Knowledge Management and the limits of knowledge codification

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Abstract

Purpose

The idea that knowledge needs to be codified is central to many claims that knowledge can be managed. However there appears to be no empirical studies in the Knowledge Management context which examine the process of knowledge codification. This paper therefore explores codification as a Knowledge Management process.

Methodology/ Approach

The paper draws upon findings from research conducted around a Knowledge Management project in a section of the UK Post Office, using a methodology of participant-observation. Data were collected through observations of project meetings, correspondence between project participants, and individual interviews.

Findings

The principle findings about the nature of knowledge codification are first, that the process of knowledge codification also involves the process of defining the codes needed to codify knowledge, and second, that people who participate in the construction of these codes are able to interpret and use the codes more similarly. From this we can see that the ability of people to decodify codes similarly places restrictions on the transferability of knowledge between them.

Research implications

The paper therefore argues that a new conceptual approach is needed for the role of knowledge codification in Knowledge Management which emphasises the importance of knowledge decodification. Such an approach would start with our ability to decodify rather than codify knowledge as a prerequisite for Knowledge Management.

Originality/ value of paper

The paper provides us with a conceptual basis for explaining limitations to the management and transferability of knowledge.

1.   Introduction

The idea that knowledge needs to be codified is central to many claims that knowledge can be managed. In the mainstream Knowledge Management literature, commentators such as Ruggles (1997) and Davenport and Prusak (1998) view codification as the primary vehicle by which knowledge becomes 'portable,' 're-usable' or 'transferable' within the organisation. Indeed, the idea that knowledge needs to be moved around or 'transferred' within organisations is a fundamental precept of Knowledge Management. However, such literature says little about the actual process of codification, and appears to gloss over the many complex issues that the concept of codification raises: Codification as a process (cf. Saviotti, 1998) is ignored in preference for discussing the management of codified knowledge as information (e.g. Zack, 1999) and the process of codifying knowledge is discussed as unproblematic in the organisational context (e.g. Zander and Kogut, 1995; Cohendet and Steinmuller, 2000; Cowan et

al, 2000). More recently it has been suggested that the preoccupation with codification arises from an over-simplistic view of knowledge, particularly the relationship between tacit and explicit knowledge (e.g. Connell et al, 2003; Styhre, 2003; Tell, 2004). Styhre (2003) argues that such a 'reductionist' view necessarily results in organisations neglecting the dynamic and complex practices of knowledge in favour of less valuable information. Nevertheless, a fundamental aspect of how we communicate our knowledge depends upon information flowing between people, and as such, the role and nature of codification within this process remains an important topic for research in organisations.

This paper draws upon empirical research into processes of knowledge codification in a Knowledge Management context conducted in a single case-study organisation, the UK Post Office. The research was conducted using a methodology of participant-observation around a Knowledge Management project initiated to transfer knowledge through the medium of codified text 'captured' in an interview situation. This project involved mobilising intermediaries to broker this process, acting as interviewees tasked with eliciting specialist knowledge from an identified group. Observing the nature of interaction among those participants has generated some interesting findings about the nature of the knowledge codification process.

This paper builds upon these empirical findings to propose that a new conceptual approach is needed for the role of knowledge codification in Knowledge Management, leading to a more integrated approach to practice. Critical to this approach is understanding how to generate the closest possible coalescence between the codification **and** decodification processes. It is argued

that knowledge codification and decodification should be treated as dependent processes in order to effect the transfer of knowledge, but that this coalescence has inherent limitations.

The paper first presents a review of existing literature on knowledge codification in a Knowledge Management context. In section 3 the paper presents key empirical findings about the nature of knowledge codification in a KM context, drawing upon evidence from the research in the UK Post Office. In Section 4, the paper then draws upon these findings to propose that a new conceptual approach is needed for the role of codification in Knowledge Management, which indicates the importance of generating the closest possible coalescence between knowledge codification and *decodification* processes. This has implications for practice which are brought out in the concluding section.

2. Knowledge Management and knowledge codification

As is now widely recognised, the term knowledge management – or KM – has emerged as the label many people use to characterise this broad and eclectic field. In this paper, the term Knowledge Management (note the capital letters) is adopted as a generalised label for the field, and to convey the aspirations of many organisations in this context, while falling short of suggesting there is particularly hard evidence that knowledge – when sensibly conceived of as a human activity of knowing (Blackler, 1995) – can be managed by organisations at all.

