The firm as an epistemic community:
The knowledge based view revisited

Lars Håkanson
Department of International Economics and Management
Copenhagen Business School
Porcelain Garden/Pocelænshaven 24, DK-2000 Frederiksberg, Denmark.
lh.int@cbs.dk

Abstract
Based on a social-constructivist conceptualization of knowledge as residing in groups of practitioners, *epistemic communities*, this paper proposes a new perspective on the knowledge based view of the firm and sketches the outline of a new research agenda. It argues that the cost of governing knowledge processes depends as much on the cognitive background of the exchange partners as on the tacitness of the knowledge. Firms exist because they may form epistemic communities in their own right with enabling and motivational properties superior to those of markets in the governance of knowledge processes across epistemic boundaries. Establishing a firm as an epistemic community requires transaction specific investments that are difficult to realize under market forms of governance.

1. Introduction

One of the fundamental aspects of the evolutionary perspective in economic theory (Nelson and Winter, 1982) was the conceptualization of business firms as "organizations that know how to do things" (Winter, 1987). Inspired by evolutionary theory, 'knowledge' and ´capabilities' became central elements in the advancement of the so-called knowledge- or competence-based theory of the firm. Seen variously as an alternative or a complement to the dominating transaction-cost approach, this line of research was premised on the conviction that the possession and accumulation of 'knowledge', 'competences' and 'capabilities' are fundamental characteristics of firms, and should therefore have significant roles in theory addressing the rationale for their existence, the determinants of their boundaries and their internal organization.

This emphasis on firms' internal operations could be traced to Edith Penrose's (1959) seminal work and was in contrast to the neo-classical conceptualization of the firm as a production function – a 'black box' transforming inputs to outputs (Pitelis and Wahl, 1998). In Penrose's tradition, but unlike Oliver Williamson (1975, 1985) and transaction cost economics, most versions of knowledge-based theory focused on the costs of operations rather than those of exchange (Pitelis, 2004). Hierarchical organization was seen not as a means to align incentives and reduce opportunism; its primary role was to facilitate knowledge sharing and knowledge creation through the on-going proximity of interacting and interdependent human resources:

> When men have become used to working in a particular firm or with a particular group of other men in a firm, they become individually and as a group more valuable to the firm because the range of services they can render is enhanced by their knowledge of their fellow workers, or the methods of the firm, of the best way of doing things in the particular set of circumstances in which they are working. (Penrose, 1959, p. 52)

The idea that firms offer conditions conducive to efficient knowledge governance gained widespread acceptance and gave rise to a rich empirical and theoretical literature. Since Penrose, a main line of argument was that much of the knowledge in firms is experience-based, tacit, socially complex and therefore difficult to transfer or apply to outside settings (Buckley and Casson, 1976; Penrose, 1959; Kogut and Zander, 1992, 1993, 1996). According to 'knowledge based' theory, firms exist because they provide means to manage knowledge-intensive processes more efficiently than is possible through market transactions (Conner, 1991; Conner and Prahalad, 1996; Foss 1996; Grant, 1996a, 1996b; Nahapiet and Ghoshal, 1998; Nickerson and Zenger, 2004, Kogut and Zander, 1992, 1993, 1996; Madhok, 1996). The contributors to this approach – sometimes bridging earlier insights from transaction cost theory (Coase, 1937, Williamson, 1975, 1985) – considerably enriched our understanding of the significance of knowledge processes, especially as regards the rationale for the existence of firms and the determinants of their boundaries.

However, in spite of many commonalities and reasonably narrow aims, the knowledge based theory of the firm remained a rather diverse literature (Kaplan, Schenkel, von Krogh and Weber, 2001). Some contributions emphasized the efficiency of firms in the *exploitation of existing knowledge* (Kogut and Zander, 1993; Winter and Szulanski, 2001); others viewed their superiority in the *creation of new knowledge* (Nahapiet and Ghoshal, 1998; Kogut and Zander, 1992). In some accounts, firms were argued to be superior vehicles for the transfer of knowledge *within* functional or occupational groups whose members have the same training and professional experience (Kogut and Zander, 1992); others emphasized their role in facilitating integration of specialist knowledge *across* different such groups, where lack of common expertise makes knowledge-sharing difficult (Grant, 1996a, 1996b).

Moreover, there was little agreement as to the definitions of central concepts, such as 'knowledge', 'competences' and 'capabilities' and ambiguity also as to the relevant level of analysis (Felin and Foss, 2005; Felin and Hesterly, 2007). For some scholars, knowledge was seen to reside in individuals (Felin and Foss, 2005; Grant, 1966a), but most contributions took a more collectivist perspective, emphasizing – following Nelson and Winter (1982) – the role of firm-level, social knowledge (Kogut and Zander, 1992; Nahapiet and Ghoshal, 1998; Spender, 1966a). The conceptualizations employed were often highly abstract ones, typically assuming that knowledge can be meaningfully discussed without reference to its content and context. Many contributions assumed that different 'types' of knowledge have different governance implications, commonly emphasizing the distinction between 'tacit' and 'explicit' knowledge (Polanyi, 1962, 1966; Nonaka, 1994), but sometimes using more elaborate classifications (Ancori, Bureth and Cohendet, 2000; Boisot, 1995; Johnson, Lorenz and Lundvall, 2002; Sanchez, 1997; Spender, 1996b, 1998). The perspective typically took, at least implicitly, an essentially static view on knowledge, assuming that its basic characteristics, such as its degree of articulation, remain constant over time[1]. Focusing on *cognitive* and *stable* aspects of knowledge, this 'taxonomic' perspective (Tsoukas, 1996, p. 13) contrasted with a parallel stream of research in the sociology of knowledge, which emphasized the *practical* aspects of knowledge (Blackler, 1995; Brown and Duguid, 1991, 1998, 2001a, 2001b; Dougherty, 1992; Lave and Wenger, 1991; Orlikowski, 2002; Tsoukas, 1996; Wenger, 1998). Often adopting constructivist conceptualizations, 'knowing' was here seen as *processual* and *evolving*, inherently *provisional*, and *situated* (socially and technically).

Given this state of affairs, it is hardly surprising that the knowledge based view has been subject to much criticism. In the judgment of one recent review,

> … the knowledge-based theory of the firm seems more like a theoretical patchwork than a solid body of theoretical knowledge. In effect, empirical research is scant, and we should not expect a successful empirical project unless we are able to resolve some of the more fundamental controversies at the present time. (Kaplan *et al.*, 2001, p. 3)

At the core of the criticism have been two related issues. The first has concerned "…obscure and often tautological definitions of key terms; and failures of operationalization" (Williamson, 1999, p. 1093) which have been claimed to have hindered the empirical testing needed for the field to advance (Kaplan *et al.*, 2001, p. 9). The second has focused on the "micro-foundations" of the theory, i.e. the assumptions about the motivations and cognitive characteristics of individuals and the nature of the links between the individual and collective levels (Felin and Foss, 2005; Felin and Hesterly, 2007). "The problem", as Teppo Felin and Nicolai Foss (2005, p. 444) put it, "is that because routines and capabilities do not have an anchor in individual antecedents, they can be virtually anything at the organizational level."

Taking its lead from this criticism, this paper departs from the taxonomic, static, and abstract view of knowledge characteristic of inherited theory. It is premised on a social-constructivist and contextual conceptualization of knowledge as residing in groups of practitioners, *epistemic communities*, an idea first suggested by the German sociologist Burkart Holzner (1968). The objective is to explore the consequences of adopting Holzner's perspective on knowledge to the questions raised in the knowledge-based approach to the theory of the firm, to demonstrate how this helps resolve some of the fundamental ambiguities of the approach, and to explicate the contours of the research agenda this invites.

The argument proceeds as follows: The next two sections discuss the nature and implications of Holzner's constructivist conceptualization of knowledge and how it relates to the ones employed in earlier literature. In section 4, the concept of 'epistemic communities' is applied to the knowledge governance issues addressed in some well known contributions to the knowledge-based theory of the firm. It identifies four distinct types of knowledge processes, each with its own characteristics and strategic significance. The analysis suggests that firms are superior to markets primarily in the governance of knowledge processes requiring the integration, combination and reconciliation of knowledge across different epistemic communities. The implications of this are discussed in section 5, which argues that firms can meaningfully be seen as epistemic communities in their own right, established precisely because they can help overcome differences in their members' specialized expertise. Section 6 outlines the core elements of the new research agenda that the proposed perspective seems to invite, borrowing for the characterization a set of six 'key moves' originally proposed by Oliver Williamson (1999) in a paper critically 'benchmarking' 'the competence perspective' against the 'governance perspective'.[2] Section 7 offers a brief concluding summary.

