

The Relationship between Information and Knowledge

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Abstract. Knowledge has widely been acknowledged as the perhaps most important factor for corporate competitiveness, and we have all witnessed the explosion of IT solutions claiming to provide support for knowledge management (KM). Although organisation theorists and other non-technocrats have pointed out that KM is so much more than merely technology, the interest for KM has continued to thrive within the IT community. What seems to be missing though, is an explanation of exactly how systems and technology intended for *information* can be able to assist in the managing of *knowledge*. Without losing myself in a philosophical discussion, I shall analyse the concepts of information and knowledge and, from an IT perspective, establish a working relationship between these two important entities. The practical organisational implications of my analysis are exemplified with a concluding discussion of the intranet.

1 From philosophy to IT

Ever since the ancient Greek period, the quest of philosophy has been to find what knowledge is. Early thinkers such as Plato and Aristotle were followed by Hobbes and Locke, Kant and Hegel, and into the 20th century by the likes of Wittgenstein, Popper, and Kuhn, to name but a few of the more prominent western philosophers. In recent years, we have witnessed a booming interest in knowledge also from other disciplines; organisation theorists, information system analysts, and application developers have all been swept away by the knowledge management avalanche. It seems, though, that the interest is particularly strong from the IT community. A plausible question to ask then is how knowledge relates to technology. Can IT at all be used to handle knowledge, and if so, what sort of knowledge? What sorts of knowledge are there? What is knowledge?

It seems we have no choice but to return to the question that has kept philosophers occupied for thousands of years. However, we should not approach it from a philosophical 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. However, theoretical frameworks are sometimes necessary analytic tools to help us understand and explain phenomenon observed in practice so that it may inform the design of useful IT artefacts. The discussion in this paper shall therefore be aimed at addressing knowledge from an IT perspective, asking questions such as “How does IT affect the interaction between information and knowledge in today’s organisations?”, “How can the knowledge that resides with the organisational members be made visible using IT?”, and “How should IT be used to leverage the knowledge of the organisational members?”

Epistemologically, this paper shall address the difference between tacit and explicit knowledge by accounting for some of the views more commonly found in the KM literature.

Some of these views shall also be questioned, and in particular, the prevailing assumption that tacit and explicit are two forms of knowledge shall be criticised by returning to Polanyi's original work. Ontologywise, my primary interest is on the group and organisational levels. However, these two levels are obviously made up of individuals and we are thus bound to examine the personal aspects of knowledge as well, though be it from a macro perspective. The purpose is to review and criticise the contemporary KM literature in order to clarify the relationships between information, knowledge, individuals, and organisations that are commonly and implicitly assumed within the IT community.

2 Two opposite traditions – and a middle way?

When looking at the knowledge literature, two separate tracks can be identified: the commodity view and the community view. The commodity view of knowledge as some absolute and universal truth has since long been the dominating view within science. Rooted in the positivism of the mid-19th century, the commodity view is still especially strong in the natural sciences. Disciples of this tradition understand knowledge as an artefact that can be handled in discrete units and that people may (or may not) possess. In this objectivistic approach, knowledge is a thing for which we can gain evidence, and knowledge as such is separated from the knower (Spender, 1998). Metaphors such as drilling, mining, and harvesting are used to describe how knowledge is being managed.

There is also a shorter tradition that can be labelled the community view or the constructivist approach. This tradition is rooted in the critique of the established quantitative approach to science that emerged primarily amongst social scientists during the 1960's, and resulted in the publication of books by Garfinkel, Bourdieu, Habermas, Berger and Luckmann, and Glaser and Strauss. These authors argued that reality (and hence also knowledge) should be understood as *socially constructed*. According to this tradition, it is impossible to define knowledge universally; it can only be defined in practice, in the activities of and interactions between individuals.