There are similar difficulties in the use of language to convey the sense of 'movement' of knowledge which much popular KM literature recommends. For example Davenport and Prusak recommend the importance of knowledge 'transfer', Ruggles (1997) talks about knowledge 're-

use', while Probst et al (2000) use the term 'distributing' knowledge. In a way none of these terms is satisfactory, as they imply that a principal KM activity of organisations is to package up knowledge as information in order to move it from A to B. The use of such terms leads us away from viewing knowledge as how we, as individuals, know and learn in an organisational context and how our knowledge interacts with other people's knowledge. Under such a view, movement of knowledge might be more sensibly conceived of as the movement of *people*. Thus Skyrme (1999), who takes a practical view of knowledge as capable of being managed at an individual level, carefully avoids any implications arising from terms such as 'transfer' and 'distribution', and sticks with knowledge 'share' as a more satisfactory term for conveying such movement of knowledge towards the organisation's advantage.

A number of commentators (for example, Roos and Von Krogh, 1996; Sveiby, 1996; Quintas et al, 1997; Alvesson and Karreman, 2001; Swan and Scarborough, 2001) have noted this apparent dichotomy in how people talk about knowledge and its management: One approach treats knowledge – or more significantly 'knowing' – as a human process which occurs between people in social networks, characterised by Swan et al. (1999) as the 'community' perspective. Another perspective treats knowledge as a reifiable object, capable of being packaged up, owned and passed around, characterised as the 'cognitive' (Swan et al., 1999) or 'cognitivist' (von Krogh, 1998) perspective, or as the 'epistemology of possession' (Cook and Brown, 1999). Thus Hansen et al. (1999) argue that practical approaches to Knowledge Management tend to broadly focus on either the relationships between people, or on the relationships between people and information, which Hansen et al characterise as 'personalization' and 'codification' strategies.

This discussion does not intend to imply that these views of knowledge are incommensurable, nor that it is necessary to come down on one view of knowledge or the other. Whether an approach to KM within an organisation focuses predominantly on facilitating relationships between people, or relationships between people and information, is a false dichotomy if the intention is to effect the movement of knowledge: Work in an organisational context inevitably involves the flow of knowledge between people, often necessitating the use of information. Of course it is possible that knowledge can be acquired without codification, for example, as in the assimilation of cultural norms and routines in an organisation (Blackler, 1995), or as in the master-apprentice approach to the learning of craft skills (Nonaka and Takeuchi, 1995). However, this paper examines an organisation's attempts to effect the movement of knowledge through codification, and as will be shown in the discussion of the empirical research, the approach was very much predicated on the codification of knowledge as the principal vehicle for bringing this about.

Nevertheless, we are still left in a quandary over how to talk about this sense of knowledge movement which organisations are attempting to generate in a KM context. On balance the term transfer is adopted in this paper because it most closely encompasses what many organisations, including the organisation in which this empirical research was conducted, are attempting to do about Knowledge Management – i.e. that the knowledge of people gained in one context within the organisation may be usefully transferred to people in another context. It is not intended to imply, by adopting the term, that the concept of knowledge transfer is unproblematic. Nevertheless the assumption of knowledge transfer provides a useful platform upon which to examine the concept of knowledge codification.

Knowledge codification

As maintained in the introduction to this paper, codification of knowledge into information is seen as the predominant mechanism by which knowledge transfer in organisations can be achieved. In the KM literature presented above, Davenport and Prusak (1998) and Ruggles (1997) place particular emphasis on knowledge codification as a way of effecting the transfer of knowledge. While there has been much interesting discussion in the literature about the transferability of 'tacit' knowledge through processes such as 'socialisation' (Nonaka and Takeuchi, 1995), in practice many of the recommended approaches and solutions to KM problems are predicated on the need to codify knowledge into information. According to Blackler (1995), among Western managers codified knowledge enjoys a 'privileged status.'