2. Epistemic communities

2.1 Defining 'knowledge'

Most contributions to knowledge-based theory assumed a central characteristic of knowledge to be its degree of 'tacitness' – the extent to which it can be (or has been) articulated and codified. This practice can be traced to Sidney Winter's (1987) supposition that explicit knowledge is not only easier and less costly to deliberately pass on and replicate than is tacit knowledge, but it is also more susceptible to imitation. Conversely, he argued, tacit knowledge is more difficult both to transfer and to imitate than is explicit knowledge; it can only be passed on through costly face-to-face interaction. Being difficult to move or apply outside the group or context where it resides, tacit

knowledge was assumed to be 'sticky' and therefore a potential source of competitive advantage (Szulanski, 1996; von Hippel, 1994). As formulated by Spender and Grant (1996, p. 8), a basic proposition of this line of thinking was that "... [tacit] knowledge which is embodied in individual and organizational practices… cannot be readily articulated. Such knowledge is of critical strategic importance because, unlike explicit knowledge, it is both inimitable and appropriable." Taking the argument one step further, the 'knowledge based approach' to the theory of the firm argued that *the very existence of firms* is due to their ability to manage knowledge, especially in its tacit forms, more cheaply and efficiently than is possible under other forms of governance.

In contrast, the social-constructivist conceptualization adopted here suggests that obstacles to knowledge transfer arise not only from 'tacitness', but also – and often more importantly – from the fact that all knowledge is inherently context dependent and that knowledge that is recognized as relevant and useful in one context may be totally meaningless in another. The knowledge context is defined by the '*epistemic community*' where it resides (Holzner, 1968).[3] Epistemic communities consist of individuals with identical or similar 'frames of reference' and cognitive 'orientation systems'. These are associated with specific social roles, such as those of different occupational groups, and are acquired in a process of cognitive socialization, usually through a combination of formal training and on-the-job experience.

> Roles may… be viewed as frames of reference and theories in terms of which the role occupants deal with the situations which come in their way. … [S]ocial roles in their orientational function provide epistemologies, basic categorical schemes, preference systems and methodologies through which the role occupant organizes encountered experiences and provides explanations for them… The guard in a zoo, the administrator in a complex organiza-

tion, the plumber, all possess more or less specialized frames of reference and explanatory theories which presumably equip them to do their jobs. (Holzner, 1968, p. 65)

Holzner (1968, pp. 104 ff.) linked the formation and differentiation of epistemic communities to the historical evolution of 'exchange mechanisms' from "traditional ascriptive-reciprocal interactions within a village or group of villages" to the complex mixture of markets mechanisms and planning characteristic of the present day. This development, he argued, was associated with an increasing specialization of knowledge, as the importance of non-autonomous physical labor was replaced by work situations requiring increasingly specialized knowledge-based skills (Holzner, 1968, p.127).

The reality constructs accepted (believed to hold 'true') by an epistemic community reflect the specific epistemic criteria of validity and reliability that it subscribes to (Holzner, 1968, pp. 51-59; Holzner and Marx, 1979, pp. 103-106). The *empirical* tests and institutionalized methodological procedures employed in scientific communities are just one example. In communities defined through their preoccupation with a specific work practice, especially those relying to a great extent on tacit knowledge, the pre-dominant 'reality test' tends to be *pragmatic*, i.e. whether or not a particular procedure 'works'. Knowledge will be judged to be 'true' to the extent that its application results in desired results with a degree of accuracy deemed to be sufficient. These types of reality tests are often combined with *deductive* or *logical* verification of the symbolic and theoretical consistency of knowledge propositions. However, not all reality tests are rational. Sometimes, reality constructs are accepted because they emanate from or are approved by some accepted authority. *Authoritative* reality tests are common, for example, in religious organizations, political parties and bureaucratic structures.

The view of 'knowledge' implied by Holzner's analysis of epistemic communities and adopted in much subsequent research on the sociology of knowledge differs from Plato's classical definition of 'knowledge' as 'justified true belief'. As expressed by Holzner and John Marx (1979: 93) "…knowledge as the subject matter of sociological inquiry is simply what a group or society takes as knowledge." It is inherently provisional, context dependent and social (Berger and Luckmann, 1996/1991).

2.2 Delimiting epistemic communities

As employed in the subsequent literature, neither the concept 'epistemic community', nor the related, more widely accepted 'community of practice', introduced by Lave and Wenger (1991), are altogether unambiguous. There is ambiguity concerning (1) the explicit or implied significance of tacit knowledge in such groups – as opposed to knowledge expressed in symbolic form, (2) the relation of epistemic communities to knowledge creation, and (3) their degree of geographic local-ization. In consequence, there is ambiguity also (4) regarding the operational question as to how 'epistemic' communities can be distinguished both from one another and from other kinds of social groups. In order to found the discussion on conceptually firm ground, each of these issues will be discussed in turn.

2.2.1 The role of tacit knowledge

Holzner's 'epistemic communities' bear strong resemblances to the 'communities of practice' and related phenomena discussed in the more recent research in the sociology of knowledge (Brown and Duguid, 1991, 1998, 2001a, 2001b; Lave and Wenger, 1991; Wenger 1998).[4] Like epistemic communities, communities of practice consist of people engaged in a common enterprise and mas-tering a shared repertoire of skills, thereby developing a common understanding of what the com-

8

munity does, the means and methods it employs, the standards by which its activity is judged, and how it relates to other communities and their practices (Brown and Duguid, 1998; Lave and Wenger, 1991). However, in contrast to this vein of research which tended to emphasize the role of tacit knowledge (Delamont and Atkinson, 2001; Duguid, 2005), Holzner's (1968) original discussion focused almost entirely on explicit knowledge expressed in symbolic form. Only in passing did he recognize the significance of implicit knowledge and role-embedded and experience-based skill and judgment, acquired through situated apprentice-type learning in a process of 'cognitive socialization' (Holzner, 1968, pp. 28 ff.), a close parallel to the 'legitimate peripheral learning' referred to by Lave and Wenger (1991):

> Certain frames of reference, while always having the status of the context of inquiry and therefore not reflected on during its progress, are explicitly codified and articulated. Other frames of reference remain implicit and lack specific symbolic articulation. The modern professionals will tend to be able to discuss their frames of reference with much greater precision than traditional craftsmen can. (Holzner and Marx, 1979, p. 100)

Somewhat at odds with Holzner's original emphasis on explicit knowledge but in line with the sentiment expressed in this paragraph and with more recent contributions, I shall in the following assume that the knowledge shared in epistemic communities include both tacit elements and explicit cognitive schemata, ranging from simple rules of thumb to explicit scientific theory (Håkanson, 2007).

2.2.2 Knowledge creation

A further ambiguity concerns the relation of 'epistemic communities' to knowledge creation. Holzner and Marx (1979, p.108) provided the following definition:

The term *epistemic communities...* designates knowledge-oriented communities in which cultural standards and social arrangements interpenetrate around a primary commitment to epistemic criteria in knowledge production and application" (Holzner and Marx, 1979, p. 108, italics in the original).

This usage parallels Karin Knorr Cetina's later (1999) discussion of 'epistemic cultures' and that of some subsequent accounts, where the term 'epistemic communities' was used to denote communities with a primary commitment to deliberate knowledge creation (see e.g. Cowan, David and Foray (2000), Amin and Cohendet (2004) and Cohendet and Llerena (2003)). However, for the present purpose, I will assume that to varying degrees, all epistemic communities engage in learning and knowledge creation – both by deliberate intention and through accident. This is in line with Holzner's original formulation, where "knowledge orientated communities", such as scientific ones, were only one example of epistemic communities, others including "…religious communities, work communities, some ideological communities and the like (Holzner, 1968, p. 69)".

