makes people focus on the financial compensation rather than on being truly creative, and it also make people more reluctant to share ideas or seeds for ideas with others. It may prove difficult for Mindpool to gain acceptance in such an environment. Other structural elements such as how the intranet is used and what the daily routines are have also yet to been analysed.

Using the evaluation framework introduced by Pinsonneault *et al.* (1999a), we see that Mindpool scores fairly well. However, it can be argued that an evaluation free of context is useless, and the suggested framework is not very helpful when trying to determine how useful any one approach is in a particular setting. We may find that idea generation is too context dependent to be measured in advanced. A later user evaluation will show whether Pinsonneault *et al.*'s assessment schema is a good estimate of how Mindpool would perform in our office setting.

### *5.5 Future work*

An empirical evaluation of the system in use would obviously provide valuable data to support or refute the scenario suggested here. The prototype has in fact been implemented, but since the data collecting and analysis phases had not been concluded in time for this article, empirical findings will be presented in forthcoming papers.

## 6. Summary

Traditional suggestion systems have a number of drawbacks limiting their effectiveness. One problem is that suggestions are not displayed to the organisation as a whole. Another problem is that many ideas never get into the systems at all. In this paper, it has been argued that by building a hybrid system that borrows features from electronic brainstorming (EBS) these shortcomings might be circumvented, and Mindpool, an intranet prototype of such a system, is introduced.

However, also EBS systems have their particular sets of problem. The relative performance of brainstorm methods has been calculated as the sum of the process gains and the process losses, and while EBS systems score well on process gain they also account for many process losses. This may explain why EBS groups fail to outperform nominal groups despite the obvious benefits noted in the literature.

The work described here brings together the lessons from EBS research with that of creativity studies and offers a somewhat different perspective. By cross-fertilising an EBS application with a traditional suggestion system, we are able to combine the strengths of EBS (the process gains) with the strengths of nominal groups (the lack of process losses). This article has shown that Mindpool scores well in a theoretical evaluation but also that there are many uncertain aspects yet to be evaluated empirically.

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# Paper 5

## Group Cohesiveness and Extrinsic Motivation in Virtual Groups: Lessons from an Action Case Study of Electronic Brainstorming

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## Abstract

One form of group support system that has received the attention from much cross-disciplinary research is electronic brainstorming (EBS). While it is generally held that group cohesiveness is lower in virtual settings that in face-to-face interactions, it has also been argued that this does not matter in cognitive work such as idea generation. However, most work on EBS has been carried out in academic settings, and though such environments provide more control, they may be insufficient to capture all nuances of on-going office work. Hence, we describe an action case study of a failing attempt to introduce an EBS prototype in an organisational setting. The analysis suggests that virtual groups engaged in cognitive work in competitive environments may need to maintain a group identity, counter to what is previously suggested. The conclusion is that it is not the reward system *per se* but the combination of extrinsic motivation and low group cohesiveness that caused the undesired effect.

# 1. Background and motivation

Much of the work done in today's organisations is performed not by isolated individuals but by groups (Finholt & Sproull, 1990; Sproull & Kiesler, 1991). Historically, these groups had to meet face-to-face with all the spatial and temporal restrictions associated with physical meetings, but with the advancement of information technology (IT) group work is now becoming increasingly virtual. Research aiming to support group work has largely been targeted at facilitating co-operation and collaboration between people distributed in time and/or space. In doing so, it has been suggested that the resulting applications should be understood not merely as technology to emulate traditional face-to-face meetings, but rather as an entirely new medium for group work (McKinlay *et al.*, 1999; Whittaker, 1995)]. This implies that research on group support system (GSS) should not just provide support for current work practices, but enable possibilities beyond those utilised today. However, when moving into new territories it is important to carefully examine how the displacement of face-to-face work affects different aspects of group work (McKinlay *et al*., 1999]. One such aspect that is currently largely neglected is motivation.

This paper reports from an action case study of what turned out to be an unsuccessful attempt to implement a intranet-based electronic brainstorming (EBS) system prototype in an organisational context. Having analysed the users' experiences, the author shall compare group cohesiveness in face-to-face and electronic brainstorming, and show how the presence of extrinsic motivation in form of an institutionalised reward system in combination with the differences in cohesiveness negatively affected the group work. More specifically, the focus of the analysis is on the relationship between motivation, cognitive work, and group cohesiveness. Counter to what is suggested in the literature, the conclusion presented here suggests that low cohesion may affect group work performance also for work of a more cognitive nature. This means that mechanisms to ensure group cohesiveness must be considered when designing GSS in general and EBS systems in particular.