However, as suggested in the opening paragraph to this paper, the complexities of knowledge codification as a concept – and particularly as a process – are not well understood in the KM literature. There is therefore a need to explore and understand better the process of knowledge codification as a vehicle for effecting the transfer of knowledge. The field of semiotics (see Chandler, 2002) – which is concerned with the social construction of signs and their meanings and how signs are combined into codes – points to the social dimensions to codification. Indeed, when we consider the behavioural nature of codes – e.g. a moral code or code of conduct – and the way codes are used as a platform for communication, we can quickly see that people's ability to interpret and act upon codes similarly in one sense defines them in a social relationship. For example, communities are linked by common languages, perhaps dialects, or professions may be delimited by codes of practice, such as the medical profession's Hippocratic oath.

When applying the term codification to knowledge, however, KM commentators such as Davenport and Prusak (1998) and Ruggles (1997) appear to gloss over the social dimensions to knowledge codification which follow from the generation, use and interpretation of the codes needed to communicate knowledge. Moreover, the literature on communities of practice suggests that similar knowledge bases and "shared histories of learning" (Wenger, 1998) link practitioners in informal relationships which, according to Wenger and Snyder (2000), are an "ideal forum for sharing and spreading best practices across a company." However, this literature does not offer many insights into the processes by which members of such communities are able to communicate their knowledge on a common platform. It is argued that knowledge codification is a fundamental part of this process.

Of course it is necessary to have a working definition of knowledge codification, and for this purpose, Cowan and Foray (1997) is a helpful start. They define knowledge codification as "the process of conversion of knowledge into messages which can then be processed as information." Literature on knowledge codification in the KM context largely concurs with this definition, and appears to coalesce around two aspects of such an information creating process:

- **Codification of previously 'tacit' knowledge**

  This is what Nonaka and Takeuchi (1995) are talking about in their distinction of a movement between tacit and explicit forms of knowledge. Codification of knowledge in this sense may well involve the use of language to articulate, describe, explain etc. While there is considerable debate over whether Polanyi's concept of tacit knowing effectively defies

codification (e.g. Cook and Brown, 1999), codification can simply be taken as a process by which knowledge is made explicit, whether it be 'tacit' knowledge or not. This can perhaps be seen as a primary level of codification – not necessarily for the first time, but primary in the sense that the codification emerges from the person who has the knowledge.

- **Codification of information**

  In this case we are referring to knowledge which has already been codified into information. In this context Sorensen and Lundh-Snis (2001) view codification as a process of classification, while Baumard (1999) talks about the codification of research data. This can be seen as a 'secondary' level of codification, where the codification is of knowledge which has already been codified as information (we can still call this information codified 'knowledge' from the perspective of the person responsible for its primary codification, even though it is 'information' from someone else's perspective).

However, the empirical research will show that codification involves more than simply the codification of knowledge into information. The process of codification – as noted by Chandler (2002) in the field of semiotics – also involves defining the codes themselves. This is clearly a neglected aspect of the KM literature previously cited. Cowan et al (2000) have noted how 'codebooks' emerge in the early stages of knowledge codification, but do not define this as an aspect of the codification process *per se*. The research found that attempting to transfer knowledge through the codification of information necessitated the emergence and definition of codes, even though the participants themselves were unaware of the importance of this part in the process. This finding has a clear implication for the transferability of knowledge to individuals

and groups who do not know how to interpret – or decodify – the code. In a process of knowledge transfer, decodification is not simply one of understanding words at face value, but also requires a recipient to possess or acquire context-dependent knowledge necessary both to decodify the codes themselves, and the knowledge codified using them.

3.   Findings from the empirical research

The empirical research was conducted within an internal consultancy division of the UK Post Office Group, known as Post Office Consulting, over an 18 month period between 1999 and 2000. Using a methodology of participant-observation within the Knowledge Management group, the research was able to gain detailed insight into the organisation's efforts to formulate an approach to Knowledge Management within its broader aspiration to become a 'knowledge organisation.' In the words of the CEO at the time, "we are no longer managers in Royal Mail delivering letters, we are knowledge workers in a consultancy delivering knowledge."

