Mismanagement of tacit knowledge: the importance of tacit knowledge, the danger of information technology, and what to do about it

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Abstract

Businesses are increasingly finding themselves in a world characterized by globalization, turbulence and complexity, paralleled with an exponential advancement in information technology (IT). Although empirical evidence indicates a lack of support for the positive economic impact of IT, we have seen that companies increasingly invest in the new technology. As this technology is limited to the transfer of explicit knowledge, this may relegate tacit knowledge to the background, in spite of the strategic importance of tacit knowledge, hence, leading to the mismanagement of knowledge. The problem stated in this article is as follows: How does investment in, and the use of IT influence tacit knowledge and what impact does this have on the ability of firms’ to create sustainable competitive advantages? The purpose of the article is to improve our understanding of the role of tacit knowledge and to reflect on and give guidance on how to handle the relationship between tacit knowledge and IT. (\textcopyright{} 2001 Published by Elsevier Science Ltd.

Keywords: Information technology; Tacit knowledge; Innovation; Knowledge management

1. Introduction

Business are increasingly finding themselves in a world characterized by globalization, turbulence and complexity, paralleled with an exponential advancement in information and communication technology, denoted in its extreme form as hypercompetition (D’aveni, 1994). Within this picture, signifying the transition from an industrial society to a knowledge-based society, we have witnessed an increasing focus on knowledge as the most important resource for companies.
Drucker (1993) postulates that knowledge, as an input resource will have a greater impact than physical capital in the future. This has also been underlined by Quinn, Anderson, and Finkelstein (1996); Thurow (1997); Sveiby (1997); Solow (1997) and Stewart (1997). Grant (1996) argues that as the market for knowledge resources experiences the same dynamic competitive conditions as is the case within the product markets, knowledge has appeared as the most strategically important resource for companies. We have also seen an increased emphasis on innovation as paramount in creating and sustaining competitive advantages (e.g. Freeman, 1995; Landabaso, 1995). The pace and magnitude of this development are changing the rules of the game (Spender & Grant, 1996; Sveiby, 1997) and the challenge is to find new recipes for increasing firms continuous improvements, innovation and performance, so as to create sustainable competitive advantages. The focus on knowledge has lead to increased attention towards information technology (IT) as one of the most important sources of competitive advantages (European Commission, 1996). Although empirical evidence indicates a lack of support for the positive economic impact, we have seen that companies increasingly invest in IT. As this technology is limited to the transfer of explicit (codifiable) knowledge (Antonelli, 1997), our concern is that this may relegate tacit knowledge (Polanyi, 1962, 1966) to the background, in spite of this knowledge being emphasized by the literature as an important strategic resource for most companies (Black & Boal, 1994; Gøranzon, 1993; Gøranzon & Florin, 1990; Howells, 1996; Nonaka & Takeuchi, 1995). Hence, leading to the mismanagement of knowledge.

The problem stated in this article is as follows: How does investment in, and the use of information technology influence tacit knowledge and what impact does this have on the ability of firms to create sustainable competitive advantages? The purpose of the article is to improve our understanding of the role of tacit knowledge in a knowledge-based society where IT gains access to many social areas, and also to reflect on and give guidance on how to handle the relationship between tacit knowledge, IT, continuous improvements, innovation, performance, and sustainable competitive advantages. The remainder of the paper is divided into three parts. First, we develop a conceptual model based on a discussion of the importance of knowledge and the consequences of IT investments. The model presents us with the puzzle of handling both explicit and tacit knowledge. For better understanding the puzzle, and what to do about it, a revised model explaining the role of tacit and explicit knowledge in creating sustainable competitive advantages is then presented. Finally, in the conclusion we present a number of suggestions for how to overcome the mismanagement of knowledge.