So, some understand knowledge to be coupled to the individual while others see it as related to context. Maybe it is a little bit of both. A concerto pianist has the knowledge – i.e. the *ability* – to play the piano, something the Metropolitan opera audience is able to appreciate. This pianist, given a suitable instrument, would be able to express his or her knowledge equally well in some other location with a completely new audience. Thus, knowing how to play resides within the pianist and is, in a sense, context-independent. However, should the same pianist be stranded in the middle of the Amazon jungle and picked up by some unknown Indian tribe, her knowledge cannot be manifested. Even if a piano would be available, the Indians would not be able to recognise (and possibly not even appreciate) a classic masterpiece. To make sense, the piano-playing knowledge of the pianist requires the context of a knowledgeable audience. Thus, knowing how to play is meaningless in the wrong tradition or environment. This inter-relationship between individual knowledge and tradition is dealt with by Polanyi when he speaks of personal knowledge as something not entirely subjective and yet not fully objective (Polanyi, 1958/1962). We shall return to this topic in section six, but first, let us deal with some definitions.

3 Data, information, and knowledge

Not many would question the fact that information can be made tangible and represented as objects outside of the human mind. Knowledge, on the other hand, is a much more elusive entity – while some see it as an object, others regard it as an interpretation or representation that is constantly re-negotiated. Add *data* and we have a both intricate and challenging situation of intertwined and interrelated concepts. It has often been pointed out that data, information, and knowledge are not the same, but despite efforts to define them, many researchers use the terms very casually. In particular, the terms knowledge and information are often used interchangeably, even though the two entities are far from identical.

Kogut and Zander (1992), for example, define information as “[...] knowledge which can be transmitted without loss of integrity [...]” (p. 20), thus suggesting that information is one

form of knowledge. This is typical of early texts on knowledge management, which did not sufficiently separate information from knowledge. Nonaka, who is widely quoted in the KM-discourse, has too been criticised for such carelessness (cf. Baumard 1996/1999, pp.133-134). However, Nonaka correctly argues that knowledge and information are both about meaning in the sense that both are context-specific and relational. Hence, knowledge and information are similar in some aspects. However, knowledge and information are also different. While information is more factual, knowledge is about beliefs and commitment. Further, knowledge is always about action – the knowledge must be used to some end (Nonaka and Takeuchi, 1995, pp. 57-58). The KM literature is rich of different, more or less explicit, attempts to define data, information, and knowledge and their inter-relationships, often in terms of each other, and some of these have been synthesised in table 1.

Table 1: Some definitions of data, information, and knowledge.

Author(s)	Data	Information	Knowledge
Wiig, 1993	-	Facts organised to describe a situation or condition	Truths, beliefs, perspectives, judgements, know-how and methodologies
Nonaka & Takeuchi, 1995	-	A flow of meaningful messages	Commitments and beliefs created from these messages
Spek & Spijkervet, 1997	Not yet interpreted symbols	Data with meaning	The ability to assign meaning
Davenport, 1997	Simple observations	Data with relevance and purpose	Valuable information from the human mind
Davenport & Prusak, 1998	A set of discrete facts	A message meant to change the receiver's perception	Experience, values, insights, and contextual information
Quigley & Debons, 1999	Text that does not answer questions to a particular problem	Text that answers the questions who, when, what, or where	Text that answers the questions why or how
Choo, Detlor, & Turnbull, 2000	Facts and messages	Data vested with meaning	Justified, true beliefs

Not only are the *definitions* of the three entities vague and imprecise: the *relationships* between them are not sufficiently covered. The literature (e.g. Ackoff, 1997; Bellinger *et al.*, 1997; Davenport and Prusak, 1998; Choo *et al.*, 2000) often describes the relationships as a hierarchy consisting of data at the bottom, followed by information, and with knowledge on top. This image holds two tacit assumptions: Firstly, it implies that the relationship is asymmetrical, suggesting that data may be transformed into information, which, in turn, may be transformed into knowledge. However, it does not seem to be possible to go the other way. This assumption can be noticed also in Table 1, where several commentators define information in terms of data and knowledge in terms of information. Obviously, this is

incorrect, since we all on several occasions have used our knowledge to derive information, and created data out of information.