In 1998 Post Office Consulting set about developing and adopting a range of tools, techniques and processes to further this vision of knowledge work within a new organisation. Examples of the tools adapted and developed internally by Post Office Consulting were the After Action Review technique, a CV/Skills database, and a technique for capturing tacit knowledge [sic] called the 'Knowledge Interview.' Under the aegis of a 'Knowledge Programme', a 'Knowledge Cycle' was developed which defined Post Office Consulting's KM process as the continuous need to 'capture, deploy, use, and review' knowledge.

In 1999, Post Office Consulting's new Knowledge Director, keen to put these tools and techniques into practice and see how they would stand up to live use, funded a Knowledge Management project. This project – called the Argentina Knowledge Capture Project, or AKAP for short – sought to capture knowledge from Post Office consultants who had been working on a consultancy project for the Argentinean Post Office following its privatisation. It was felt that some of this knowledge gained in Argentina could be of benefit to people elsewhere in the Post Office. For this reason a 9 month project was funded, and a team of 6 people, mostly from Post Office Consulting's Knowledge Management group, was formed to carry it out.

The principal tool for knowledge capture used was the Knowledge Interview technique. This involved a trained Knowledge Interviewer eliciting the knowledge of the Argentina consultant in a recorded interview, the generation of an interview transcript by a trained typist, and finally the writing of one or more 'case-studies' by the Interviewer around certain aspects of the interview. The outputs from these interviews (in total 16 were conducted) were 'analysed' by the project team in order to extract the 'key learning from the Argentina experience', and from this analysis, a number of project reports were produced.

There had been an intention at the outset of the project to start by focusing on the information needs of specific users. However, the approach quickly turned first to capture the knowledge of consultants who had been working in Argentina, then to work out where their knowledge may be of use. Due to a number of complex factors, the AKAP project's ambitious plans to host knowledge share workshops – where the results from the knowledge capture process would be targeted towards key end-users – ultimately did not happen. Eventually, 'deployment' of

knowledge from the project meant placing the documents on a Lotus Notes-based electronic database, which due to fears of confidentiality and sensitivity of some of the material captured from the consultants, was closed off from general use.

Clearly the use of knowledge codification played a predominant role in how Post Office Consulting conceived of its Knowledge Management activity. From this case, key findings emerged about the nature of knowledge codification:

- *Knowledge codification is also the process of defining codes*
  Through the different stages of the AKAP project, similar codes were emerging in the interaction among participants, enabling them to share knowledge about what they were doing. For example, important terminology emerged around participants' understanding of what constituted the 'technical' or 'generic' knowledge of Argentina consultants, and the project reports were constructed using these codes which the project team had developed to make sense of the process. Similarly, the codification of Post Office Consulting's Knowledge Cycle emerged with the codes 'capture-deploy-use-review' to convey what its codifiers understood by the 'cycle'.

- *People with similar knowledge and experience are able to use and interpret the codes more similarly*
  In the Post Office Consulting case, intermediaries tasked with transferring knowledge in many cases did not have sufficient existing knowledge to engage effectively in the process. There were deficiencies in their familiarity with the Argentina Consultancy

Project, meaning they had to spend considerable time becoming familiar with the details of the project before the knowledge capture process made much sense to them. There were also deficiencies in some participants' knowledge of postal operations, which was much harder to acquire for those who were relatively new to the organisation. Thus participants who had greater existing knowledge of postal operations proved more effective in their ability to use and interpret the codes required to transfer knowledge. As Cowan and Foray (1997) point out, "knowledge is easier to codify and codified knowledge is easier to diffuse within a community of agents who can read the codes."

However, to outsiders, the codes may not be so clearly codified. In other words, while they may understand the words at face-value, this may not be sufficient for them to interpret the codes and act upon them similarly to people who do share similar knowledge. This was seen in the codification of the Knowledge Interview as a knowledge capture tool, where the Knowledge Interview process was applied very differently by people outside the tool's original codifying group: Outside this group, Knowledge Interviewers did not share the common knowledge and experience to enable them to interpret use of the tool similarly.