2.2.3 Geographic localization

The term 'community of practice' was usually taken to denote tightly knit work groups or functional departments, characterized by engagement in a common enterprise and mastery of a shared repertoire of skills (Brown and Duguid, 1998; Orr, 1996; Wenger, 1998). Mutual engagement requires interaction and is therefore favored by geographical proximity. But once the skills of the community have been acquired, mutual engagement does not necessarily require face-to-face interaction but can – "given the right context" – take place over the phone, by email or over the radio (Wenger, 1998, p. 74). As Paul Duguid (2005, p. 113) noted, most professional communities extend beyond individual organizations and localities: "…not all practice is local. In many areas, the practice is shared widely among practitioners, most of whom will never come into contact with one

another." This conceptualization parallels that of Holzner (1968, p. 140), and I will in the following use the term '*epistemic community*' to denote groups of people mastering the tools, codes and theories of a common practice (as defined below) regardless of their geographical location and the intensity of mutual contact that they may maintain. The term '*community of practice*' I will reserve for geographically localized work groups, characterized by frequent, usually personal interaction among its members.[5]

2.2.4 Operational delimitation

According to Holzner (1968, pp. 68f.), the central criterion for the identification and delimitation of a community of practice was the similarity of its members in terms of their cognitive frames of reference, role orientations and the 'reality tests' they employ to validate their knowledge. 'Similarity', of course, is a relative concept, and implicit in his discussion was the idea that epistemic communities can be distinguished at different levels of detail:

> …the actual degree of similarity in the frames of reference with which role occupants approach the situation is a matter of wide variation. There are several possibilities here: the first one is the complete identity, or a high degree of similarity of the orientation systems. Fellow believers in a common faith, persons with the same occupation and training may be illustrations of this category… Where we find such similarity of frames of reference, of epistemologies, we find naturally also agreement on the application of similar reality tests. In the case of organized social arrangements which maintain similar epistemologies we may speak of 'epistemic communities' such as that of science, of organized religion, an ideological following and the like. (Holzner, 1968, p. 68)

The problems associated with the operational delimitation of epistemic communities resemble those encountered in the classification of 'industries'. The aim is to amalgamate on the basis of some

defined criteria of similarity the smallest units of observation – individual products or establishments in the case of industries, individual persons or communities of practice in the case of epistemic communities – into ever larger groupings. In both cases, the theoretical meanings of the basic constructs are relatively fixed, but in their empirical application, precise operationalizations into broad or narrower categories will depend on the purpose of the enquiry, the availability of data and the time and resources available. Within the limits of such restraints, identification of epistemic communities can potentially be accomplished through a whole range of both primary methodologies (e.g. interviews or questionnaires) and secondary data (e.g. membership in professional associations or occupational census data)[6]. Like in the case of industries, the resultant classifications can be defined with different degrees of precision, i.e. into narrow, rather homogenous categories or broader more heterogeneous ones.

3. Epistemic communities as interpretation systems

Epistemic communities provide 'interpretation systems', which help their members to interpret the world and provide meaning to their activities (Daft and Weick, 1984; Holzner, 1968, pp. 45 ff.). Their 'practice' is always (negotiated) social practice and includes both explicit and tacit components. Epistemic communities are where knowledge resides, skills are applied and articulation and knowledge creation can take place. Individuals belong simultaneously to several epistemic communities, all of which affect their conceptions of identity and associated world views:

> The organization of the cognitive field… emerges as a process of constant structuring and ordering, or interpretation. It is guided by the repertory of role-specific frames of reference offered to a person by his social participations, and by the inherent organization of these frames of reference into major institutional and cultural domains. (Holzner, 1968, p. 44)

In Holzner's (1968, pp. 46 ff.) conceptualization, the frames of reference of an epistemic community have both cognitive and practical properties – to borrow Wanda Orlikowski's (2002, p. 250) apt phrase, knowledge and practice are 'reciprocally constitutive'.[7] They include both '*theories*' (including scientific theories but also, for example, magical and religious ones), which summarize the reality constructs of the community and rationales for their explanation, and '*active procedures*', in the form of epistemologies and methods.[8] 'Theories' specify (1) accepted "orientations" towards and "preference systems" regarding the matters relevant to a community. They also include (2) "categorical schemes", permitting symbolic descriptions of what is apprehended, and (3) "explanatory systems", providing their members with communicable explanations of experienced events. The "procedural" aspects of a community's frames of reference include "…an epistemological position… which defines implicitly or explicitly its relevant criteria of 'truth'", identifying accepted methodologies and prescribing how events and experiences are recorded and classified.
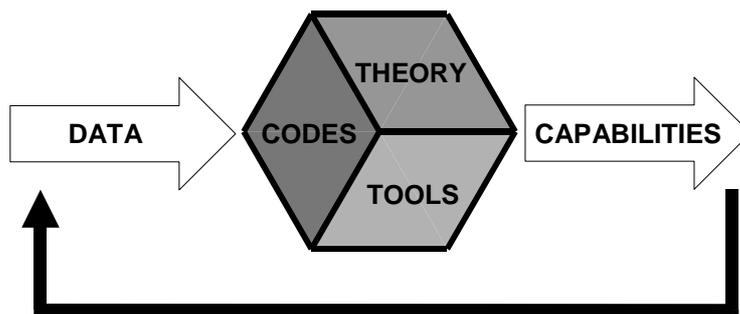
Figure 1   The functional elements of epistemic communities (Adapted from Daft and Weick, 1984)

Slightly rephrasing Holzner's argument, epistemic communities can parsimoniously be defined and delineated by their generation, maintenance and mastery of three elements, here labeled *theory, codes* and *tools,* each incorporating both explicit and tacit components (Figure 1) (Håkanson, 2007). I use the concepts broadly. Thus, 'theory' refers to the cognitive frames of reference that enable a community to make sense of the messages exchanged within it. It includes tacit cultural elements – such as 'mental maps' and inherited rules-of-thumb but also explicit statements and models of the causalities deemed relevant to the practice. 'Codes' refer to all symbolic means, through which the community communicates with its environment and its members with one another, including both ordinary language and more specialized varieties, such as mathematics, chemical formulae or computer code – and pictorial representations (graphs, maps, diagrams and pictures, etc.). 'Tools', finally, is used to denote the *physical artifacts* that the community employs in the execution of its tasks and the development of its practice, including "instrumentalities", tools that permit observation of phenomena outside the realm of unaided sense perception (Price, 1984), and the artifacts that hold a community's physical "memory" – both the tools and machines which embody its experience and technology and the physical records in which these have been codified.[9]

4. Epistemic communities and knowledge governance

In spite of the argument's intuitive plausibility, there was little agreement in the knowledge-based literature as to precisely how, when and why the cooperation and coordination of individual experts can be more efficiently achieved within a firm than through as set of mutual contracts. According to Kogut and Zander (1992, p. 390) "[c]omplex organizations exist as communities within which varieties of functional expertise can be communicated and combined by a common language and organizing principles." But why precisely, could these conditions not equally well be realized over the market? As Nicolai Foss (1996, p. 472) pointed out, "[a]gents (human resources) could simply

meet under the same factory roof, own their own pieces of physical capital equipment or rent it to each other, and develop value-enhancing higher order organizing principles among themselves (as a team)". Many of the fundamental premises of the knowledge-based approach have remained under dispute: *Under what conditions are firms superior to markets in the governance of knowledge processes? Does this superiority apply to all kinds of knowledge processes or only to some? What role, if any, does transaction cost considerations have?*

Burkart Holzner's (1968) concept of epistemic communities and the social constructivist conception of knowledge that it implies invite a new perspective in addressing these questions. Rather than the more common focus on the 'tacitness' of knowledge, it directs attention to its socially and situationally context dependent nature and to the fundamental difference between knowledge processes *within* and *across* epistemic boundaries.

Epistemic communities are significant, first, because membership affects the *ability* to exchange knowledge. Mastery of the explicit codes, theory and tools of a community enables the members of a community to transmit and receive codified knowledge as 'information' (Kogut and Zander, 1992; Lane and Lubatkin, 1998). Moreover, exposure to the same type of experiential learning processes ensures that much of the tacit knowledge of the community is also held in common (Boisot, 1995; Sanchez, 1997). This is important because it facilitates the transfer also of incompletely codified knowledge, such as that embodied in physical artifacts.[10] Thus, both through voluntary sharing and through involuntary imitation, community membership provides potential access to the knowledge available to all communities of practice within the same epistemic community.