Secondly, it connotes the appraisal that knowledge is more valuable than information, which in turn is superior to data. This, too, has been challenged. Tuomi (1999) argues that data emerges as a result of adding value to information, which in turn is knowledge that has been structured and verbalised. According to her view, there is no “raw” data, since every measurable or collectable piece of fact has already been affected by the very knowledge process that made it measurable and collectable in the first place. Knowledge, embedded in our minds, is thus a prerequisite. We can instantiate some of this knowledge as information, which is explicit and processable. By examining the structure of this information, we may finally codify it into pure data, which, from an IT perspective, is the most valuable of the three. Since only data can effectively be processed by computers, the value hierarchy should thus be turned around and have data on top (Tuomi, 1999). However, it is not one way or the other. Instead, data, information, and knowledge are interwoven and interrelated in more complicated ways than any of these two previous models suggest. Both data and information require knowledge in order to be interpretable, but at the same time, data and information are useful tools for constructing new knowledge. 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. In this sense, data and information plays a similar role, and this paper does not make a sharp distinction between data and information. As shall be argued in more detail below, data and information are only two opposite ends on a continuum. What one conceives as information another sees as data. The determining factor is the knowledge that the beholder brings into the situation.

4 Information

While knowledge management, as the term is used in this article, is a relatively new phenomenon, the study of information goes back at least to 1948, when two studies were presented at the Royal Society Scientific Information Conference (Choo, 1998). Choo has categorised the studies of information usage that have been conducted over these more than fifty years along two axes: system/user orientation versus task directed/integrative research. A *system orientated* study views information as an objective entity independent of social structures and with a content-based reality of its own, while a *user orientated* study views information as a subjective construction created primarily in the mind of the user. Further, a *task-directed* study is concerned with the activities that constitute the information-seeking process itself, such as identification of sources or analysis of different information-sharing modes, while an *integrative* study includes understanding of situations and context, and what the user does with the information once it has been obtained. The analysis shows that information studies have moved from an orientation that was primarily task and system centred to an orientation that is more integrative and user focused (Choo, 1998).

By taking an interest in the users perspective, it is acknowledged that though a document may be seen to carry its own information representation, the user wraps this, in a sense objective, content in an interpretative envelope, thereby giving the information a subjective meaning. It is this combination of content and interpretation the user finds valuable. The value of any given piece of information does thus reside in the relationship between the user and the information. On its own, the information is useless. Consequently, the same objective information may result in different subjective meanings and values. A researcher with a user centred interest would thus not only examine the information itself but also the user's cognitive and psychological needs and preferences (Choo, 1998). The interest in such user behaviour has also propelled more integrative research efforts. The scope for an integrative researcher includes understanding of the situation where the user develops the information need, and analysis of the usage of the same information once it has been interpreted by the user.

Information affects knowledge and vice versa. Choo suggests that the outcome of information usage is “a change in the individual's state of knowledge and a capacity to act” (*ibid*, p. 62). When the information is used, i.e. interpreted in the light of the user's previous knowledge and experiences, or, as Kidd (1994) puts it, when new facts *inform* us, it does not

become knowledge but it alters the *existing* knowledge by increasing (or shifting) the individual's knowledge state, thereby opening new possibilities to act. As we shall see in section eight, this coupling between knowledge and acting is a reoccurring theme in the knowledge literature. First, let us examine knowledge in more detail.

5 Epistemology

The division of philosophy that investigates the origin and nature of knowledge is called epistemology, and its objective is to investigate the foundations upon which human knowledge rests. By examining and justifying different types of knowledge and make explicit the relationships and interactions between these types we can develop knowledge schemata capable of answering to questions about the outcome of such interactions (Spender, 1998). Following a constructivist approach, there will inevitable be several such knowledge schemata. Spender (1998) speaks in favour of a pluralist epistemology, acknowledging that no single reference system is capable of establishing the "universal truth". Referring to Rescher (1993), Spender further argues that in a world of bounded rationality and imperfect knowledge, where personal experiences is our principal source of learning, dissensus is a natural state. Attempts to arrive at a view shared by all humans are bound to fail. What we can do is to reflect upon our own beliefs and state these so that others may appreciate where our different understandings stem from. It also seems plausible that different knowledge schemata are applicable in different situations and it is therefore important to ask how a certain perspective is useful in a specific situation. A pluralist epistemology is thus inherently pragmatic and situated (Spender, 1998).