- *When attempting to broker the transfer of knowledge, unexpectedly the knowledge of intermediaries was codified in the process*
The AKAP approach involved the use of intermediaries to broker the transfer of knowledge from the Argentina Consultants to other possibly interested parties elsewhere in the organisation. In creating information sources for transfer to other people, it was not

anticipated that the knowledge of the intermediaries themselves would become codified in the process. Thus the 'case-studies' distilled from the Knowledge Interviews, or the AKAP Learning Summary Report, both partially represented the knowledge of the Argentina Consultants, and partially represented the interpretation of their knowledge made by the intermediary participants. This leads us to question whether knowledge can be transferred by the use of intermediaries, as the intervention of an intermediary's own knowledge inevitably changes the process in some way.

- *The process of codifying knowledge into information was obstructed by intermediaries' ignorance of the end-user*

  Throughout the AKAP project, much of the process was occurring with no sense of an end-use context, or who the knowledge was being codified for. There was simply an underlying assumption that if knowledge is codified, then the information created might be useful in the future. This made the codification process difficult, particularly in the cases of the Knowledge Interviews. It is difficult to codify knowledge when there is no sense of the end-use context or knowledge of how the information might be decodified. Conversely there were cases of knowledge codification where the process was guided by a better sense of an end-use context, for example the final project reports to the client. In these cases, the codifiers had a better sense of the information needed from the process, and who they were writing for.

The paper will now build upon these findings to propose that a new conceptual approach is needed for the role of codification in Knowledge Management, which accounts for the

importance of the *decodification* process. This has implications for practice which are brought out in the concluding section.

4.   Towards a new conceptual approach to knowledge codification in KM

Of fundamental importance to the shape of the KM approach in the Post Office was the use and influence of intermediaries. These intermediaries were not bringing the sources of knowledge and the end-users together, but instead were taking on the role of codifier and decodifier themselves. In their ignorance of the end-user, these intermediaries unconsciously assumed the default position by taking on the role of what we might call a proxy-user. This was clear in how they focused in on what they understood, what they found interesting, and what they needed to know in order to make sense of what they were being told. The approach of using intermediaries to capture knowledge to 'deploy' to a third party clearly is going to necessitate the codification of information, but without having codified the knowledge for a third party, the usefulness of the information created is bound to be limited outside the context of the project. Thinking about this more conceptually, the codes developed to codify the knowledge, and the way the knowledge is codified, will have limited meaning outside the codifying group.

The Post Office Consulting approach only considered the codification side of knowledge transfer, and did not consider how an end-user might decodify the information created. The approach involved codifying knowledge to move around as information, but was not concerned with how a recipient would translate this information into knowledge and action. This missing

element is important to understand if we are serious about the potential for knowledge transfer through codification.

A number of commentators (for example, Sveiby, 1996; Baumard, 1999) have critiqued the appropriateness of such a 'sender-receiver' model in the formulation of approaches to Knowledge Management activity, which only focuses on the message which is transmitted from the sender and not on the sense made of the information by the receiver:

> "Information is but a medium to initiate and formalize knowledge. Most theories of information direct all their attention to the manner in which it is transported, distributed or exchanged, while it remains necessary to develop a theory that looks more closely at the *sense* of the information and the *messages* that convey information in organizations." (Baumard, 1999, p.20).

This paper agrees that there is a need, but does not go so far as to develop such a theory. The advantage of the Knowledge Management discourse is that it should bring attention to the human processes of knowing and thereby to the question of how meanings and understandings are constructed when humans communicate their knowledge. However this clearly did not happen in the Post Office Consulting approach to Knowledge Management.

It is important therefore, that people, as individual and unique knowers, are at the centre of any approach to Knowledge Management. Focusing predominantly on the creation of information and how that information gets moved around does not get close enough to understanding how the information contributes to someone else's knowledge and work. There seems little point codifying knowledge for the purpose of transferring it elsewhere in the organisation without

someone else able to decodify it. And without knowing who that someone is, it is difficult to know how to codify the knowledge to begin with.

The importance of decodification

There is therefore a need to bring attention to the importance of 'decodification' within the Knowledge Management discourse: When attempting to transfer knowledge through codification, there can be no knowledge transfer without decodification. It is argued that codification and decodification need to be thought of as inter-dependent processes.

However the argument goes deeper than this: An assumption of decodification is inherent and implicit in the act of codifying knowledge. Usually when codifying knowledge we have a decodifier or a decodification context in mind. If we wish someone else to be able to decodify our knowledge, then we need to codify it in a language and using terms which they are likely to understand. Theoretically the closest possible coalescence between both the codification and decodification of knowledge is likely to occur when the codifier and decodifier are the same person.