2. Developing the conceptual model: information technology and the mismanagement of tacit knowledge

Knowledge can be categorized in two different categories: explicit and tacit knowledge (Nonaka & Takeuchi, 1995). Explicit knowledge can relatively easily be formulated by means of symbols and can be digitalized. This knowledge can thus with relative ease be transferred to others by e.g. the use of information technology. Tacit knowledge (Polanyi, 1962, 1966) is entrained in action (practice) and is linked to concrete contexts (Rolf, 1995; Molander, 1993; Gøranzon, 1993; Schön, 1987). This knowledge is difficult to communicate to others as information, and can at best be difficult to digitalize. Tacit knowledge is defined by Howells (1996, p. 92) as: “non-codified, disembodied
know-how that is acquired via the informal take-up of learned behavior and procedures. … tacit knowledge does not involve the generation and acquisition of tangible products and processes, or the more formal element of intangible knowledge flows associated with specific research, technical or training programs”. Fleck (1996, p. 119) describes tacit knowledge as: “a subtle level of understanding often difficult to put into words, a trained recognition and perception, a good feeling for the technology. This form of knowledge is wholly embodied in the individual, rooted in practice and experience, expressed through skillful execution, and transmitted by apprenticeship and training through watching and doing forms of learning”. Polanyi (1966, p. 4), who was the first one to introduce the concept of tacit knowledge, expresses the meaning of the concept in the following simple and precise way: “We can know more than we can tell”.

What happens when enterprises unilaterally invest in IT? The focus will easily be on the part of the knowledge base that can be formalized, i.e. that can easily be communicated to others as information. The tacit knowledge can then easily be de-emphasized. However, much of the literature argues that it is tacit knowledge which will determine to what extent companies will be competitive in a turbulent market, and a global economy (Nonaka & Takeuchi, 1995; Spender & Grant, 1996; Sweeney, 1996; Teece, Pisano, & Schuen, 1997). If the tacit part of knowledge is important to generate sustainable competitive advantages for companies, they will easily lose their competitive edge if they emphasize investments in, and use of IT without taking tacit knowledge into consideration. To put it more directly, companies invest into a position where they lose, and do not improve competitive advantages, if they do not emphasize the entire knowledge base. This argument is consistent with the “strategic necessity hypothesis” (Clemons, 1988; Powell & Dent-Micallef, 1997). The hypothesis argues that firms cannot expect IT to produce sustainable competitive advantages because most IT is readily available to all firms in competitive factor markets. Conclusions being drawn on the basis of the resource base point of view (e.g. Grant, 1996) and the dynamic capability approach (e.g. Teece et al., 1997) seem to reinforce the trends towards deteriorating competitive ability, if investment in IT is emphasized without any consideration for tacit knowledge.

The part of the knowledge base which can be communicated to others as information, and which can be formalized in various IT solutions, is of course important. But it is so well taken care of by public and private enterprises alike, that we do not need to worry about it to the same extent as in the case with tacit knowledge. But tacit knowledge (which cannot be formulated in instruction manuals, between covers, in data bases, and which cannot be transmitted by means of electronic mail, internet or intranet, be hidden in the group-ware, and which cannot be encapsulated numerically or alphabetically), is probably the part of the knowledge base which in the information and knowledge society will make the difference in creating and sustaining competitive advantages for companies. The above arguments are summarized in Fig. 1.

3. The puzzle: the importance of knowledge and the consequences of information technology investments

3.1. Information technology investments and use

From the beginning of the 1980s there has been extensive focus on IT and increased organizational efficiency. Fielder, Grover, and Teng (1994) argue that traditionally, the conservative
approach for applying IT was through the automation of the existing processes within the boundary of a traditional function, such as finance or marketing, and based on the assumption that the design of the original process was satisfactory. Hammer and Champy (1993) also point out this development. In this context, IT’s role focuses primarily on creating operational efficiency through improving administrative and management information systems. This approach could also be linked to the “amplifier effect of IT” (Cron & Sobol, 1983), where its use reinforces existing management approaches. From the beginning of the 1990s, the focus has increasingly been more centered towards including communication technology as an important part of IT. Freeman (1995, p. x) states that: “Information and communication technology has become the dominant technology in the world economy”.

Although we observe a general optimism, in the society as a whole, concerning IT’s potential for creating sustainable competitive advantages, recently, challenges to the earlier optimism have risen from the emerging empirical evidence which indicate a lack of support for the positive economic impact of IT investments (Loveman, 1994; Morrison & Berndt, 1990; Strassman, 1990; Brynjolfsson, 1993; Wilson, 1993; Dos Santos, Peffers, & Mauer, 1993; Powell & Dent-Micallef, 1997). This is denoted as the “productivity paradox of information technology”. Sweeny (1996, p. 6) argues that: “The expectation that investment in science and high technology would result in higher levels of economic prosperity has not been fulfilled. Something has gone wrong”. This is also consistent with the observations of the Nobel Prize winner in economics, Robert M. Solow (1987), who argued that he could see the computers everywhere except in the productivity statistics.