Second, epistemic communities also provide *identity* to their members, thereby influencing their readiness and *motivation* to share knowledge (Buckley and Carter, 2000; Fiol, 1991; Holzner, 1968: 94 ff.; Nahapiet and Ghoshal, 1998; Osterloh and Frey, 2000; Kogut and Zander, 1996; Wenger, 1998).[11] As emphasized by Lave and Wenger (1991, p. 53) "… identity, knowing, and social membership entail one another." 'Learning' takes place not only in the mind of the learner. It is also a social process of becoming an 'insider':

> Learners do not receive or even construct abstract, "objective," individual knowledge; rather, they learn to function in a community. They acquire that particular community's subjective viewpoint and learn to speak its language. Learners are acquiring not explicit, formal "expert knowledge," but the embodied ability to behave as community members. (Brown and Duguid 1991, p. 48)

Of course, identities are never singular. Individuals belong to and identify with multiple epistemic communities, both occupational and private ones. Occupational identities themselves are often complex. Individuals tend to identify, for example, both with their professions and with the firms where they are employed, but occupational identities may also be linked to work groups, functional departments or geographical sites (Fiol, 1991; Kogut and Zander, 1996). In interaction with others, individuals situationally select the frame of reference appropriate to the group and structural context at hand, while reconciling their actions with other such frames which are also part of their personal history and identity (Holzner, 1968, pp. 69 ff.).

4.1 Four types of knowledge processes

As already indicated, some contributions to the 'knowledge-based approach' focused on the *exploitation* of existing capabilities, others on the *creation* of new ones. In the terms of the theoretical framework outlined here, some discussed the knowledge exchange *within* epistemic communi-

ties; others emphasized the problem of communicating knowledge *across* epistemic boundaries. Combining these two dimensions yields a simple typology of basic knowledge processes and knowledge governance problems (Figure 2).

	Creation of new capabilities	**Exploitation of existing capabilities**
***within* epistemic communities**	*Articulation* Cowan *et al.* 2000 Håkanson 2007	*Replication* Kogut & Zander 1993 Zollo & Winter 2002
***between* epistemic communities**	*Combination* Nickerson & Zenger 2004 Nahapiet & Ghoshal 1998	*Integration* Grant 1996a; 1996b

Figure 2   Typology of knowledge processes

4.1.1 Articulation

Knowledge creation *within* epistemic communities takes place through *articulation* of the tacit knowledge informing craftsman-like practice into explicit codes, tools and theory (Balconi, Pozzali and Viale, 2007; Cohendet and Meyer-Krahmer, 2001; Cowan *et al.*, 2000; Håkanson, 2007; Prencipe and Tell, 2001; Zollo and Winter, 2002). Explication of tacit knowledge requires the existence or creation of a suitable code. Much knowledge can be articulated in ordinary language, provided that a suitable vocabulary exists. But oftentimes more dedicated codes are needed, such as blueprints and other pictorial representations, flow charts or computer programs. At its most basic level, articulation involves *classification, standardization and naming* (Bowker and Star*,* 1999) and – as discussed below – the *creation and definition of interfaces* of the activities of the practice. It facilitates the *division of labor* and the exploitation of related benefits, such as those associated with *specialization*, *replication* and *control* (Håkanson, 2007). Articulation implies knowledge creation

in that it allows tasks to be accomplished that could not previously be accomplished or not accomplished so well. By definition, articulation leads to an increase in the amount of explicit knowledge available to the community. But since the application of new, more explicit theory, tools and codes creates new experiential learning opportunities, articulation increases also the tacit components of a community's knowledge base (Boisot, 1995; Zollo and Winter, 2002).

4.1.2 Replication

Replication, the duplication or reproduction of organizational capabilities, is a prerequisite for growth and, hence, a fundamental business process (Nelson and Winter, 1982). Like articulation it is an activity that takes place *within* epistemic communities. Sometimes, transfer and replication of capabilities can be accomplished through the mere transmission of an artifact or a set of blueprints, but the transfer of less completely codified technologies may require the personal, face-to-face engagement of the partners to the exchange (Baden-Fuller and Winter, 2005; Kogut and Zander, 1993; Simonin, 1999; Winter and Szulanski, 2001;). Since the ease of replication is related to the degree of articulation, the desire to facilitate and perfect the former is often an inducement to invest the time and money needed to increase the latter (Cowan *et al*., 2000; Håkanson, 2007; Winter and Szulanski, 2001; Zollo and Winter, 2002).

4.1.3 Integration

The activities of firms require the mobilization and coordination of specialized and diverse expertise. Luckily, *integration* of knowledge and other types of coordinated action between members of different epistemic communities do not require that each acquire the knowledge of every other:

> Although knowledge can be learned more effectively in specialized fashion, its use to
> achieve high living standards requires that a specialist somehow use the knowledge of other

specialists. This cannot be done by *learning* what others know, for that would undermine gains from specialized learning. It cannot be done only by *purchasing* information in the form of facts, for in many cases the theory that links facts must be mastered if facts are to be put to work (Demsetz 1988, p. 157, italics in original).

In the words of Boland and Tenkasi (1995, p. 356), integration of knowledge across epistemic communities involves '*perspective taking*', a process "in which the perspective of another [community] can be taken into account as part of a community's way of knowing." Since it involves the coordination *between* epistemic communities, among experts with different theories, codes and tools, as well as different value systems and objectives, knowledge integration is distinctly different from that of passing on, or replicating knowledge *within* such communities; it is often difficult or impossible to achieve unless requisite 'integrating devices' are in place (Grant, 1996a; Lawrence and Lorsch, 1967).

4.1.4 Combination

In line with Schumpeter's (1934) classical definition of innovation, a number of authors (Kogut and Zander, 1992; Grant 1996b; Nahapiet and Ghoshal, 1998; Galunic and Rodan, 1998; Nickerson and Zenger, 2004) discussed the relative advantages of firms in the generation of new capabilities through new *combinations* of specialized knowledge. As Carliss Baldwin (2008) recently emphasized, the optimal governance of combination, i.e. the creation of new configurations of knowledge from different disciplinary and functional areas, can be influenced by deliberate design decisions. The ease of carrying out such combinations and the associated transaction costs (both the 'mundane' ones of "standardizing, counting and compensating" and those associated with the risk of opportunism) depend on the degree of articulation and codification of the underlying knowledge bases. Articulation and improved theoretical understanding make possible the development of

design rules which can provide well defined interfaces between epistemic communities. This facilitates the specialization of cognitive work and increases the feasibility of knowledge combinations through the uncomplicated transfer across epistemic boundaries of physical artifacts, such as blueprints or components (Garud and Kumaraswamy, 1995; Sanchez and Mahoney, 1996). More complicated are the management and choice of governance for innovation processes based on knowledge combinations, where epistemic interfaces have not been defined (or are impossible to define due to the inherent uncertainty).

4.2 Governance of knowledge processes

Articulation and *replication* involve the cooperative efforts of experts pursuing the common goals of a shared practice. As members of the same epistemic community they tend to have similar backgrounds in terms of formal training and job experience. They interpret their common practice in similar ways and share mastery of its codes and tools. Within epistemic communities, codified knowledge is "...alienable from the person who wrote the code" and "...can be transmitted without loss of integrity once the syntactical rules required for deciphering it are known" (Kogut and Zander 1992, pp. 386 f.). Moreover, engagement in the same practice provides also similar types of experiential or tacit knowledge. Replication through imitation also of incompletely codified capabilities between communities of practice within the same epistemic community can often be accomplished with relative ease regardless of their geographical locations and organizational memberships. In consequence, the governance of such activities takes a multitude of forms, ranging from the virtual communities developing open source software, over government financed research institutions to the R&D departments of private firms. Appropriability conditions and transaction cost considerations appear decisive for the choice of governance.

In contrast, *combination* and *integration* refers to knowledge processes involving professional experts from different epistemic communities, each with its own vocabulary, set of theories and tools. As recent research in the sociology of organizational knowledge has demonstrated, in the absence of well-defined interfaces, integration and exchange of knowledge across the boundaries of functional departments and professional expertise do not come about easily but require continual investments and effort (Dougherty, 1992; Bechky 2003a, 2003b; Carlile, 2002; Carlile and Rebentisch, 2003). As outlined in the following section, firms have the potential to form epistemic communities in their own right, putting them in a privileged position to overcome the obstacles associated with knowledge processes crossing the epistemic boundaries of heterogeneous occupational and functional groups (Nightingale, 2000; Sosa, Eppinger and Rowles, 2004).