Where there is no such sense of who is going to use the information and how they might decodify it – as in the AKAP case – this makes the process of codification much more problematic. If the participants in AKAP had known for whom they were codifying the knowledge and what the end-use context of decodification might be, then they might have known how to manage the codification process. However, this could only have been a response to the symptom of a fundamentally flawed approach. Starting from the perspective of

decodification – rather than what knowledge can be codified – would bring the focus of attention around to how people incorporate other people's knowledge into their own knowledge and work.

The decodification of codes

It is clearly necessary to maximise the coalescence between codification and decodification for knowledge transfer to occur. As we have seen within the interaction of AKAP participants, this occurred through the emergence of codes which had specialist meaning within the group. However, even to some within the group, the codes had limited meaning because they lacked the underlying knowledge and experience of postal operations. While Quintas (2002) explores the divisions of knowledge that create communication barriers between specialisms, this paper looks at how codes – and the ability to interpret or decodify them similarly – both enables and inherently limits the communication of knowledge within and between groups. However the meaningful interpretation of codified knowledge is not just a case of understanding what the words mean, it also requires sharing the underlying knowledge necessary to interpret the use of codes similarly.

5. Conclusions: Implications for KM practice

So if we are serious about Knowledge Management, and wish to effect the transfer of knowledge in organisations, what are the practical implications of an approach which accounts for the importance of both codification and decodification as inter-dependent processes?

First, the approach would steer clear of Ruggles' (1997) advice to treat knowledge codification as "the capture and representation of knowledge so that it can be re-used either by an individual or an organization" and Davenport and Prusak's (1998) exhortations to codify knowledge to enable its 'portability' and 'distribution.' As this paper has argued, there is limited value in simply codifying knowledge in the hope that someone, someday, might find the information useful. Starting the process with what knowledge can be captured inevitably brings primary attention to what knowledge people have, rather than what knowledge people *need*. It is suggested that a database of information sources – codified in the hope that one day someone might look through and find something useful – does not really play a big part in how people seek information and benefit from other people's knowledge in practice. There needs to be more research to understand how people actually seek information and make sense and use of it in the context of their working lives.

The approach would therefore start from the perspective of the individual knower – how are people able to decodify knowledge and make sense of knowledge communicated to them through codification by other people, and how are they able to incorporate that meaningfully into how they do their work? This is arguably where the real added-value lies in knowledge transfer in the organisational context. Understanding why the knowledge is needed and how it might be used should inform how the knowledge is codified. Understanding the role of decodification plays a key part in formulating the approach.

In general, individuals are best placed to determine how they want to receive information. In the AKAP approach, the type of knowledge transfer which the project was attempting to effect

would have been best approached by mobilising direct relationships between people. In this way, people who could benefit from the consultant's knowledge about working in Argentina could ask questions directly. Alternatively, knowledge could have been presented in some form of master class. There is a big difference between speaking to someone and reading text. In the AKAP approach, the text represented answers to questions someone else wanted to ask. When speaking to someone directly, we can ask each other the questions we need to know. The text at best could be a route to finding someone useful to talk to, but how much text is it worth wading through to find this out? The ability to ask questions directly is an important process in decodifying knowledge. Intermediaries in any Knowledge Management approach should therefore focus on mobilising relationships between people who could benefit from sharing knowledge – for example, by setting up meetings or master classes – rather than actually intervening in the creation of information themselves.

In conclusion, this exploration of knowledge codification – particularly the emergence and use of codes and the ability to decodify them – provides a theoretical basis for explaining what it is which both enables and limits the communication of knowledge. Although the research upon which these conclusions are reached was conducted in a single case-study organisation, the AKAP example is typical of much Knowledge Management practice which seeks to codify knowledge into information as a way of effecting knowledge transfer. Close observation and participation in this representative case-study has enabled an in-depth examination of the nature of knowledge codification as a process, which has significantly wider practical implications for the formulation of approaches to Knowledge Management and the role of information in knowledge transfer.