Next, some previous work on aspects of computer-mediated group work shall be summarised as a theoretical framework for the discussion later. Thereafter the research site and the methodological approach are

accounted for. The prototype EBS tool used in this research is described briefly in section four, followed by the presentation of the empirical findings. In section six, these results are then discussed in terms of the relationship between motivation and group cohesiveness. Consequences and implications for future research and design of EBS systems are also discussed, from both an IT and an organisational perspective.

# 2. Aspects of computer-mediated group work

Research regarding groupware and GSS as well as the work of social psychologists have previously shown that computer-mediated intra-group communication is unable to support the fuller range of communicative acts typically employed by face-to-face groups (McKinlay *et al*., 1999; Spears *et al*., 1990). Examples of such acts and cues difficult to mediate are facial expressions, gestures, and body postures. As a result of this loss of media "richness", work on virtual groups have consistently reported group members to experience lower group cohesiveness and feel more loosely connected (Spears *et al*., 1990), and that maintaining a clear group identity in such environments is problematic (Finholt & Sproull, 1990). In this section, the complexity of computer-mediated group work in general and EBS in particular shall be highlighted, and the prevailing approach to GSS studies shall be criticised.

## *2.1 Critique of media richness*

The use of the phrase "media richness" is somewhat unfortunate since richness connotes positive values such as wealth and prosperity. More is not always better; there are for example numerous occasions where in fact less information is to prefer. An alternative, albeit less frequently seen, interpretation of media richness would thus be media overload. Therefore, an emotionally neutral expression such as media density might be more appropriate, since an unreflecting use of the word richness may mislead us to implicitly perceive media richness as something inevitably good.

Furthermore, richness as an intrinsic and objective property of communication technology has been used to form theories on predictability of technology usage, with information richness theory (IRT) (Daft &

Lengel, 1986) being the most prominent example. However, IRT has been heavily criticised, not the least so by Markus (cf. El-Shinnawy & Markus, 1992; Markus, 1994), who have shown impressive empirical results refuting the premises of IRT. The analysis of this paper is thus not based on IRT or on richness as an analytical construct. We merely observe that the ability to support communication and convey meaning varies between different media, and whether or not a rich environment is to prefer depends on the context.

### *2.2 Complexity of group work situations*

The effects of reduction of media density and cohesiveness on group behaviour seem somewhat ambiguous, since what at first glance appears to be conflicting data has been reported. On the one hand, it is argued that many of the socio-emotional phenomena that arise when people interact face-to-face are present also when communicating and collaborating electronically, albeit less pronounced. This is nicely illustrated in a study of senior net users, who, aged 50+, let the social norms of their generation characterise their online behaviour (Mynatt *et al*., 1999). It has on the other hand also been suggested that some of these mechanisms are depending on social presence, and therefore cannot easily be transferred to or sustained in a virtual environment (McNeil *et al*., 2000). Thus, it remains unclear whether or not a shift to virtual environments actually results in a loss of socio-emotional cues.

To further add to the complexity there is no consensus on whether a loss of socio-emotional cues, should it occur, is good or bad. Some data suggest that users of groupware tools miss the immediate social feedback that visual cues mediate in face-to-face interactions, and this may for example explain why such users seem to prefer being linked by video although no tangible effect on group performance has been observed (Olson *et al*., 1995). There are also situations when social protocol is detrimental to group effectiveness, and under such circumstances, the loss of these conventions is not only acceptable but also in fact desirable. For example, the absence of participation regulators such as gender or hierarchical status explains why virtual groups sometimes have more equal participation than have face-to-face groups (Finholt & Sproull, 1990).