5. Firms as epistemic communities

Membership in the community of a firm provides identity and has both enabling and motivational consequences. Like other epistemic communities, those formed by firms and other organizations are defined by the uniqueness of the theories, codes, and tools that their members share; in the case of firms, these translate into organizational culture, common vocabulary, and boundary objects (Figure 3).
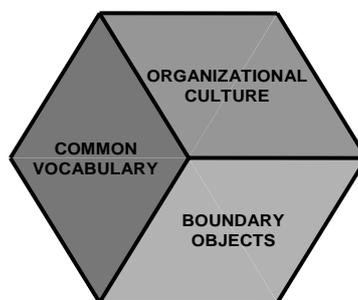
Figure 3   Firms as epistemic communities

The term '*organizational culture*' is here used as a shorthand to indicate both articulated 'theories' and unarticulated beliefs and cognitive maps that guide organizational decision-making by providing the shared knowledge infrastructure necessary for efficient knowledge integration (Crémer 1993; Grant 1996a.). In Schein's (1985, p. 7) classical definition, these "… assumptions and beliefs are learned responses to a group's problems of survival and to problems of internal integration. They come to be taken for granted because they solve those problems repeatedly and reliably." Whether tacit or explicit, the mental maps of organizational culture provide guidelines regarding relevant cause-effect relationships and facilitate discourse among people of otherwise different cognitive backgrounds (Smircich, 1983; Choo, 1998). Moreover, strong and successful organizational cultures provide their members with a sense of identity and a sense of motivation that helps align incentives among different groups (Ouchi 1980; Wilkins and Ouchi 1983; Kogut and Zander 1996; Osterloh and Frey 2000).

A second central characteristic of firms is their ability to provide their members with a *common language* or code (Arrow 1974; Crémer 1993). Sometimes, local terminologies are canonically prescribed in company manuals, but oftentimes spontaneously developed local jargon is equally important in facilitating communication among community members (Allen, 1977; Brown and Duguid, 1991; Orr, 1996). Once acquired, local codes tend to be taken for granted and their mastery is largely tacit. While local codes enhance intra-organizational knowledge exchange, their tacit, 'taken-for-granted' character is sometimes problematic. Idiosyncratic codes create problems of communication across organizational boundaries, but may, of course, be a means to appropriate private knowledge rents (Kogut and Zander 1992).

Thirdly, firms and other organizations are supported not only by cognitive schemata and intangible codes but also by tangible physical artifacts that bridge the epistemic boundaries of the specialized occupational and functional groups of which they are composed (Carlile 2002; Bechky 2003a; 2003b; Star 1989). Such *boundary objects* "…inhabit several communities of practice and satisfy the informational requirements of each of them. In working practice, they are objects that are able both to cross borders and maintain some sort of constant identity (Bowker and Star 1999, p. 16)". Modern computer and information systems are pervasive examples of dedicated boundary objects, but many other physical manifestations of knowledge, such as drawings, prototypes and physical products can serve the same purpose (Bechky 2003a; Carlile 2002).

The formation of firms as epistemic communities, i.e. the creation and maintenance of organizational culture, a common language and efficient boundary objects, does not come about automatically but requires investment and effort on the part both of the firms' owners and managers and of their employees. Some of these investments have value also in alternative usage. The computer hardware of a management information system can be sold and used in another company and many of the skills that employees acquire in their jobs can be exploited in other firms. However, a large portion of the physical and intangible assets needed to establish the firm as an epistemic community is highly situational and cannot readily be transferred to applications outside the organizational context where they were created. Arrow (1974, p. 56), discussing the role of firm specific codes, noted that "learning the information channels within a firm and the codes for transmitting information through them is… a skill of value only internally". Therefore, "…the learning of a code by an individual is an act of irreversible investment for him. It is therefore also an irreversible capital accumulation for the organization (Arrow 1974, p. 55)."[12]

The requisite transaction specific investments are difficult to realize under market forms of governance. Conversely, and this is, in fact, often the very reason they are undertaken, such investments can provide unique and difficult-to-imitate capabilities (Hennart 1994). As Bob Grant perceptively argued,

> … the critical source of competitive advantage is knowledge integration rather than knowledge itself. Specialized knowledge cannot, on its own, provide a basis for sustainable competitive advantage, first, because the specialized knowledge resides in individuals, and individuals are transferable between firms; second, because the rents generated by specialized knowledge is more likely to be appropriated by individuals than by the firm. (Grant, 1996b, p. 380)

6. Implications

In a scathing critique of the 'competence perspective' to strategic management – and, by implication, the knowledge based theory of the firm – Oliver Williamson (1999) called attention to its failure to provide clear and operationalizable definitions of key terms, such as 'competence' and 'knowledge'. As outlined above, the concept of 'epistemic communities' provides a means to address this core weakness. Its emphasis on the inherently context-dependent nature of knowledge provides not only a new and less abstract definition of knowledge and a new taxonomy of knowledge processes. It also suggests the contours of a new research agenda, the central aspects of which can be provisionally delineated in terms of five 'moves' employed by Williamson (1999) when 'benchmarking' the competence view with the transaction cost perspective:[13]

6.1 Human actors

The *cognitive assumptions* underlying the notion of epistemic communities are broadly consistent with but also considerably richer and more precise than those of 'bounded rationality' and 'tacit knowledge' that have dominated the knowledge based literature since Richard Nelson and Sidney Winter's (1988) seminal work.[14] Whereas bounded rationality in Nelson and Winter and in much of the subsequent knowledge based literature appears as a 'background argument' (Foss, 2003, p. 193) and the assumed importance of tacit knowledge takes center piece, the opposite characterizes the behavioral assumptions underlying the idea of epistemic communities. The problems involved in the transfer and exchange of tacit knowledge are recognized, but is assumed that the ability of individuals to engage in knowledge transactions is primarily determined by their epistemic backgrounds, rather than by the degree of tacitness of the knowledge they hold. *Within* epistemic communities, individuals often possess the same tacit, experiential knowledge or can with relative ease pass it on in personal contact; when this is not the case, it can often be articulated within shared symbolic and theoretical frames. Knowledge transactions *between* communities face more deep-seated difficulties, determined not only by tacitness but more fundamentally by the degree of incommensurability of cognitive frames. In contrast to the view of bounded rationality as originally suggested by Herbert Simon (1947) – the cognitive capabilities of human agents are not primarily seen as bounded by the 'information handling capacity' of the human brain, but by the limits imposed by frames of reference, value systems and modes of symbolic representation prevailing in the epistemic communities to which they belong.

In terms of *motivational assumptions*, Holzner's (1968) discussion suggests that intra-community transactions are influenced by perceived loyalty and sense of identity, but that they are also governed by considerations of mutual self-interest and authority-imposed obligations. In contrast to

intra-community exchanges, both intrinsic and extrinsic motivational factors reduce the probability that an agent will behave opportunistically in interaction with her peers.

6.2 Unit of analysis

Framing knowledge processes in terms of interactions between agents belonging to specific epistemic communities implies that individual 'knowledge transactions' constitute the most basic unit of analysis. Knowledge transactions occur when through the interaction of individual agents the capabilities of one or both increase. Sometimes transactions leave tangible traces documenting their occurrence and attributes, but many are unrecorded, intangible and more difficult to observe. Although empirical methodologies will therefore vary, key attributes for the operationalization of such transactions include (1) the epistemic characteristics of the interacting partners, (2) the purpose of their interaction, (3) its costs (in terms of time and travel, for example), as well as (4) expected or realized benefits.

6.3 Describing the firm

Depending on their relative emphases, different contributors to the competence perspective variously conceived the firm as a bundle of resources, capabilities or competences. The perspective outlined in this paper suggests a complementary perspective, viewing the firm in terms of the number, size and characteristics of the epistemic communities of its employees, and in terms of the structure of interaction within and between such communities. Being less abstract, it is also much more amenable to empirical observation.

6.4 Purposes served

A key criterion in Williamson's (1999) benchmarking of the capability perspective with that of transaction cost economics was the theory's ability to explain (or predict) the alignment of transactions with different attributes to appropriate modes of governance. The gist of Williamson's critique was that the competence perspective could not well predict when hierarchic governance is preferred to markets or when markets prevail. "Given that all firms are repositories of knowledge and that all firms develop interpersonal relations, the question is when this is best done in separate firms rather than in one (Williamson, 1999, p. 1097)."

According to Bruce Kogut and Udo Zander (1992, p. 384), "…what firms do better than markets is the sharing and transfer of the knowledge of individuals and groups within an organization." In their view, firms exist because they can provide superior conditions for the management of productive activities involving tacit knowledge. The argument developed in this paper implies that firms are more efficient than markets not primarily in the governance of knowledge processes involving tacit knowledge but of those that require the integration or combination of knowledge originating *in different epistemic communities* when the interfaces between them are not clearly defined. The superiority of firms in this respect derives from their ability to form epistemic communities in their own right, thereby providing both motivational and enabling advantages that cannot easily be replicated through market contracting. In the case of knowledge processes involving articulation and replication of knowledge *within the same epistemic community* firm governance brings no additional benefits. In these cases, hierarchy may *for other reasons*, such as those set out in inherited transaction cost theory, be the preferred mode of governance, but not because it is inherently superior to markets in governing these sorts of knowledge processes.