Indeed, a variety of knowledge schemata have been presented: Nonaka (1994) distinguishes between tacit and explicit knowledge; Boisot's (1995) advocates a typology consisting of proprietary, public, personal, and commonsense knowledge; Choo (1998; 2000), building on Boisot, suggest a differentiation between tacit, explicit, and cultural knowledge; Blackler (1995), elaborating on Collins (1993), speaks of embodied, embedded, embrained, encultured, and encoded knowledge; Spender (1996) separates knowledge into explicit, implicit, individual, and collective. However, as I shall argue in more detail later, these views are all based on the assumption that some knowledge is difficult to articulate through language and only exist in form of experiences of which we are not always aware. This form of knowledge was first discussed by Polanyi (1958/1962), who coined the phrase *tacit knowledge*. Another assumption implicitly present in the work of the above scholars is that some knowledge can be expressed verbally, collected in books and manuals, and distributed electronically. This is referred to as *explicit knowledge*. I shall later question the phrase explicit knowledge and claim that all knowledge is tacit and explicit "knowledge" is in fact information.

Tsoukas (1996) acknowledge that the dichotomy between tacit and explicit knowledge and the typologies derived from this duality by several authors has advanced our understanding of organisational knowledge by showing its multifaceted nature. However, such typologies also limit our understanding by the inherent formalism that accompany them. Building on Pepper, Tsoukas observes that "[t]he conceptual categories along which the phenomena are classified must be assumed to be discrete, separate, and stable. The problem is that they hardly ever are" (Tsoukas, 1996, p.14). Latterly, the discourse within the European Knowledge Management field seem to move away from the tacit-explicit distinction, possibly because it is not perceived to add to the debate anymore. The KM community seems to think that the topic has been exhausted and that it is time to move on. However, maybe giving up the distinction between tacit and explicit knowledge is not the best option? I think not, especially so since most analytic work on KM has been organisational theory informed research and not IT related studies. Some things in organisations are tacitly expressed but therefore not outside the reach of IT support (Stenmark, 2001). I think we should look deeper into the tacit side of knowledge.

6 Tacit knowledge

The notion of tacit knowledge was introduced by Polanyi, a philosopher made known to a larger audience by being quoted in the writings of Kuhn in 1962 (Kuhn, 1962) and which 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 what Polanyi himself did. Due to the strong influence of Nonaka’s writings on the knowledge management discourse, this misconception has been widely adopted. While Polanyi speaks of tacit knowledge as a backdrop against which all actions are understood, Nonaka uses the term to denote particular knowledge that is difficult to express.

Although referring to and building on the arguments of Polanyi, different scholars come to contradictory conclusions. Cook and Brown (1999) 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” (*ibid.*, p. 384). In contrast, Tsoukas (1995), *also* building on Polanyi, claims that tacit and explicit knowledge are mutually constituted and should *not* be viewed at two separate types of knowledge. 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” (*ibid.*, p. 14, emphases in original). Tsoukas believes that the two are so inseparably related that to even try to separate the two is to “miss the point”. 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). It seems that most scholars share the opinion of Tsoukas. For example, Molander (1996) argues that it is useful to treat tacit knowledge separate from explicit knowledge, but only as long as the two are seen as two separate *aspects* of knowledge and not as different *sorts* of knowledge.

In Polanyi’s understanding of tacit knowledge, it is related both to the society in which we act and to our personal interests and commitments. We have been socialised into a knowledge tradition that forms an unarticulated background for our understanding (Tsoukas, 1996). Our experiences in this environment are interpreted in the light of our tradition. When tradition is merged with personal interests and experiences, Polanyi refers to this tacit understanding as *personal knowledge*. Among the prerequisites for knowledge are habits of action and certain dogma in which one believes – knowledge cannot be built entirely on questioning. Such habits and beliefs are often learnt without reflecting upon them, and the same is true for socialisation in certain cultures or communities (Molander, 1996). The cultural inheritance we carry is transferred from generation to generation through a social interplay that both utilises and transcends language. Via socio-semiotic cues and verbal manifestations, we learn not only from the individuals we interact with directly, but also from generations before them. Although experiences cannot be accumulated in a strict sense, our language enables us to be part of a process where individuals and tradition interact (Rolf, 1995). Individuals and tradition shape each other. Without being aware of, or able to express, the knowledge that is tacitly embedded in our tradition and culture, we use it as an unarticulated background against which we distinguish the particulars to which we currently attend (Polanyi, 1958/1962).