### 2.3 EBS as a group activity

Further examples of complex group situations can be found in the field of electronic brainstorming (EBS), where it is maintained that group idea generation is primarily a cognitive exercise and not a social activity (Nagasundaram & Dennis, 1993). This is true also for traditional face-to-face brainstorming, but since it is a physical meeting, social conventions kick in. An example would be turn-taking, which since long has been known to reduce productivity in face-to-face groups. Excluding such social hindrances eliminates production blocking and boosts the idea generating process, and may partly explain why EBS outperforms face-to-face brainstorming (Diehl & Stroebe, 1987). During an EBS session, when the users have to rely on computer-mediated communication, it is suggested that the participants do not operate as a group in the social sense, and instead should be understood as a bunch of individuals interacting with an emerging set of ideas and therefore be unaffected of social aspects (Nagasundaram & Dennis, 1993).

We can conclude this section by observing that the only thing that seems clear is that the effects of socio-emotional aspects on group work performance vary with group mode (physical vs. virtual), media density (high vs. low), type of work (cognitive vs. non-cognitive), cohesion (strong vs. weak) and possibly a number of additional parameters. When shifting from face-to-face to computer-mediated work practices several of these aspects may be changed simultaneously, and thus one must be careful when designing GSS, not to create a situation in which group performance is affected negatively.

### 2.4 Experiments vs. field studies in GSS research

Much of the GSS research carried out in the 1980s and early 1990s were laboratory experiments with students as subjects. In a review from 1994, Pervan (1994) reports that 172 out of 203 investigated GSS research cases (i.e., almost 85%) were carried out in *research* environments and not in *business* environments. In a review from 2001 (Fjermestad & Hiltz, 2001), 54 case and field studies of GSS use in "real" settings were identified, and approximately 55% of these were carried out after 1994. Obviously, there is some GSS activities taking place in real business environments, but although the total number of laboratory experiments

during the same period is not available, it can be assumed higher. This is understandable, since it is much easier to allocate a group of students than to persuade business executives to invest their time and efforts in research activities. Nevertheless, the use of students is highly problematic for at least two reasons: Student groups are formed solely for the experimental task and thus have no history (Pinsonneault & Kraemer, 1990); Students show substantially other reasons for and reactions to participation than do the business people they are substituting (Dennis *et al*., 1990).

# 3. Research site and method

An electronic brainstorming (EBS) application can be understood as a GSS targeted at enhancing organisational creativity. The work presented herein started as an action case study with the ambition to introduce an intranet-based, distributed EBS system prototype in an industrial environment. The results presented in this article are thus based on experiences from a real business setting. Below, the research site and the methodological approach are described in more detail.

## *3.1 The Volvo Information Technology site*

This research was carried out during December 1999 to May 2000 at Volvo IT's head office in Göteborg, Sweden. Volvo IT is an IT service providing company within the Volvo Group and had at the time of the investigation approximately 2,500 employees world-wide. Some 1,400 of these worked in Sweden, and roughly 900 in the Göteborg area.

Despite being an IT service company, Volvo IT was heavily influenced by its manufacturing siblings and the industry legacy was evident. Volvo IT's organisational processes were all arranged to meet the business requirements of the other corporate companies, which for many years had been the only customers. As with many of the other companies in the group, Volvo IT had a traditional suggestion system implemented, which was based on extrinsic motivation in form of financial rewards. Employees were supposed to submit ideas and suggestions for improvement to a proposal-handling committee (PHC), which would honour a good idea by rewarding the proposer with an amount corresponding to half of the company's first year's savings.

Such a bonus might come to a substantial amount of money. During 1999, the PHC received 226 proposals, and spent the sum of approximately US$ 45,000 on individual rewards.

Although not institutionalised, brainstorming as a method for idea generation and problem-solving was widely adopted within the company and had been used for many years. Brainstorming should however not be understood in the strict Osbornian (Osborn, 1953) sense but rather as an unprejudiced and informal meeting where also "wild" and tentative ideas were allowed and encouraged.

As IT professionals, the employees were all well acquainted with various computer environments and systems. The employees had individual computers (PC or UNIX station), and these computers were all connected with the corporate intranet. The highly decentralised intranet consisted of approximately 750 web servers and contained both formal and informal information.

### *3.2 Methodological approach*

A previous EBS prototype had been implemented in December 1998 (Stenmark, 1999). Prior to that work, the author discussed the design and intended use of the application with various organisational members, including both members of the PHC, i.e., the people responsible for evaluating submitted ideas, and ordinary office workers such as systems programmers and application developers. The insights from the first prototype informed the design of a second prototype, which, when evaluated theoretically, showed promising results (Stenmark, 2001).