6.5 Empirical

Applying Holzner's concept of epistemic communities to the problem of knowledge governance opens up a rich field for empirical research on both micro- and macroeconomic levels, focusing on the description, analysis and theoretical explanation of the structure of the knowledge systems in society (the problem that Holzner (1968) and Holzner and Marx (1979) theoretically address without systematic empirical underpinnings) and in individual organizations. Together with the development of requisite theoretical advances, this area of research could perhaps, analogous to 'industrial organization' be denoted 'epistemic organization'. Whereas 'industrial organization' has characterized and studied individuals, establishments and firms according to the nature of the goods and services they produce, 'epistemic organization' would provide a complementary view, characterizing and studying individuals by their professions (or other epistemic communities to which they belong) and establishments and firms by the structure and composition of the epistemic communities they encompass.

7. Concluding summary

This paper argues that the so called knowledge based view of the firm has tended to misleadingly overemphasize the importance of 'tacit knowledge' for the choice of governance of knowledge-intensive processes. Employing a social-constructivist view of knowledge and the concept of 'epistemic communities', as developed by Burkhart Holzner (1968) and Holzner and John Marx (1979), it argues that the ease or difficulty of managing knowledge-intensive interactions is more dependent on the cognitive background of the exchange partners than on the characteristics of the knowledge they exchange (c.f. Cohen and Levinthal (1990) and Zahra and George (2002)).

The proposed conceptualization offers a means to reconcile and synthesize the literature on the knowledge based approach to the theory of the firm. It suggests a simple typology of four basic knowledge processes: *Replication and articulation* involve cooperative efforts *within* epistemic communities, i.e. among individuals who share a commitment to a common practice and mastery of its epistemic base; *integration* and *combination* require coordination and reconciliation of knowledge *across* epistemic communities, whose members are often unfamiliar with one another's specialized codes, theories and tools. Whereas common community membership provides motivational and enabling conditions that facilitate within-community interaction, exchange of knowledge across different communities is often fraught with difficulties. Since firms have the potential to form epistemic communities in their own right - conferring on their members the means by which specialist knowledge can be effectively combined and integrated – hierarchy is generally superior to markets in the governance of between-community cooperation in the form of integration and combination. There is no *a priori* reason to assume that firms are generally superior to markets for the organization of replication and articulation – knowledge processes involving people belonging to the same epistemic community.

The establishment of a firm as a 'community of communities' requires the development of a shared codes, theory and tools, i.e. common vocabulary, organizational culture and boundary objects. Many of the associated investments are highly situational and cannot easily be transferred to other contexts The employment of 'firms' rather than 'markets' in the creation of "social communities of voluntaristic action" (Kogut and Zander 1992) reflects not only their motivational and enabling advantages but also their ability to mitigate the moral hazards associated with the transaction specific investments necessary to establish them as epistemic communities.

Applying the concept of epistemic communities to the problem of knowledge governance opens up a rich field of research, the contours of which are sketched in the penultimate section of the paper.

Acknowledgements

Endnotes

[1] The seminal contributions by Bruce Kogut and Udo Zander (1992, 1993 and Zander & Kogut, 1995), for example, were based on the critical but unstated assumption that the characteristics of manufacturing technologies, such as their degree of 'codifiability', remain constant over several decades. The present paper takes the view that *articulation*, the process whereby tacit skills and knowledge are made explicit, and *codification*, the process of rendering articulated knowledge in fixed, standardized and easily replicable form, are fundamental to the dynamics of knowledge creation (Håkanson, 2007).

[2] Williamson, of course, was not totally impartial in this debate. As he admitted, the choice of benchmarking criteria may have stacked the cards against the former in favor of the latter and the comparison "… could be… unfair…, in that competence is asked to play on transaction cost turf. (1999, p. 1094)."

[3] The minimum community size is two; there are forms of knowledge that only lovers share and can appreciate. Other kinds of knowledge seem so universal that they are probably shared by all human beings. Most types of knowledge relevant in managerial practice and for economic theory – the types that this paper attempts to address – lie between these two extremes.

[4] Deborah Dougherty (1992), following Douglas' (1987) retranslation of Fleck's (1935/1979) 'Denkkollektiv' ('thought-collective'), used the term 'thought worlds' to denote the beliefs and perceptions common to members of functional departments. Boland and Tenkasi (1995) used the phrase 'communities of knowing', Bechky (2003a; 2003b) preferred 'occupational communities' while Grant (1996a) and Carlile (2002) discussed 'expert knowledge' primarily in terms of business functions. John Seely Brown and Paul Duguid (2001b, p. 205) proposed the term 'networks of practice', quoting the works of Strauss (1978, 1982, 1984) on 'social worlds', Knorr Cetina (1999) on 'epistemic cultures' and Ziman (1967) on 'public knowledge' in scientific communities. As discussed below, a separate tradition defined 'epistemic communities' as small groups of heterogeneous knowledge-creating agents pursuing a common goal and accepting a common 'procedural authority' (Cohendet and Llerena 2003, p. 283; Cowan *et al.*, 2000, p. 234). In subse-

quent elaboration of this usage, the concept came to take on a meaning almost the opposite of Holzner's (1968) original definition (and the one adopted in this paper). Bart Nooteboom (2006, pp. 2f.), for example, defined 'epistemic communities as "…groups or networks of people who perform exploratory learning. They engage in transdisciplinary and/or transfunctional activities, at the interstices between the various disciplines. In contrast with communities of practice, they are not organized around a common discipline or practice but around a common topic or problem." Based on Holzner and Marx (1979), the concept is has also been employed in the field of international relations to denote communities whose members (1) share a common set of values and beliefs, (2) have common theoretical understanding regarding causalities regarding policy measures and desired outcomes, (3) have shared criteria for validity, and (4) pursue the same policy enterprise (Haas, 1992).

[5] Although individual communities of practice usually belong to larger epistemic communities, and epistemic communities are often composed of many localized communities of practice, the definitions do not rule out the possibility that specific communities of practice may develop such unique epistemic characteristics that they could be considered to be separate epistemic communities.

[6] The classification of epistemic communities – like that of industries - is complicated by the fact that their boundaries are not constant. As the knowledge base of a community expands, its practice and membership often change reciprocally (Brown and Duguid, 1998, p. 96). Such epistemic differentiation increases the role complexity and repertory of frames of reference and cognitive orientations of society, with individuals typically belonging simultaneously to several epistemic communities (Holzner, 1968, p. 69). This tendency parallels the way that industrial establishments often produce goods and services belonging to different industries.

[7] Economists have traditionally focussed on knowledge as information, i.e. propositional knowledge; many sociologists have emphasized its practical aspects, i.e. knowledge as capabilities. However, the two are clearly so intertwined that in the present context it is almost impossible to discuss the one without the other. Cognitive understanding in the form of propositional knowledge derives its economic significance through *application* in the performance of an economically meaningful activity, i.e. the exercise of the skill that it informs. Michael Polanyi (1966, p. 7) took a similar position: ''These two aspects of knowing have similar structure and neither is ever present without the other . . . I shall always speak of 'knowing' therefore, to cover both practical and theoretical knowledge.''

[8] The 'knowledge' informing skilled practice includes not only cognitive understanding of the principles that determine its performance but also a more or less vital tacit component: "Knowledge is applied to practice in the sense that the theoretical principles of universal validity become the ground for the formulation of the principles of practice. However, there is no way in which practice can be directly deduced from theory. There is always remains an element of judgment through which the practitioner 'distinguishes whether something is the case or not' (Holzner and Marx, 1979, p. 36)."

[9] Holzner (1968) and Holzner and Marx (1979) do not explicitly discuss the roles of tools and other artifacts. They are included here because they are basic to the *methodologies* available to a community and central to its frames of reference. By extending the efficiency of the human body, as well as man's senses and intellect (Rogers, 1983, p. 2; Håkanson, 2007), tools help determine the capabilities of a community, i.e. the range and efficiency of the tasks it can perform as well as the range, precision and reliability of its observations of reality. Tools and artifacts are important both as outcomes of a community's effort and as means to evaluate such outcomes (Garud and Rappa, 1994). Moreover, competent mastery of its tools is a significant criterion of community membership (Brown, Collins and Duguid, 1989; Delamont and Atkinson, 2001).