6.   References

Alvesson, M., & Karreman, D. (2001). "Odd couple: Making sense of the curious concept of knowledge management." *Journal of Management Studies*, 38(7), pp. 995-1018.

Baumard, P. (1999). *Tacit knowledge in organizations*. London: Sage.

Blackler, F. (1995). "Knowledge, knowledge work and organizations: An overview and interpretation." *Organization Studies*, 16(6), pp. 1021-1046.

Chandler, D. (2002). *Semiotics: The basics*. London: Routledge.

Cohendet, P., & Steinmueller, W. E. (2000). "The codification of knowledge: A conceptual and empirical exploration." *Industrial and Corporate Change*, 9(2), pp. 195-209.

Connell, N. A. D., Klein, J. H., and Powell, P. L. (2003). "It's tacit knowledge but not as we know it: Redirecting the search for knowledge." *Journal of the Operational Research Society*, 54, pp. 140-152.

Cook, S. D. N., & Brown, J. S. (1999). "Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing." *Organization Science*, 10(4), pp. 381-400.

Cowan, R., David, P. A., & Foray, D. (2000). "The explicit economics of knowledge codification and tacitness." *Industrial and Corporate Change*, 9(2), pp. 211-253.

Cowan, R., & Foray, D. (1997). "The economics of codification and the diffusion of knowledge." *Industrial and Corporate Change*, 6(3), pp. 595-622.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know.* Boston, Mass: Harvard Business School Press.

Hansen, M. T., Nohria, N., & Tierney, T. (1999). "What's your strategy for managing knowledge?" *Harvard Business Review*, March-April, pp. 106-116.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford: Oxford University Press.

Probst, G., Raub, S., & Romhardt, K. (2002). *Managing knowledge: Building blocks for success*. Chichester: Wiley.

Quintas, P. (2002). "Implications of the division of knowledge for innovation in networks." In: J. de la Mothe and A. N. Link (eds.) *Networks, alliances and partnerships in the innovation process.* Boston: Klewer Academic Publishers, pp.135-163.

Quintas, P., Lefrere, P., & Jones, G. (1997). "Knowledge management: A strategic agenda." *Long Range Planning,* 30(3), pp. 385-391.

Roos, J., & Von Krogh, G. (1996). "The epistemological challenge: Managing knowledge and intellectual capital." *European Management Journal*, 14(4), pp. 333-337.

Ruggles, R. L. (1997). "Tools for knowledge management: An introduction." In: R. Ruggles (ed.), *Knowledge management tools*. Boston: Butterworth-Heinemann, pp. 1-8.

Saviotti, P. P. (1998). "On the dynamics of appropriability, of tacit and of codified knowledge." *Research Policy*, 26, pp. 843-856.

Skyrme, D. (1999). *Knowledge networking: Creating the collaborative enterprise*. Oxford: Butterworth-Heinemann.

Sorensen, C., & Lundh-Snis, U. (2001). "Innovation through knowledge codification." *Journal of Information Technology*, 16, pp. 83-97.

Styhre, A. (2003). "Knowledge management beyond codification: Knowing as practice/ concept." *Journal of Knowledge Management*, 7(5), pp. 32-40.

Sveiby, K.-E. (1996). "Transfer of knowledge and the information processing professions." *European Management Journal*, 14(4), pp. 379-388.

Swan, J., Newell, S., Scarborough, H., & Hislop, D. (1999). "Knowledge management and innovation: Networks and networking." *Journal of Knowledge Management*, 3, pp. 262-275.

Swan, J., & Scarborough, H. (2001). "Editorial." *Journal of Information Technology*, 16, pp. 49-55.

Tell, F. (2004). "What do organizations know? Dynamics of justification contexts in R&D activities." *Organization*, 11(4), pp. 443-471.

Von Krogh, G. (1998). "Care in knowledge creation." *California Management Review*, 40(3), pp. 133-153.

Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.

Wenger, E. C., & Snyder, W. M. (2000). "Communities of practice: The organizational frontier." *Harvard Business Review*, January-February, pp. 139-145.

Zack, M. H. (1999). "Managing codified knowledge." *Sloan Management Review*, 40(4), pp. 45-58.

Zander, U., & Kogut, B. (1995). "Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test." *Organization Science*, 6(1), pp. 76-92.