The second prototype, which is the focus in this paper, was introduced as a change agent in order to improve the suggestion system in use. The work was also part of a master thesis project and to set a baseline for the evaluation, the master student first conducted 10 semi-structured interviews about creativity and brainstorming in general. After the EBS prototype had been implemented, 32 users from various departments were explicitly invited to test the application. These 32 employees included the 10 users previously interviewed. Not all of the 32 invited employees took the opportunity to participate in the test, but since the application was available on the corporate intranet, other users found it and interacted with it. Log file analysis revealed that 52

different users visited the application during the first three weeks. After these three weeks, eight users were randomly selected from the log file and interviewed concerning their views of the application. These open-ended interviews, which lasted approximately 40 minutes, were all taped. Finally, the result of the master thesis work was presented and discussed at a workshop, which the master student, the author, and some 20 organisational members attended. The notes from this discussion and the interview transcripts were thereafter analysed by the author.

Although not explicitly subscribing to the grounded theory methodology as presented by Glaser and Strauss (1967), the research method applied here can be said to be inspired by grounded theory in the sense that no pre-determined hypothesis has been formulated from the outset. Instead, rather than imposing an existing scheme that may later be tested, the data itself has been left to suggest categories and concepts in an open coding technique similar to that suggested by Strauss and Corbin (1990). After the first round of analysis, the reward system surfaced as a strong theme. By going over the data in an iterative and interpretative fashion (Walsham, 1995), what seemed to be three central concepts emerged: group brainstorming, the suggestion system, and the EBS prototype. The theories on group cohesiveness presented above have been used as the framework within which an understanding of the relationship between the observed phenomena has been reached.

# 4. Mindpool - the prototype EBS system

Mindpool, the prototype EBS application used in this research, is an intranet application and represents a hybrid system, i.e., a mix between an EBS application and a traditional suggestion system. A more thorough description of Mindpool was presented at HICSS-34 (Stenmark, 2001) and cannot due to space limitations be reproduced here. However, the most fundamental design principles behind Mindpool are derived directly from Osborn's (1953) original rules for brainstorming: i) quantity over quality; ii) elaboration on others' ideas, and; iii) absence of criticism. Below follows a quick overview of Mindpool and the rationale behind the design decisions.

### *4.1 Opting for quantity*

In compliance with Osborn's ideas (Osborn, 1953), there was a desire to opt for quantity and variation. Most EBS systems are designed to help solve a problem or reach a decision, which means that there is a pronounced purpose of which all attendants are aware. There are also only a limited number of attendees and a limited amount of time available. Consequently, EBS sessions focus on producing as many relevant ideas as possible within the specified timeframe and for the given problem. The objectives of Mindpool were quite different since the idea instead was to blend in features from more traditional suggestion systems. Firstly, there was no specific problem to solve or topic to focus on. Instead, any suggestion that in some way improved the current work practice in the organisation was welcomed. Secondly, since the system was distributed, i.e., there were no physical restraints as to how many contributors the system could host, any member of the organisation could participate. Since participants were using individual computer terminals, idea entry and sharing could be performed simultaneously, thus eliminating production blocking. Thirdly, since an improvement process is a continuous event without any start or stop, the brainstorming environment provided by the prototype enabled an equally uninterrupted and asynchronous process. These alterations to the usual understanding of an EBS system were made to increase the number of entries, provide a wider range of topics, and activate a large portion of the employees.

### *4.2 Idea elaboration*

The benefit with the group approach to idea generation is the ability to see and get inspired by other group members' ideas. When conducting a face-to-face brainstorm session, ideas are typically written down on a flip chart or a white board for all participants to see and elaborate on. The ideas are often recorded in the order they emerge, i.e., chronologically, without any links or other visible connections to the previous idea(s) that might have initiated them. Mindpool mimics the creative atmosphere often found in these group brainstorm sessions with the addition of using the intranet instead of a flip chart. The main design ideas are easy idea entry and company-wide exposure of ideas. Unlike most other EBS systems, Mindpool supports asynchronous

brainstorming, allowing ideas to develop long after the point of introduction.