[10] This may help to explain the (unexpected) finding by Zander and Kogut (1995), that the hazard of involuntary imitation manufacturing technologies is unrelated to their 'codifiability'.

[11] "The maintenance of the specific role orientation… is based on powerful motivational forces… They may involve control by peers, the supervision by authority figures, the reference to an explicit code, as well as the situational requirements of the encountered tasks themselves (Holzner, 1968, pp. 94 f.)."

[12] For employees, mastery of the codes, theory and tools of a firm-specific epistemic community adds to their value and negotiating strength vis-à-vis that particular employer. Firms, in turn, have an incentive to let their employees appropriate some of that value since it creates barriers to their mobility, thereby reducing the threat of imitation (Williamson 1985; Montgomery and Wernerfelt 1988; Peteraf 1993).

[13] I leave out Williamson's sixth 'move' – 'efficiency criterion' – which appears too general to be useful for the present purpose.

[14] As pointed out by Foss (2003) and Paul Nightingale (2003), the epistemological basis of bounded rationality, as developed by Herbert Simon (1947), and that of tacit knowledge according to Polanyi (1962, 1966) do not, in fact, easily match. The social constructivist approach proposed here avoids this problem.

References

Allen, T. J. (1977), *Managing the Flow of Technology*. MIT Press: Cambridge, MA.

Amin, A. and Cohendet, P. (2004), *Architectures of Knowledge: Firms, Capabilities, and Communities*. Oxford University Press: Oxford.

Ancori, B., Bureth, A. and Cohendet, P. (2000), 'The Economics of Knowledge: The Debate about Codification and Tacit Knowledge', *Industrial and Corporate Change*, 9, 255-287.

Arrow, K. J. (1974), *The Limits of Organization.* Norton: New York.

Baden-Fuller, C. and Winter S. G. (2005), 'Replicating Organizational Knowledge', *EBK Working Paper 2005/22*, Economic and Social Research Council.

Balconi, M., Pozzali, A. and Viale, R. (2007), 'The "Codification Debate" revisited: A Conceptual Framework to Analyze the Role of Tacit Knowledge in Economics', *Industrial and Corporate Change*, 16, 823-849.

Baldwin, C. Y. (2008), 'Where do Transactions come from? Modularity, Transactions, and the Boundaries of Firms', *Industrial and Corporate Change*, 17, 155-195.

Bechky, B. A. (2003a), 'Object Lessons: Workplace Artifacts as Representations of Occupational Jurisdiction', *American Journal of Sociology,* 103, 720-52.

Bechky, B. A. (2003b), 'Sharing Meaning across Occupational Communities: The Transformation of Understanding on a Production Floor', *Organization Science,* 14, 312-330.

Blackler, F. (1995), 'Knowledge, Knowledge Work and Organizations: An Overview and Interpretation', *Organization Studies,* 16, 1021-1046.

Boisot, M. (1995), *Information Space: A Framework for Learning in Organizations, Institutions and Culture*. Routledge: London.

Berger, P. and Luckmann, T. (1996/1991), *The Social Construction of Reality.* Penguin Books: London.

Boland, R. J. and Tenkasi, R. V. (1995), 'Perspective Making and Perspective Taking in Communities of Knowing', *Organization Science,* 6, 350-372.

Bowker, G. C. and Star, S. L. (1999), *Sorting Things Out.* MIT Press: Cambridge, MA.

Brown, J. S., Collins, A. and Duguid, P. (1989), 'Situated Cognition and the Culture of Learning', *Educational Researcher*, 18, 32-42.

Brown, J. S. and Duguid, P. (1991), 'Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation', *Organization Science,* 2, 40-57.

Brown, J. S. and Duguid, P. (1998), 'Organizing Knowledge', *California Management Review,* 40, 90-111.

Brown, J. S. and Duguid, P. (2001a), 'Structure and Spontaneity: Knowledge and Organization', in I. Nonaka and D. Teece (Eds.) *Industrial Knowledge* (pp. 44-67). Sage: London.

Brown, J. S. and Duguid, P. (2001b), 'Knowledge and Organization: A Social-Practice Perspective', *Organization Science,* 12, 198-213.

Buckley, P. J. and Carter, M. J. (2000), 'Knowledge Management in Global Technology Markets: Applying Theory to Practice', *Long Range Planning,* 33, 55-71.

Buckley, P. J. and Casson, M. (1976), *The Future of the Multinational Enterprise.* Macmillan: London.

Carlile, P. R. (2002), 'A Pragmatic View of Knowledge and Boundaries: Boundary Objects in New Product Development', *Organization Science* 13: 442-455.

Carlile, P. R. and Rebentisch, E. S. (2003), 'Into the Black Box: The Knowledge Transformation Cycle', *Management Science,* 47, 1180-1195.

Choo, C. W. (1998), *The Knowing Organization: How Organizations Use Information to Construct Meaning, Create Knowledge, and Make Decisions.* Oxford University Press: New York.

Coase, R. H. (1937), 'The Nature of the Firm', *Economica,* 4, 386–405.

Cohen, W. M. and Levinthal, D. A. (1990), 'Absorptive Capacity: A New Perspective on Learning and Innovation', *Administrative Science Quarterly,* 35, 128-52.

Cohendet, P. and Meyer-Krahmer, F. (2001), 'The Theoretical and Policy Implications of Knowledge Codification', *Research Policy,* 30, 1563-1591.

Cohendet, P. and Llerena, P. (2003), 'Routines and Incentives: The Role of Communities in the Firm', *Industrial and Corporate Change,* 12, 271-297.

Conner, K. R. (1991), 'A Historical Comparison of Resource-Based Theory and five Schools of Thought within Industrial Organization Economics: Do we have a New Theory of the Firm?' *Journal of Management,* 17, 121-154.

Conner, K. R. and Prahalad, C. K. (1996), 'A Resource-Based Theory of the Firm: Knowledge versus Opportunism', *Organization Science,* 7, 477-501.

Cowan, R., Paul. D. A. and Foray, D. (2000), 'The Explicit Economics of Knowledge Codification and Tacitness', *Industrial and Corporate Change,* 9, 211-253.

Crémer, J. (1993), 'Corporate Culture and Shared Knowledge', *Industrial and Corporate Change,* 2, 351-386.

Daft, R. L., and Weick, K. E. (1984), 'Toward a Model of Organizations as Interpretation Systems', *Academy of Management Review,* 9, 284-295.

Delamont, S. and Atkinson, P. (2001), 'Doctoring Uncertainty: Mastering Craft Knowledge', *Social Studies of Science,* 31, 87-107.

Demsetz, H. (1988), 'The Theory of the Firm Revisited', *Journal of Law and Economic Organization,* 4, 141-161.

DiMaggio, P. J., and Powell, W. W. (1983), 'The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields', *American Sociological Review,* 48, 147-160.

Donnellon, A., Gray, B. and Bougon, M. G (1986), 'Communication, Meaning and Organized Action', *Administrative Science Quarterly,* 31, 43-55.

Dougherty, D. (1992), 'Interpretive Barriers to Successful Product Innovation in large Firms', *Organization Science,* 3, 179-202.

Douglas, M. (1987), *How Institutions Think*. Routledge and Kegan Paul: London.

Duguid, P. (2005), '"The art of knowing": Social and Tacit Dimensions of Knowledge and the limits to the Community of Practice', *The Information Society,* 21, 109-118.

Felin, T. and Foss, N. J. (2005), 'Strategic Organization: A field in Search of Micro-Foundations', *Strategic Organization*, 3, 441-455.

Felin, T. and Hesterley, W. S. (2007), 'The Knowledge-Based View, Nested Heterogeneity, and New Value Creation: Philosophical Considerations on the Locus of Knowledge', *Academy of Management Review,* 32, 195-218.

Fiol, C. M. (1991), 'Managing Culture as a Competitive Resource: An Identity-Based View of Sustainable Competitive Advantage', *Journal of Management,* 17, 191-211.

Fleck, L. (1935/1979), *The Genesis and Development of a Scientific Fact.* University of Chicago Press: Chicago.

Foss, N. J. (1993), 'Theories of the Firm: Contractual and Competence Perspectives', *Journal of Evolutionary Economics,* 3, 127-144.

Foss, N. J. (1996), 'Knowledge-Based Approaches to the Theory of the Firm: Some Critical Comments', *Organization Science,* 7, 470-476.