Various explanations to the lack of empirical findings have been proposed. Brynjolfsson (1993, p. 73) grouped the explanations into four groups: (1) Mismeasurement of outputs and inputs, (2) Lags

![Diagram](Fig. 1. Investment in IT, the firm's knowledge base and its sustainable competitive advantage.)
due to learning and adjustments, (3) Redistribution and dissipation of profits, and (4) Mismanage-
ment of information and technology. Our main concern in the present paper is on mismanagement.
However, when Brynjolfsson (1993, p. 76) discussed the issue, he argued that “the problems of
mismanagement stem from the lack of explicit measures of the value of information, which makes it
particularly vulnerable to misallocation and over consumption by managers”. We take a rather
different approach by arguing that the mismanagement of IT is found in the lack of understanding
of tacit knowledge, and the relationship between tacit knowledge and IT.

Also, most of the literature concerning the economic impact (or lack of it) of IT investments are
limited to using productivity as an output measure. However, Merrifield (1994) argues that
conventional measures of productivity are limited in their usefulness in hyper-competitive markets.
Hence, only emphasizing productivity as an output measure may be misleading in searching for the
value of IT, especially within hypercompetitive situations. We argue that there is a need for
focusing on a wider range of performance measures in order to reveal factors that contribute to
creating and maintaining sustainable competitive advantages. Throughout the paper we use
continuous improvements, innovations, performance and sustainable competitive advantages as
output measures.

3.2. The importance of tacit knowledge

Tacit knowledge is the practical knowledge used to perform a task, and it is also “the knowledge
that is used as a tool to handle what is being focused on” (Sveiby, 1997, p. 30). Consequently, tacit
knowledge is, in the business context: practical, action-oriented, experience-based, context-linked
and personal, but not subjective or relative. It is objective, i.e. can be tested, checked, investigated
empirically, in the sense that it is objective in its consequences. This means that the work done by
using tacit knowledge can be tested for quality, durability, and reductions in the cost of production.
Tacit knowledge is as real as explicit knowledge, but the processes to acquire this kind of
knowledge, i.e. tacit knowing, rely on awareness of details which cannot be specified or tested in
any known scientific way. But this does not apply to tacit knowledge, which is the outcome of the
processes of tacit knowing (Polanyi, 1966, pp. 3–27). Tacit knowing is a process of a complex whole,
a pattern that escapes when taken apart for analysis. But tacit knowing is not only involved in the
process by which tacit knowledge is gained. It is also involved in the processes by which all
knowledge is gained (Polanyi, 1958). For Polanyi (1958) tacit knowing is the dominant principle of
all knowledge.

In spite of the great interest in knowledge processes in organizations, the link between know-
ledge, particularly tacit knowledge, and IT, have not been explained and concretized (see Nonaka
& Takeuchi, 1995; Stewart, 1997; Stehr, 1994). Although there exists a Scandinavian tradition
having studied this link (see Gøranzon, 1983, 1988, 1993), the main streak in this tradition has been
linked to vocational knowledge and computerization.

Until fairly recently tacit knowledge has been overlooked or toned down in terms of competitive
importance for companies, both by academics, managers and policy-makers (see Sveiby, 1997;
Stewart, 1997; Howells, 1996; Sparrow, 1998; Fleck, 1996). This is clearly expressed by Howells
(1996, p. 91): “Just as technological innovation up until the 1960s was treated as an unexplained
variance in economic growth and performance, so tacit knowledge as an element within technolo-
gical innovation has, until recently, been seen in a similar way”. This development has, however,
fairly recently changed in favor of emphasis on this part of the company’s knowledge base (see Nonaka, 1994; Nonaka & Takeuchi, 1995; Grant, 1996) and is now “recognized as playing a key role in firm growth and economic competitiveness” (Howells, 1996, p. 91).

The emphasis on tacit knowledge as a strategic competitive factor has emerged along with the increasing globalization (see Thurow, 1997) and hyper-competition (see D’Aveni, 1994) in the economy. In the strategy literature the resource base perspective (Penrose, 1959; Robins & Wiersema, 1995; Barney, 1991; Peteraf, 1993; Dierickx & Cool, 1989; Mahoney & Pendian, 1992; Teece, 1984; Black & Boal, 1994; Grant, 1991, 1996) the knowledge theory (see Grant, 1996), in addition to the dynamic capability approach (Penrose, 1959; Teece, 1988, 1990; Teece et al., 1997; Mahoney, 1995; Nelson & Winter, 1982; Hamel & Prahalad, 1991) have addressed parts of this development, but still we know little about links between tacit knowledge, and IT (see Howells, 1996). What we know about tacit knowledge, from a company perspective, is that it is developed through organizational processes, where procedures (Nelson & Winter, 1982), internal communication processes, in addition to external meeting places (Lei, 1997) constitute essential factors for the development and transfer of this part of the company’s knowledge base. What we on the other hand do not know, is how tacit knowledge influences and is influenced by the new IT.