### *4.3 Blocking early critique*

Since early negative feedback is one of creativity's worst enemies, early critique must be avoided at all cost. This is why Osborn clearly stipulated that critique and evaluation must not be allowed during brainstorming sessions (Osborn, 1953). In Mindpool, this is achieved by not having a threaded discussion list, since it would otherwise be far too easy to enter negative feedback. Although systems with threaded discussions may be considered more user-friendly than unstructured bulletin boards, the possibility to publicly comment others' suggestion run counter to the brainstorming principle. The system further allows the proposer to be anonymous to the public, since evaluation apprehension is known to be an impeding factor in brainstorming (Diehl & Stroebe, 1987). Not revealing the contributor also helps separating personalities from the real issues, thereby promoting a more objective evaluation, which is especially important when power differences exist among the participants (Nunamaker *et al*., 1991). At the same time, the logging capability of computer software can be used to reduce social loafing, since information on the relative performance of each individual may be made salient in retrospect. Mindpool also offered the readers an opportunity via a form to send comments to the proposer without the system revealing the identity of the latter.

## 5. Empirical findings

The data presented here has been organised under the three sub-headings that emerged out of the analysis, as described in the methodological section earlier. The three themes or aspects that we like to examine the organisational understanding of are the following: Brainstorming, which depicts the respondents experiences of and attitudes towards brainstorming in general; The suggestion system, which describes Volvo IT's institutionalised way of handling organisational creativity, and; The Mindpool application, which accounts for the users' comments regarding the prototype system itself.

### *5.1 Brainstorming*

Although not being institutionalised, brainstorming as a method for idea generation and problem solving had informally been used within Volvo for many years, and all respondents had participated in brainstorming sessions on several occasions. These interactions had all been traditional face-to-face brainstorming sessions since the company did not have any EBS system installed. The interviewees regarded brainstorming as a useful method both to solve problems and to think up new ideas. They further considered brainstorming sessions to be less prestigious than other meetings, especially so if the brainstorming participants already knew each other, which was often the case.

> *"Usually you know all the other guys in the group and then it's easier to, eh..., you don't have to compete. You can relax and be crazy, which is usually better; you get a better result at the end of the day. And what you do during the process won't backfire since only the final result of the group is what counts."*

The respondents expressed a sense of security that allowed them to suggest also wild ideas, or ideas not thoroughly thought through. None of the respondents expressed any concern for evaluation apprehension. On the contrary, several interviewees described the open climate that characterised these meetings.

> *"You can speak without thinking first. Whatever association you get, it's okay to suggest it. And even if you say something really dumb, others elaborate on it and it becomes something else… so in the end no-one knows or cares who suggested what. It doesn't matter."*

The respondent also set hierarchical differences aside while brainstorming. Individual identities and roles where suppressed for the benefit of the group.

> *"You're all on the same level, so to speak. There is no 'expert' or 'boss' – it's a group thing where you really co-operate."*

The three statements above also illustrate the commonly shared view of the result as a collective effort. It seemed to be generally so that no-one was keeping track of who suggested what or who contributed the

most. The brainstorming group as a whole was responsible for the final outcome. None of the interviewees mentioned anything about being explicitly rewarded.

#### Summing up

Brainstorming was perceived as an informal, friendly, and useful group activity for coming up with wild and tentative ideas. In this un-competitive atmosphere, individual credits were not an issue and the reward system was never referred to.

### *5.2 The suggestion system*

All respondents said they believed the suggestion system to be an important institution – there must be a forum to which you can send your ideas. However, none of the interviewees seemed very interested in submitting anything. In all, only four of the 18 interviewees had in fact ever submitted proposals, and in all four cases, the latest submission was several years back. The company proposal-handling committee (PHC) annually received proposals from approximately eight percent of the employees. None of the respondents knew how the PHC worked, but the general assumption was that submitted suggestion had to be both concrete and well thought through to be considered. Another opinion shared by all the respondents was that the threshold for contributing to the suggestion system was too high.

> *"It has to be serious stuff, which makes you a bit reluctant [to submit]. I mean, it has to be something really worthwhile. And much of what I do is part of my daily work and it's not something you would submit – it's part of my ordinary tasks."*

Despite the fact that not many of the interviewees were engaged in or submitted proposals to the suggestion system, all respondents viewed the potential reward as something good and motivating. They argued that a reward would be a fair and tangible recognition of a good performance. Without such a bonus, they argued, people would not bother or care to go through the process of suggesting improvements, as the following two quotes illustrate.