Hence, the statement “mass equals energy” is not difficult to say, but this does not imply that it is easy to understand; there is no knowledge in the words *per se*. There is a difference between the description and the object being described. When one says, “I cannot describe how to do it”, one often means that one cannot describe it sufficiently for someone else to fully understand it or be able to do it. Understanding requires familiarity with both the concepts and the context in to which they normally belong. This understanding, which is tacit, gives meaning to the words and thus is all knowledge basically tacit. What, then, is explicit knowledge?

7 Is there any explicit knowledge?

Is there really any explicit knowledge? If so, what is the difference between explicit knowledge and information? These seem to be important questions and fundamental to our understanding of knowledge management, at least from an IT perspective. It is therefore surprising to see that they remain unanswered.

If we, for example, look at Choo, we find that he proposes that the knowledge of an organisation may be differentiated into tacit knowledge, explicit knowledge, and cultural knowledge (1998). While Choo try hard to justify and distinguish cultural knowledge as a separate category (see also (Choo *et al.*, 2000)), it remains unclear what exactly the contribution is. The cultural category does not seem to have any characteristics not already covered by the tacit and the explicit knowledge. Instead, it seems that Choo's cultural knowledge is an overlapping category covering aspects of both tacit and explicit knowledge, as suggested in Figure 1. The cultural dimension does thus not add any analytic value, and the suggested taxonomy does not seem very helpful. We still have some aspects that can easily be articulated and others that are very difficult to verbalise.

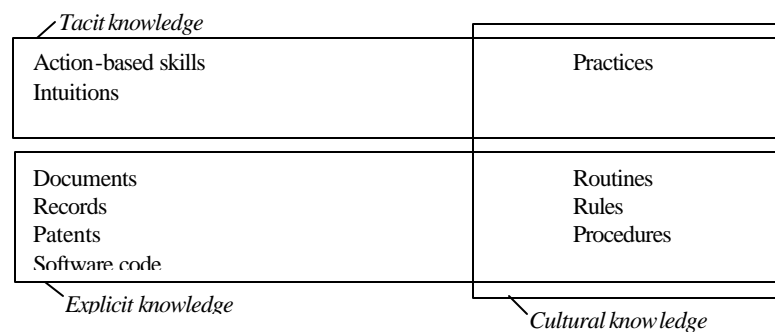


Figure 1: My interpretation of Choo's notion of tacit, explicit, and cultural knowledge

It can be argued that although we may not be able to fully describe the face of someone with whom we are familiar, and also unable able to give more than a mediocre description of what really happens when we ride a bike from a scientific perspective, the little information provided may still be helpful. However, descriptions, including reminders, advice, and hints, play a vital role in all knowledge transfer and acquisition (Molander, 1996). Although the narrative in itself is not enough for the other part to gain a complete understanding, there are always various means to describe and express feelings and actions. However, the fact that routines, rules, documents, and the other examples of "explicit knowledge" given by Choo, are *useful* does not make it knowledge. It is still only information, albeit interwoven with the knowledge required both to create it and to interpret it. Alavi and Leidner (2001, p. 109) posit that "information is converted to knowledge once it is processed in the mind of individuals and knowledge becomes information once it is articulated". This interaction between information and knowledge, the articulated and the tacit, is illustrated in Figure 2.



Figure 2: Some of our tacit background knowledge can be articulated into information, but to be fully understandable, it depends on knowledge.