Polanyi’s theory about tacit knowledge (see Polanyi, 1962, 1966) describes how individuals develop and use knowledge in a process. It is action-oriented and focused on the process itself. Transferred to companies the process perspective is interesting, since the dynamic perspective in Polanyi’s theory also corresponds to the evolutionary perspective presented by Nelson (1987, 1988) and Nelson and Winter (1982), among others, and “Austrian economics”, discussed by Jacobsen (1992). Helfat (1994) has also pointed out the link between tacit knowledge and the evolutionary perspective.

Polanyi (1962, 1966) argues that tacit knowledge belongs to the personal domain, but is still embodied in the meeting between the individual and the culture he belongs to. Vygotsky (1978, 1986) strongly points out that all knowledge is social in some way or the other, and thus contingent on social structures existing in social systems. Thus to Vygotsky, knowledge exists in the collective structure existing in social systems. Simon (1987) argues in favor of the view that tacit knowledge can be made explicit by “unfreezing social habits”. Simon focuses on organizations, while Vygotsky focuses on social structures, and Polanyi has his attention directed towards the meeting between individual and culture. These three authors are, however, concerned about the process where the tacit dimension can be made explicit, which is also in evidence with Nonaka and Takeuchi (1995). A point that is important to be aware of has been formulated in the following way by Nonaka (1994, p. 14): “… organizational knowledge is created through a continuous dialogue between tacit and explicit knowledge”. This means that tacit knowledge cannot be studied without regard to the explicit part of the knowledge base. This view is also underlined by Senker and Faulkner (1992).

When tacit knowledge is made explicit it could be subject to collective reflection (see Schön, 1987). This is an important point in international research; to make tacit knowledge explicit (see Nonaka, 1991, 1994; Nonaka & Takeuchi, 1995; Sveiby, 1997). Hence, for companies, the challenge is to make tacit knowledge at the personal level explicit at the organizational level, to ensure collective reflection.

We argue that tacit knowledge, which is knowledge based on personal experience, and social in some way or another, can be made explicit at the organizational level through thrust and relationship building processes. We further argue that this is best provided by organizing the
company in teams based on apprenticeship were practical experience based on thrust and a helping attitude predominates. This is also consistent with the argument of Johannessen et al. (1997). We denote this organizing as “apprenticeship teams”. The importance for the individual company of focusing on this process, is that the explicit knowledge is only “the tip of the iceberg” (See Sveiby, 1997), and the competitive position of companies will be strengthened if processes are developed to make larger parts of the knowledge base visible (see Thurow, 1997; Stewart, 1997).

3.3. An example: the importance of tacit knowledge, and the transfer of such knowledge

As we have seen, tacit knowledge is essential in creating sustainable competitive advantages. However, tacit knowledge needs to be made explicit. As we have argued, and will see in the following example, the role of IT in making this happen is rather limited. The example is from a Norwegian shipyard, employing 650 people. The case study was conducted from December 1990 to July 1994. A thorough example of this case is given by Johannessen, Olaisen, and Hauan (1993a–c) and Johannessen and Hauan (1994).

In a reorganization of the shipyard, two fundamental changes in production were made. One was the development of teams where a multi-skilled group of people that possessed all the specialized skills necessary to perform the required operations. The second was a transition to vertical sections where each ship was built according to a “brick” principle. Through a system of partial job rotation, members of the teams were supposed to serve as instructors (apprenticeship) to their fellow workers within their particular skill, thus enabling all members of the group to perform at least the more basic operations across particular skills whenever the need may arise.

In focusing on making tacit knowledge explicit within the teams, they experienced a high level of team learning. Organizing in such teams was seen as a win–win situation for everyone in the team, creating the foundation for thrust and a helping attitude within the team. This also implied that members of the teams were more inclined to share crucial knowledge without the fear of losing ownership. In addition to increased flexibility, enlarging the scope of interaction contributed toward releasing the full creative potential inherent in the team by making tacit knowledge more explicit. However, in making tacit knowledge explicit within the process team, part of it became, over time, a knowledge that was difficult to communicate to others outside the team. I.e. part of the tacit knowledge that had become explicit within the team became tacit for others, as we shall see.