> *"The person [who suggests something that get implemented] should naturally have a part [of the profit/savings], not the least so considering that he or she would otherwise not do anything about it.*

*If you come up with something that is financially very good for the company, and you know you can have a piece of it, of course you get motivated […]".*

*"It's not more than fair that if someone manage to save a large sum of money for the company by doing something smart, they get their share. I mean, you want credit for being creative".*

### Summing up

Although infrequently used, the suggestion system was considered an important institution. In particular, the embedded reward system was perceived as a motivating factor that would encourage creativity.

## *5.3 The Mindpool application*

The users of the Mindpool prototype gave mixed responses. Some thought of it as a potentially useful system if only the critical mass problem could be solved, while others had difficulties seeing any benefits at all. Most respondents automatically made the comparison between Mindpool and the traditional suggestion system, which they perceived as a competitor. Many interviewees also spontaneously started to discuss the reward mechanisms, which, in their opinion, worked against the concept of Mindpool.

*"If you have a good idea, why post it here [in Mindpool] instead of submitting it to the suggestion system? There you might get a reward […]".*

There was also a strong focus on the individual. Ideas were considered individual properties and exposing ideas to other might lead to loss of a possible reward. Hence, rather than risking being robbed of a good idea the respondents preferred to keep ideas to themselves, and, after having worked them over a bit, submit them to the suggestion system.

*"If I post [my idea] on this web site, someone might steal it and send it to the suggestion system, and if it turns out to be useful I don't get a thing. You don't want that to happen."*

During the workshop when the master thesis work was presented an interesting discussion emerged concerning the underpinning idea to elaborate on each others' ideas. The participants debated whether only the final outcome should be rewarded or if the entire process should be remunerated and thereby encouraged. The following is a condensed version of the discussion edited for clarity. The participants assumed a scenario in Mindpool where one user submits remark A:

*"Why don't we close down our library? No-one goes there anyway".*

This suggestion may be observed by another user who totally disagree and instead proposes B:

*"Why don't we open a library in every office building?"*

Note that though A inspired B, the two do not connect visibly. In practice, there may be weeks or even months between A and B. Suggestion B may in a similar manner eventually lead to C, which in turn inspires D and E, and so forth. None of these suggestions or ideas needs to be "good" or "useful". However, this cumulative process eventually leads to a point where a useful, constructive, practical suggestion G can be identified:

*"Let's make the library available on the intranet and have them deliver the books to us using the internal mail system".*

The organisational members considered it unjust to only honour the final suggestion G. In such an environment, they claimed, suggestions A through E would never be put forward and users would be discouraged from participating. Note that the relationships between suggestions A-G are not necessarily obvious to a by-stander or even to the people making the suggestions. It is quite possible for a user to have been inspired by an earlier remark without being aware of this fact.

### Summing up

Many users expressed a concern for not being recognised for their individual contributions. Mindpool was seen as a competitor to the suggestion system, and the lack of explicit reward mechanisms in Mindpool was perceived as a hampering factor.

# 6. Discussion

The research described in this paper started out as a small-scale action case study aimed at improving a company's idea generation process, but the intervention failed. Accounts of failures are not as frequently found in the literature, as are success stories. However, failing often offers good opportunities for new insights (Blythin *et al*., 1997), and an unsuccessful project is only truly a "failure" if nothing was learned from it. In this section, we shall discuss the lessons learned from this study. Firstly, the relationship between motivation and group cohesiveness is examined for both face-to-face and electronic brainstorming. Thereafter, we derive some consequences from the findings, and discuss the design implications these have on organisations and GSS in general. Finally, some limitations to this work are highlighted and discussed.

## *6.1 Motivation/group cohesiveness relationship*

In this study, we have focused on three emerging entities: Physical group work in form of face-to-face brainstorming, virtual group activities using an EBS prototype, and extrinsic motivation in form of an institutionalised reward policy. We shall now in turn discuss the relationships between these entities.