As argued previously, understanding requires familiarity with both concepts and context, which is drawn from our tradition and from our personal experiences. A reader without experience, and from a tradition different from that of the author, cannot make use of a written methodology or manual. To her, it is only information. Although there is knowledge embedded in the text (e.g., a balance sheet where columns and totals have predefined meanings), the reader cannot appreciate it without bringing the required personal knowledge.

In general, people from the same tradition and culture have more tacit knowledge in common than have people from different traditions, and therefore they think more alike. Likewise, groups within the same profession or company have more tacit knowledge in common than have mixed groups. Tuomi (2000), building on the work of Fleck, describes the required shared understanding and pragmatic nature of professional knowledge as communities of *thought*. This means that a Chinese understands another Chinese more clearly than a westerner does, and a systems programmer decodes another systems programmer more easily than a car mechanic. Cultural tradition, profession, and organisational belonging all carry their own assumptions, and the more overlapping these tacit assumptions and experiences – i.e. the personal knowledge – are, the better from a knowledge sharing perspective. If all three realms overlap, the likelihood that two persons (e.g., two North American software developers working for Microsoft) will be able to understand each other, increases and the discrepancy between the information provider's intended meaning and the recipient's interpretation will be small. The information is thus understood.

In contrast, a Scandinavian microwave expert working for Ericsson might not understand the text, since she would not have the required personal knowledge to comprehend the message. In her case, additional information would have to be provided or she would have to spend time with software developers and Microsoft employees to acquire the relevant knowledge through *socialisation* (Nonaka, 1994). Information requires knowledge both to be created and to be understood, but although information and knowledge are related, the information *per se* contains no knowledge. Routines, procedures, rules, manuals, and books all need knowledge to be decoded and are therefore not explicit knowledge but information.

8 Organisational knowledge and IT

Just as Polanyi, Schön (1983) elaborates on the relationship between the tacit and the reflected, but where Polanyi discusses the cultural aspects of our society, Schön focuses on an organisational context. According to Schön, our knowledge is in our actions. Although actions in themselves are rather ephemeral in character, they often leave a tangible result, such as when building a house, making a sculpture, or implementing a software system. There are also actions that do not result in new artefacts but yet change the state of things, such as driving a car from A to B, or actions that are totally ephemeral, such as the playing of an instrument. Regardless of which, actions are the only way through which knowledge can manifest itself. This does not mean, however, that knowledge *must* result in action in order to exist. The *ability* to take action is sufficient, but as long as the knowledge remains inactive, it is of no organisational value.

One action, often seen in an organisational context, is the *creation of information artefacts* such as documents. On a corporate intranet, information seeking, information interpretation, and information creation are actions that describe the interaction between knowledge and information. By monitoring these actions, the organisation can learn where certain kinds of knowledge reside and thereby leveraging the tacit knowledge of its members. Individuals benefit both by being able to find knowledgeable colleagues and by being themselves identified as knowledgeable (Stenmark, 2001).

As discussed above, texts are not understood equally by all. Baumard (1996/1999) comments that when the search for knowledge takes place in the territorial waters of the organisation it becomes far more contextual than a search for some absolute or universal truth. In organisations, knowledge is generated by those beliefs to which the members are most committed (*ibid.*, p. 53). Commitment and beliefs vary from organisation to organisation, and even within the same tradition, organisations have their own culture, their own vocabulary, and their own (tacit) assumptions. This means that organisational members, in general, can share knowledge more easily among themselves than with people outside the organisation.

However, in large organisations where it is impossible to know every fellow employee, people tend to gravitate towards those who are similar in a *professional* sense. These clusters, referred to as communities of practice (Brown and Duguid, 1991; Orr, 1996; Wenger, 1998), provide an environment with enough coherence to allow perspective making.

Information systems and information technology, as their names imply, are meant to deal with information. As described above, knowledge is a state of preparedness built up partly by personal commitment, interests, and experiences and partly by the legacy of the tradition in which we have been brought up. Knowledge is therefore fundamentally tacit. How, then, can we expect IT to be able to successfully deal with knowledge? Sometimes, we need to focus our attention to certain aspects of knowledge, making it focal. The focal knowledge can, sometimes and partially, be articulated and furnished with words. We call this information. If the information becomes too decontextualised, i.e. too distant from the knowledge required to interpret it, we call it data. As argued above, the text 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.