The transition to vertical sections where each ship was built according to a “brick” principle, involved ships that were divided into seven main sections (bricks), which were forged together, after each of them had been fitted with as much technical “stuffing” as possible. The technical director had put much of his technical prestige/power on the line in the actual development of the design, so that a great deal of “sunk cost” was invested in the design. The team which was working on one of the seven sections at the back of the boat construction, felt, based on their personal experience, that this design did not fit one of the sub-sections they were working on. They were convinced that a more efficient use of labor could be achieved by changing some of the actual design philosophy. This change would mean that parts of the design had to be changed from vertical to horizontal production at one partial section of the boat. However, the team had difficulty in describing and explaining their suggestion verbally to the engineers involved and the technical manager. Gradually the prestige aspect was brought into the discussion. It became imperative for the engineers and the technical manager to maintain the original design, which in itself represented a large change in
relation to how the shipyard only one year earlier had manufactured boats. According to the

The team involved in this communication it was impossible to get through with the proposed change to

development office, represented by the technical manager and the engineers, because the teams' view

was based on personal experience, intuition and a grasp of the situation as such, i.e. tacit

knowledge.

However, parallel to the reorganization of the shipyard, a new management philosophy was also

introduced. One element of this management philosophy was the internal information system.

A cornerstone within this system was the ideas generated by the process team through means of

change reports. A basic principle of this information system was that no suggestions from the

operators were to be put aside without a well-founded answer, and that the rejection should be

made in the form of a face-to-face meeting between the management and the process team, opening

for dialog and possibilities for changes. The technical manager, who was the leader of the entire

innovation project, felt a strong obligation to follow the basic rule of the management philosophy

he had taken part in designing, and did so by encouraging the team to formulate a suggestion for

change without needing to argue for its solution in writing. The consequence was that the

management was not able to argue strongly enough in disfavor of the suggestion from the process

team. It wound up that the suggested change was accepted by the management. The result was

a 60% increase in productivity in the mentioned section of the ship. The result from the system as

such was also that, over a three-year period, 376 changes were implemented on the bases of these

reports, and used in a continuous change and innovation process in the company. Hence, the

company was able to maintain a higher level of sustainable competitive advantages than was

the case before they reorganized. This was partly the result of the benefit provided by organizing

the work into teams, where tacit knowledge was made explicit within the team, combined with

a management philosophy which had designed systems that allowed the tacit knowledge to be

“heard”. In digitalizing the report system process by the use of IT (which was discussed by the

management team, but rejected in designing the change report system), the possibilities for tacit

knowledge to be “heard” would have been limited considerably. In focusing on making

tacit knowledge explicit by organizing the company into teams and introducing the change

report system, where part of the tacit knowledge was transferred to the management team,

the company also facilitated organizational learning.

4. The management of knowledge and information technology

We have argued that a digitalization of companies through IT could lead to growing

opposition between explicit and tacit knowledge, which could have a negative impact on the

firm’s ability to create and sustain competitive advantages. The remaining question is: how could

the use of tacit and explicit knowledge be balanced to positively impact the outcome of a company?

To answer the question, we need to know more about how tacit knowledge and IT affect

continuous improvements, innovations, performance, and subsequently, sustainable competitive

advantages.

A natural starting point for a search for more profound understanding of the link between tacit

knowledge and IT in organizations is within the research of organizational learning. The reason is

quite simply that knowledge is closely linked to learning and could be understood in the way that
knowledge is a result of learning and includes cognitive development and behavioral change (Fiol & Lyles, 1985). Leonard-Barton (1995) has also pointed out the link between tacit knowledge and learning.

Organizational knowledge processes and organizational learning constitute an integrated process (see Spender & Grant, 1996; Sobol & Lei, 1994), and it is impossible to study one element without studying the other element as well. This is clearly underlined by Lewin’s recommendation of Nonaka’s article (Nonaka, 1994, p. 14), and is the main theme in Nonaka’s article. Pisano (1994) further underlines the increased attention focused on tacit knowledge and organizational learning. What particularly links tacit knowledge to organizational learning is perspectives linked to the concepts “situated learning” (see Lave & Wenger, 1991) and “contextual learning” (see Chaiklin & Lave, 1993; Østerlund, 1996).