### Relation #1: Physical vs. Virtual group work

From the interview data, we notice how face-to-face brainstormers refer to the result as "a group thing". The participants in a face-to-face brainstorming session are not simply randomly picked by-passers but carefully selected and invited individuals, which makes them share an affiliation even though the brainstorm group is highly temporary. Together, although being engaged in cognitive work, they act as a group and at the end of the session the group as a whole gets shared credit for their collective achievement. As is evident from the quotes, the respondents refer to other group members as fellow co-workers and they speak of the group as a whole. Although never explicitly designed, the face-to-face group has achieved clear, albeit implicit, group cohesiveness.

EBS systems are also typically not designed to enhance group cohesiveness, and the Mindpool users consequently adopt a very

egocentric perspective. The users speak in terms of themselves only and express a strong concern for not being appreciated or recognised for their individual contributions. The "group" is not discussed or even referred to at all, and the focus for reflection is entirely on the self. In compliance with the literature, group cohesiveness amongst the face-to-face group workers was strong and evident. In contrast, the group identity amongst the Mindpool users was very weak, not to say non-existent. As described above, conflicting data has been reported on this topic but the findings from this study are consistent with the theories suggesting that computer-mediated group work fosters less of a group identity (e.g., Spears *et al*., 1990).

However, it has been suggested that this loss of group cohesiveness should not affect cognitive work such as idea generation negatively. If anything, it should increase productivity. In conflict with this theory, we notice how this lack of group cohesiveness results in the respondents being unwilling even to use the EBS system at all. This behaviour cannot be fully explained by the physical vs. virtual group work relationship alone. We need to consider additional factors and one aspect that came out strongly from the data was the reward system.

### Relation #2: Brainstorming and the reward system

It is important to note that the reward system in place has been used in conjunction with the suggestion systems for several years without having a negative effect on face-to-face brainstorming. In fact, the reward system does not seem to affect face-to-face brainstorming at all. The testimonies of the respondents clearly show that physical groups are able to brainstorm successfully without competing or expressing concerns for potential rewards. Therefore, it cannot be the reward system *per se* that causes the problems. A plausible reason is instead the fact that the participants in group brainstorming think of themselves as a unit, thereby obtaining strong, albeit implicit, group identity. As group members, they all feel being part of the process and together contributing to the solution.

### Relation #3: EBS and the reward system

In the theory section earlier, we learned that when brainstorming electronically, identity and group cohesiveness is presumed to be lower, and this seems to be confirmed by the empirical findings presented here.

The respondents consistently speak of "my idea" and in other ways express purely individual aspects. What seems to concern them the most is the presumptive risk of being robbed of their ideas, thus missing a possible reward. The reward system, completely ignored by face-to-face brainstormers, is omnipresent in the testimonies of the EBS users. The conclusion is that it is not the reward system alone but the combination of extrinsic motivation and low group cohesiveness that causes the undesired effect.

### *6.2 Consequences and implications for design*

To solve the situation described in this study, two options are obvious: to abandon the reward system or to strengthen group cohesiveness. As can be seen from the empirical data, the employees considered the reward system to be a useful motivating factor, so abandoning the reward system may not be welcomed. However, this opinion might also be a misconception. Previous research on the use of traditional suggestion systems has shown that the reliance on extrinsic motivation limits participation to typically 10-15 percent of the employees, as opposed to 70-80 percent when no reward system is used, or when recognition is kept to a symbolic level (Robinson & Stern, 1997). This suggests that extrinsic motivation is not as important motivating factor as the organisational members seem to believe. Convincing the organisational members of this remains a challenge, though.

The other option would be to strengthen the group cohesiveness of the EBS users and thereby increase cohesiveness. This option holds important lessons for design implications for both organisational activities and applications such as GSS. By treating and rewarding EBS contributors collectively, for example by accumulating the reward that otherwise would have gone to individual proposers and splitting it amongst all contributors at the end of the year, the organisation would, simply by treating the proposers as a group, create a team spirit and increase group cohesiveness. Letting the reward system favour the EBS users as a group would also enhance group cohesiveness without losing the possibility to financial benefits. On the application level, the identity of the individual contributors could be made salient without revealing what suggestions where theirs. By publishing the names of the "team members", a stronger "we"-spirit would be fostered, not unlike the

phenomenon observed in the open source movement (Ljungberg, 2000). It would also be possible to centre the EBS systems on established social units, thereby having an existing group identity to start with. While such an approach may work well for GSS in general, such a strategy would not be suitable for EBS, since it would limit diversity and inter-disciplinary crossovers.