One important objective for IT would therefore be to provide an environment promoting such common understanding. Nonaka and Konno (1998) use the Japanese word *ba* to describe a shared space of physical, virtual, or mental nature, or any combination of them. However, Nonaka and Konno primarily see IT as a facilitator of the *Cyber ba*, i.e. an environment for supporting the *combinational* phase of knowledge creation where old explicit knowledge is mixed and merged to form new explicit knowledge (Nonaka, 1994; Nonaka and Takeuchi, 1995). Though such support would surely facilitate the access to and the interaction with information, there is no reason why the remaining knowledge creation phases that deal also with tacit knowledge should not be included.

Choo *et al.* (2000) describe the intranet as an information environment encompassing three different domains: the information space, the communication space, and the collaboration space. In addition to those, I advocate the introduction of the awareness space to form the model depicted in figure 3.

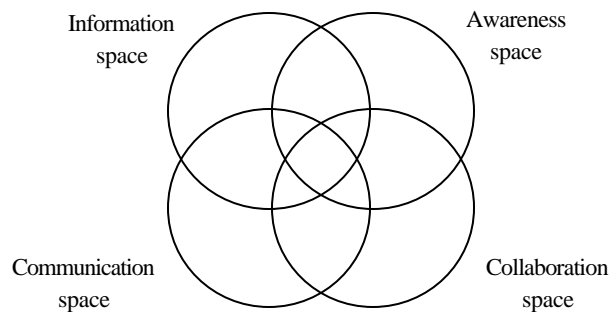


Figure 3: The four domains of the intranet information environment.

The *information space* gives the organisational members access to information in form of corporate databases and documents. Access to rich and diverse sets of information is important for organisational knowledge creation since it provides rich stimuli and requisite variety (Nonaka and 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 the individual author to reach a larger audience. To merely read the text is not enough, though. The reader must also reflect upon her assumptions, her actions, her experiences, and what consequences changing the rules will have on her future actions. Information plays an important role as a catalyst for reflection and IT is thus highly relevant for work that requires knowledge.

The *communication space* enables the organisational members to collectively interpret the available information by supporting various channels for conversations and negotiations. Schön (1983) claims that new understanding comes from reflection, and I suggest that the intranet promotes reflection by making salient different interpretations and viewpoints.

Reflection can benefit greatly from being done in dialogue, but dialogue means articulating and making tacit understanding explicit. Such a process is difficult and the resulting information is, as discussed earlier, never complete. However, the descriptions are useful as tools for reflection. For example, Kidd (1994) describes the notes made by knowledge workers as a type of scaffolding used while in the process of informing themselves.

The *awareness space* exploits not only explicit links but also tacitly expressed connections to hook up organisational members with information and people they might otherwise have missed. 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 space increases the likelihood for community building, communication, and collaboration.

The *collaboration space*, finally, provides means for organisational members to actually participate in collaborative work by offering workflows, shared project areas, and coordinating routines. When engaged in collaborative work with peers that share your objectives and understand your vocabulary, the common context necessary for knowledge sharing exists. In this environment, we can act upon our new understanding, thereby transforming our knowledge to organisational benefit. The role of IT must therefore be to enable people to actively work together based on the information available to them, and facilitate the documentation of their experiences. To achieve this, the spaces for information, communication, awareness, and collaboration must not be separated from each other but joined in an overlapping and holistic whole. Hence, to summarise this paper, I conclude that:

- We need information, created out of knowledge, to be used as a catalyst for new thoughts. The role of IT is to provide access to a rich discourse of information.
- We should reflect upon the information at hand. Therefore, we need IT tools that help us interpret the meaning and discuss the implications of the information.
- We can increase our awareness of other relevant activities by letting IT tools exploit work patterns to detect and display peers with related interests.
- We must act based upon our new state of knowledge, and IT should thus facilitate both structured and *ad hoc* cross-organisational collaboration and co-operation.

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