Organizational knowledge is a resource, resulting from various interactive learning processes. But organizational learning, knowledge processes and the use of IT all have one purpose in common in the company context, namely to generate sustainable competitive advantages. Particularly important in this context is the tacit knowledge possessed by the actors in the company, as this type of knowledge is difficult to imitate by the competitors (Wernerfelt, 1989; Rumelt, 1984, 1987; Peteraf, 1993; Nelson & Winter, 1982; Teece, 1987; Winter, 1987). The tacit knowledge constitutes a “core capability” (Grant, 1996, p. 380) for companies, as it distinguishes companies from their competitors and promotes their strategic advantages (Leonard-Barton, 1995). This type of core capability, according to Hamel and Prahalad (1994), is developed through a collective learning processes in the company. Learning by doing, using experimenting and interacting is here seen as the processes constituting tacit knowledge. This is also seen by i.e. Badaracco (1991), Dierickx and Cool (1989), Dosi (1988) and Reed and de Fillippi (1990).

We have underlined the importance of tacit knowledge in creating sustainable competitive advantages. But what about innovation? We argue that tacit knowledge, on its own, does not enhance innovation, only continuous improvements. Also, that tacit knowledge can be a key barrier to innovation. This is because tacit knowledge is usually part of a long term learning process in a specific context, being embodied in the structure of thinking, the way of thinking, and therefore functions as a conservative element in relation to innovation. Tacit knowledge, states Fleck (1996, p. 119): “is … the most crucial in restricting the social distribution of knowledge, and has been widely identified as a major constraint on the diffusion of both science and technology”. This has also been pointed at by Basalla (1988). But on the other hand, tacit knowledge is a sort of organizational “immune” system hindering imitation from other social systems. The function of tacit knowledge is then both conservative, i.e. stabilizing the system, and acting as an imitation “guard”. However, the immune system does have a flip side. Teece et al. (1997) argues that to understand imitation, one must understand replication. Replication involves transferring knowledge from one concrete economic setting to another, whereas imitation is simply replication performed by a competitor. Teece et al. (1997) argue that the more tacit the firm’s productive knowledge, the harder it is to replicate not only by competitors, but also by the firm itself. In a study of internal stickiness (connotes the difficulty of transferring knowledge within the organization), Szulanski (1996, p. 31) argues that: “a knowledge source may be reluctant to share crucial knowledge for fear of loosing ownership, a position of privilege …”, hence acting as an impediment for the transfer of both tacit and explicit knowledge within organizations. This is also consistent with Leonard and Sensiper (1998, p. 123), who argued that: “… rational people may be unlikely to
surrender the power they gain from being an important knowledge source — especially since sharing tacit knowledge requires time devoted to personal contact”.

However, continuous improvements are enhanced by tacit knowledge. Solow (1997, p. 24) argues that: “The routine continuous improvement of products and processes is arguably the most important source of increased productivity in mature industries”, i.e. the experience-based part of the firm’s knowledge base. Young (1993, p. 447) makes the following statement: “Following models of learning by doing, I assume that production experience generates new knowledge on how to produce goods more efficiently. … Experience in production increases the productivity of the new technology …”. But, tacit knowledge is bounded by a negative feedback factor. This negative factor is found when no innovation occurs in the organization, continuous improvement increases performance, but only to a certain degree. Thus tacit knowledge promotes continuous improvement only to a certain level, and then declines. This is in line with Solow (1997, p. 25), who denotes this phenomenon as “bounded learning by doing”. We assume that all tacit knowledge has this effect on continuous improvement.