### *6.3 Consequences and implications for research*

On a more general level, it can be noted that the role of motivating factors, which was identified as an important factor in this study, has largely been neglected in GSS and EBS research. Despite Grudin's early and influential work on social aspects of groupware (cf. Grudin, 1988; Grudin, 1994), the question why people would want to share ideas or co-operate in the first place is seldom asked. In a recent descriptive evaluation of GSS research conducted in the last two decades (Fjermestad & Hiltz, 2001), no result regarding motivational aspects can be found, and hence the lack of references to recent GSS or EBS research in this paper. Work in the field of social psychology of creativity reports that when people are primarily motivated by their interest in the work and the enjoyment of that activity, they are more creative than when driven by some goal imposed on them by others (Amabile, 1983; Amabile *et al*., 1996). The use of extrinsic motivation such as rewards or bonuses tend to cause a focus on the reward rather than on the task at hand, and winning the reward becomes more important than finding the most creative solution (Stenmark, 2000).

The type of reward mechanism implemented at Volvo IT and examined in this paper is not merely an isolated local phenomenon. On the contrary, suggestion systems based on monetary compensation are quite common in industry, and have existed in Europe and the U.S. since the end of the 19th century (Robinson & Stern, 1997). It seems likely that the competitiveness that these systems invite could seriously hamper successful utilisation of EBS systems. However, as discussed above, much EBS and GSS research is only performed on students or other members of the academic community, e.g., (Pervan, 1994; Brown *et al.*, 1998; Kahai & Cooper, 1999; Pinsonneault *et al*., 1999; Hilmer & Dennis, 2000). While such controlled environments are convenient for testing isolated aspects of group activity, they may be insufficient to

capture more subtle nuances of real office work. While both academia and industry present complex and challenging environments, their members, respectively, have very different agendas, and some aspects of group work can only be investigated in on-going organisational work (Finholt & Sproull, 1990). The bias towards academic settings that presently exist in the EBS and GSS literature could explain why research has been unable to foresee motivational problems, and more case studies and longitudinal research in real business and industrial settings are thus called for.

### *6.4 Limitations*

Although this research was conducted in co-operation with Volvo IT, it did not receive attention from top management and the intended purpose and objective was not communicated sufficiently within the organisation prior to the introduction of the application prototype. Several important stakeholders, for example members of the PHC, were thus taken by surprise and reacted perhaps overly defensively. It is also likely that misunderstandings concerning the objectives of this work have biased the respondents both explicitly and implicitly. Mindpool's future relationship vis-à-vis the traditional suggestion system and the reward system had not been elucidated, and this caused much concern amongst the respondents. Had these parameters been set up differently, the prototype might have received a much more positive welcome.

However, despite these uncertainties, the fact remains that although the reward system had co-existed with face-to-face brainstorming for many years without interfering, the introduction of an EBS system immediately raised questions regarding motivation and intellectual property rights. This is a clear indication of a more complex relationship between group cohesiveness, rewards, and cognitive work than previously suggested in the literature, and the theory presented here contributes to our understanding of these issues.

## 7. Conclusions

In this paper, we have seen how face-to-face brainstormers experience strong although implicit group cohesiveness while users of a distributed electronic brainstorming (EBS) application show a more individual

focus. These observations confirm existing theories. However, counter to what is suggested in the literature, it is showed that this lack of group identity amongst the EBS users causes problems. It is concluded that the reward system, completely ignored by the physical group, in combination with low group cohesion of the virtual group is the determining factor. The most useful lessons learned from this work are that:

1. EBS tools are not intended or designed to promote group cohesiveness but to facilitate creativity and ideas generation. However, in the presence of rewards mechanisms that create a competitive climate and strengthen individualism, EBS systems need to establish and sustain a clear group identity.

2. Motivational factors, amongst other things, differ between business and academic actors and the effect of motivation on EBS and GSS work must be examined more thoroughly and over time. Such research should be conducted in real business or industrial settings and preferably include longitudinal studies.

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