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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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Completing a doctoral degree means coming to the end of a long journey. Yet, the goal reached is not the final destination; it is more of a pit stop where you refuel before departing on the next leg. However, having finished a doctoral thesis is also a good reason to celebrate, to rejoice in the results achieved, and to acknowledge all those who have contributed. I would therefore like to share some of the credit with the many friends and colleagues without whom this thesis would never have been completed.

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Dick Stenmark
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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.

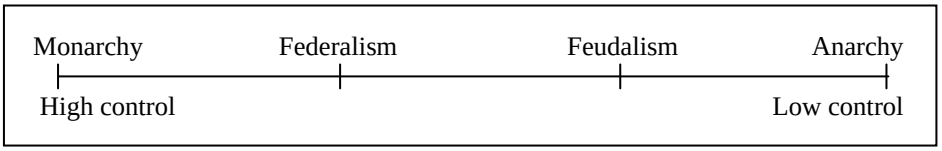

Figure 1. The four overlapping models of information governance and their position relative one another (Davenport, 1997).

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).

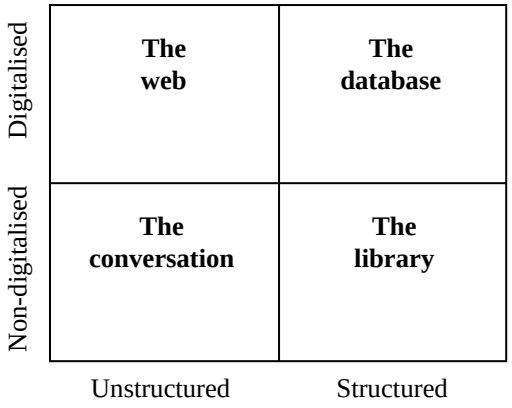

Figure 2. Four arenas of information management with examples.

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
Dick Stenmark
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
Rikard Lindgren, Dick Stenmark, Jan Ljungberg, Magnus Bergquist
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
Rikard Lindgren, Dick Stenmark
Accepted for publication in Scandinavian Journal of Information Systems, 2002.
Paper 4: The Mindpool Hybrid: A New Angle on EBS and Suggestion Systems
Dick Stenmark
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
Dick Stenmark
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.

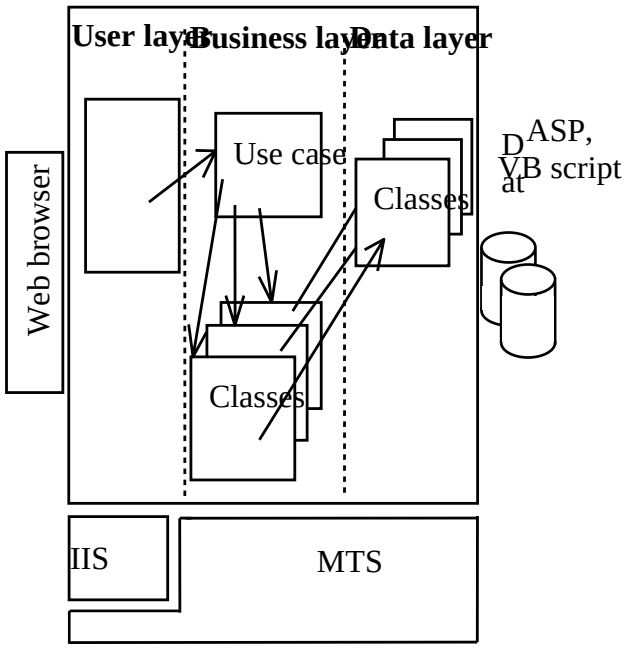

Figure 4. Three-tier implementation of Mindpool using Active Server Pages (ASP) and Visual Basic scripts running on an Internet Information Server (IIS) on top of Microsoft Transaction Server (MTS).

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.

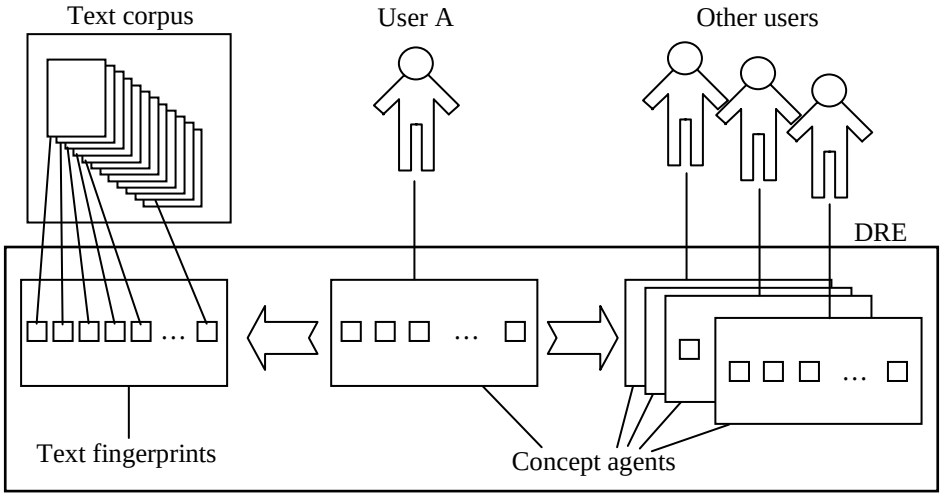

Figure 6. The Agentware architecture. User A can either have his agent find relevant information or use it to locate other users.

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.

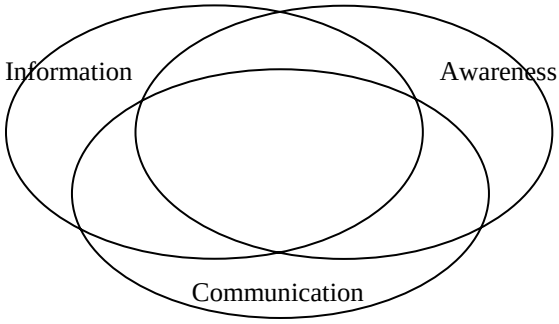

Figure 7. Three perspectives on the intranet. By simultaneously providing information, awareness, and communication, the intranet can better support the knowledge worker.

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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