We have argued that tacit knowledge “on its own” does not produce innovations. A major point is that the entire knowledge base for the individual company, the tacit part included, is developed in a social and cultural context, where the interaction between companies and among companies and external systems constitutes important elements for both the development and transfer of tacit knowledge (see Adeboye, 1997). This is very obvious with Sweeny (1996, p. 5): “In the past organizational innovation tended to be the force driving technological and social change. The indications are that social forces will determine technological and organizational change in the long wave”. Howells (1996) too elaborates this chain of arguments, where he particularly makes the link to the market as an important factor for the development and transfer of tacit knowledge. In order to study tacit knowledge in the individual companies it will therefore be highly essential to examine the external systems with which the company interacts. Hence, we argue that it is only when tacit knowledge is linked to the explicit knowledge in the system, and the systems external knowledge base, that innovations appears, increasing performance and promoting sustainable competitive advantages. Hence, linked to the external knowledge base, something new may occur and innovation is brought into the system. Both continuous improvement and innovations are created by the interaction between the system-specific knowledge base, the link to other systems in the environment and organizational learning. That innovations promote continuous improvement is shown by Fruin (1997) at Toshiba. Innovations may be understood as punctuation’s of continuous improvements (Fruin, 1997). When at a certain time innovation enters the organization performance will increase to a higher level, which gives a positive bandwagon effect upon learning by doing, using, interacting and experimenting (constituting tacit knowledge), because something new brings the learning process to a higher level of achievement. Innovation opens up a new field for learning, which gives learning by doing, using, interacting and experimenting a new input factor, even if the bounded negative feedback factor is still in operation. I.e. it is in operation, but at a new level of achievement. Learning by doing, using, interacting and experimenting is here seen as generalized tacit knowledge. The more conservative this generalized tacit knowledge is, i.e. not linked effectively to the environment, the more it is bounded by the negative feedback factor, and vice versa.

We further argue that for the company’s external knowledge base to promote innovations, it needs to be accompanied by sensitivity to change (give guidance) and external meeting places
(facilitating the transfer of external tacit knowledge) and the use of IT (facilitating the transfer of external explicit knowledge).

The use of IT influences the use of the company’s external knowledge base by effectively transferring explicit knowledge. Huber (1990) argued that the use of information technology leads to more quickly retrieved information. Kessler and Chakrabarti (1996) argued after an extensive literature review that there is a growing recognition that speed is important in the development of successful innovations. To enable firms to initiate innovations within a turbulent and complex environment, they need fast access to information. Hence, using IT increases the speed on the availability of information, which in turn enhances innovations.

However, Lee (1994, p. 143) argued that: “In the view of information richness theory, electronic mail filters out important cues such as body language and tone of voice and, unlike face-to-face meetings, is not conducive to immediate feedback”. Hence, for innovations to appear, we argue for the need for external meeting places. We further argue that external meeting places constitute an arena where tacit knowledge can be converted to explicit knowledge. This is also underlined by Nonaka and Takeuchi (1995), because the interaction between individuals at such meeting places is psychologically close and the information media is rich. Daft and Lengel (1986, p. 560) argue that: “In a sense, richness pertains to the learning capacity of communication”.

Gupta and Wilemon (1996) found that successful R&D managers were categorized as being sensitive to changes in the business environment, and by maintaining a spirit of inquiry. Song, Souder, and Dyer (1997) further argue that sensitivity to customers wants and needs is paramount for successful innovations. This might also be viewed in light of a firm’s proactiveness. Ashford and Black (1996) argue that information and feedback seeking are seen as proactive activities. Also, Premkumar and Ramamurthy (1995) argue that proactive firms are found to have a greater extent of adoption and more external connectivity. Lumpkin and Dess (1996, p. 146) argue that “...a proactive firm is a leader rather than a follower, because it has the will and the foresight to seize new opportunities”. They make a distinction between competitive aggressiveness and proactiveness, where proactiveness has to do with meeting demand, whereas competitive aggressiveness is about competing for demand. Hence, we argue that sensitivity to change both has a direct effect on the firm’s innovativeness, but that it also is a prerequisite for seeking the kind of information that enables the firm to meet customers future demands through external meeting places and by using IT.

In Fig. 2, which summarizes the above discussion, we argue that unilateral investment in IT may lead to a de-emphasizing of tacit knowledge, hindering the development of sustainable competitive advantages. If, on the other hand, tacit knowledge is emphasized, it will promote continuous improvements by learning by doing, using, experimenting, and interacting. However, although tacit knowledge is acting as an imitation guard, the negative feedback factor is only causing continuous improvements to increase performance to a certain degree. I.e. there is a need to introduce innovations into the system. To be able to do that, there is a need to link the system to its external knowledge base. The role of IT is to increase the availability and speed of external information. To give guidance, the information search needs to be accompanied by a sensitivity to change and there is a need for establishing external meeting places to capture the tacit part of the external knowledge. A central point which is implicit in the model, is a learning loop whereby innovations enhance a higher level of continuous improvements by learning by doing, using, experimenting, and interacting, creating a positive spiral. The learning loop also improves the
company’s sustainable competitive advantages, by limiting competitor’s possibilities for imitation (through a higher level of tacit knowledge), and by increasing continuous improvements, innovation and performance.

5. Conclusions

The aim of this paper was to investigate how investment in and the use of information technology influence tacit knowledge, and what impact this has on the firm’s ability to create sustainable competitive advantages. Although we observe a general optimism in the society as a whole, concerning the investment in, and use of information technology, we have argued that this may lead to a de-emphasizing of tacit knowledge. As tacit knowledge is recognized as playing a key role in determining the extent to which companies are able to create sustainable competitive advantages, the consequences may be devastating.

It may appear that research has developed a subspecies of Veblen’s “trained incapacity”, where tacit knowledge has been overlooked, toned down or completely removed from the scientific context, and where explicit knowledge has been in focus. Our main point in this article is that the
lack of empirical findings regarding the positive economic impact of IT can be attributed to a toned-down role of tacit knowledge. We find support for the argument with Sweeney (1996), and with Dertouzos, Lester, and Solow (1989) in their explanations on the declining competitive position of American companies during the 1980s. Their explanation is, roughly speaking, that research has moved upstream away from practice, that IT does not function adequately as a mechanism for creating sustainable competitive advantages. The result is the mismanagement of knowledge. To overcome the puzzle of the mismanagement of knowledge, companies need to develop knowledge strategies. In succeeding with such effort we argue for the need to focus on the total knowledge base of the company, focus on innovation processes and continuous improvement processes, focus on organizational learning and organize in apprenticeship terms. This is presented in Fig. 3 below.

5.1. Emphasize the total knowledge base of the company

A company’s knowledge base is both explicit and tacit, and exists both internally in the firm and within the company’s external connectivity. Nonaka (1994) argued that organizational knowledge is created through a continuous dialogue between tacit and explicit knowledge. We have argued that over-emphasizing on explicit knowledge, especially by IT investments, may lead to a situation were companies lose their competitive edge. On the other hand, over-emphasizing tacit
knowledge may lead to the same result, as tacit knowledge on its own does not e.g. enhance innovation. Neither does it provide the necessary speed and availability of external information. Hence, in order to achieve sustainable competitive advantage, companies need to emphasize the total knowledge base of the company, i.e. the explicit-and tacit knowledge, both internally and externally.

5.2. Focus on innovation and continuous improvement processes

Innovation is a critical activity that is vitally important for most firms to embrace in order to maintain sustainable competitive advantages (e.g. Drucker, 1985). This entails the pursuit of new knowledge. To achieve this, firms need to focus on innovation processes within the company, so as to benefit from the creative potential inherent in the company’s employees. Emphasizing the total knowledge base promotes this. Although innovation is critical, organizations also need to ensure a productive exploitation of existing knowledge (see e.g. Levinthal & March, 1993). Hence, to maintain a competitive edge, firms need both a sense of stability and continuity, at the same time, as there is a potential in continuous improvement of existing products and services within firms. Tacit knowledge plays a crucial part in the successful process of continuous improvements. An emphasis on the total knowledge base promotes this.

5.3. Focus on organizational learning

In a Schumpeterian world of innovation-based competition, with increasing hyper-competition (D’aveni, 1994), knowledge will increasingly be focused on companies ability to learn. However, such focus must entail an emphasis on both innovations and continuous improvements as “exploration and exploitation are complementary modes of organizational learning” (Choo, 1998, p. 251). We have argued for the existence of a learning loop between innovations and continuous improvements. Hence, successful innovation processes and continuous improvement processes presuppose systems for organizational learning.

5.4. Organize in apprenticeship teams

One of the great challenges we confront is making tacit knowledge at the individual level explicit at the organizational level. We have argued that tacit knowledge can be made explicit at the organizational level by organizing the company in teams based on apprenticeship where practical experience based on thrust and a helping attitude predominates. This is also consistent with the OECD report (1990) which points out very strongly that a fully efficient use of IT presupposes a change from the tayloristic production model, so widely recognized in the early stages of industrialization, to a more knowledge-based production model. In a turbulent and complex business environment, team member’s external connectivity is vital. Hence, such organizing reinforces an emphasis on the total knowledge base, the tacit, the explicit, the internal and the external.
Acknowledgements

The authors want to thank The Research Council of Norway for financial support (SKIKT-programme). Leif Mardal and Arnulf Hauan have been the discussion partners on selected issues within this paper and we want to thank them for their theoretical and philosophical comments.

References