Foss, N. J. (2003), 'Bounded Rationality and Tacit Knowledge in the Organizational Capabilities Approach: An Evaluation and a Stocktaking', *Industrial and Corporate Change,* 12, 185-201.

Galunic, D. C. and Rodan, S. (1998), 'Resource Combinations in the Firm: Knowledge Structures and the Potential for Schumpeterian Innovation', *Strategic Management Journal,* 19, 1193-1201.

Garud, R. and Rappa, M. A. (1994), 'A Socio-Cognitive Model of Technology Evolution: The Case of Cochlear Implants', *Organization Science,* 5, 344-362.

Garud, R. and Kumaraswamy, A. (1995), 'Technological and Organizational Designs for Realizing Economies of Substitution', *Strategic Management Journal,* 16 (Special Issue), 93-109.

Grant, R. M. (1996a), 'Toward a Knowledge-based Theory of the Firm', *Strategic Management Journal,* 17 (Winter Special Issue), 109-22.

Grant, R. M. (1966b), 'Prospering in Dynamically Competitive Environments: Organizational Capability as Knowledge integration', *Organization Science,* 7, 375-387.

Haas, P. M. (1992), 'Introduction: Epistemic Communities and International Policy Coordination', *International Organization,* 46, 1-37.

Håkanson, L. (2007), 'Creating Knowledge: The Power and Logic of Articulation', *Industrial and Corporate Change,* 16, 51-88.

Hennart, J.-F. (1994), 'The 'Comparative Institutional' Theory of the Firm: Some Implications for Corporate Strategy', *Journal of Management Studies,* 31, 193-207.

Holzner, B. (1968), '*Reality construction in Society.* Schenkman: Cambridge.

Holzner, B. and Marx, J. H. (1979), *Knowledge Application: The Knowledge System in Society.* Allyn and Bacon: Boston, MA.

Johnson, B., Lorenz, E. and Lundvall, B.-Å. (2002), 'Why all this Fuss about Codified and Tacit Knowledge?', *Industrial and Corporate Change,* 11, 245-262.

Kaplan, S., Schenkel, A., Krogh, G. von and Weber, C. (2001), 'Knowledge-Based Theories of the Firm in Strategic Management: A Review and Extension', *MIT Sloan Working Paper* #4216-01.

Knorr Cetina, K. D. (1982), 'Scientific Communities or Transepistemic Arenas of Research? A Critique of Quasi-Economic Models of Science', *Social Studies of Science,* 12, 101-130.

Knorr Cetina, K. D. (1999), *Epistemic Cultures: How the Sciences make Knowledge.* Harvard University Press: Cambridge, MA.

Kogut, B., and Zander, U. (1992), 'Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology', *Organization Science,* 3, 384-97.

Kogut, B., and Zander, U. (1993), 'Knowledge of the Firm and the Evolutionary Theory of the Multinational Corporation', *Journal of International Business Studies,* 24, 625-45.

Kogut, B., and Zander, U. (1996), 'What Firms Do? Coordination, Identity and Learning', *Organization Science,* 7, 502-518.

Lane, P. J., and Lubatkin, M. (1998), 'Relative Absorptive Capacity and Inter-Organizational Learning', *Strategic Management Journal,* 19, 461-477.

Langlois, R. N. and Foss, N. J. (1999), 'Capabilities and Governance: The Rebirth of Production in the Theory of Economic Organization', *Kyklos,* 52, 201-218.

Lave, J. and Wenger, E. (1991), *Situated Learning: Legitimate Peripheral Participation.* Cambridge University Press: New York.

Lawrence, P. R., and Lorsch, J. W. (1967), *Organization and Environment: Managing Differentiation and Integration.* Harvard University Press: Boston, MA.

Madhok, A. (1996), 'The Organization of Economic Activity: Transaction Costs, Firm Capabilities and the Nature of Governance', *Organization Science*, 7, 577-590.

Montgomery, C. A. and Wernerfelt, B. (1988), 'Diversification, Ricardian Rents and Tobin's q', *RAND Journal of Economics,* 19, 623-632.

Nahapiet, J. and Ghoshal, S. (1998), 'Social Capital, Intellectual Capital and the Organizational Advantage', *Academy of Management Review,* 23, 242-266.

Nelson, R. R., and Winter, S. G. (1982), '*An Evolutionary Theory of Economic Change.* Harvard University Press: Cambridge, MA.

Nickerson, J. A. and. Zenger, T. R (2004), 'A Knowledge-Based Theory of the Firm – the Problem-Solving Perspective', *Organization Science,* 15, 617-632.

Nightingale, P. (2000), 'The Product-Process-Organisation Relationship in Complex Development Projects', *Research Policy,* 29, 913-930.

Nightingale, P. (2003), 'If Nelson and Winter are only Half Right about Tacit Knowledge, which Half? A Searlean Critique of 'Codification'', *Industrial and Corporate Change,* 12, 149-183.

Nonaka, I. (1994), 'A dynamic Theory of Organizational Knowledge Creation', *Organization Science,* 5, 14-37.

Nooteboom, B. (2006), 'Cognitive Distance in and between COP's and Firms: Where do Exploitation and Exploration take Place, and how are they Connected?' Paper for DIME Workshop on Communities of Practice, Durham, 27-28 October 2006.

Orlikowski, W. J. (2002), 'Knowing in Practice: Enacting a Collective Capability in Distributed Organizing', *Organization Science*, 13, 249-273.

Orr, J. E. (1996), *Talking about Machines: Ethnography of a Modern Job.* Cornell University Press: Ithaca, NY.

Osterloh, M., Frey, B. S. (2000), 'Motivation, Knowledge Transfer, and Organizational Forms', *Organization Science,* 11, 538-550.

Ouchi, W. G. (1980), 'Markets, Bureaucracies, and Clans', *Administrative Science Quarterly,* 25, 129-141.

Penrose, E. T. (1959), *The Theory of the Growth of the Firm.* Basil Blackwell: Oxford.

Peteraf, M. A. (1993), 'The Cornerstones of Competitive Advantage: A Resource-Based View', *Strategic Management Journal,* 14, 179-191.

Pitelis, C. N. (2004), 'Edith Penrose's Organizational Theory of the Firm: Contract, Conflict, Knowledge and Management', in Tsoukas, H. and N. Mylonopoulos (eds.) *Organizations as Knowledge Systems: Knowledge, Learning and Dynamic Capabilities* (pp. 238-251). Palgrave Macmillan: Basingstoke.

Pitelis, C. N., and Wahl, M. W. (1998), 'Edith Penrose: Pioneer of Stakeholder Theory', *Long Range Planning,* 31, 252-261.

Polanyi, M. (1962), *Personal Knowledge: Towards a Post-Critical Philosophy*. Harper and Row: New York.

Polanyi, M. (1966), *The Tacit Dimension*. Doubleday: Garden City, NY.

Prencipe, A. and Tell, F. (2001), 'Inter-Project Learning: Processes and Outcomes of Knowledge Codification in Project-Based Firms', *Research Policy,* 30, 1373-1394.

Price, D. J. de Solla (1984), 'The Science/Technology Relationship, the Craft of Experimental Science, and Policy for the Improvement of High Technology Innovation', *Research Policy,* 13, 3–20.

Rogers, C. F. C. (1983), *The Nature of Engineering. A Philosophy of Technology*. Macmillan: London.

Sanchez, R. (1997), 'Managing Articulated Knowledge in Competence-Based Competition' in R. Sanchez and A. Heene (eds.) *Strategic Learning and Knowledge Management* (pp.163-187). Wiley: Chichester.

Sanchez, R. and Mahoney, J. T. (1996), 'Modularity, Flexibility, and Knowledge Management in Product and Organization Design Modularity', *Strategic Management Journal,* 17 (Winter Special Issue), 63-76.

Schein, E. H. (1985), *Organizational Culture and Leadership.* Jossey-Bass: San Francisco, CA.

Schumpeter, J. A. (1934), *The Theory of Economic Development: An Inquiry into Profits, Capital, Interest, and the Business Cycle.* (Translated by R. Opie.), Harvard University Press: Cambridge, MA.

Simon, H. A. (1947), *Administrative Behavior.* Macmillan: New York.

Simonin, B. L. (1999), 'Ambiguity and the Process of Knowledge Transfer in Strategic Alliances', *Strategic Management Journal,* 20, 595-623.

Smircich, L. (1983), 'Organization as Shared Meaning' in L. R. Pondy, P. J. Frost, G. Morgan and T. C. Dandridge (eds.) *Organizational Symbolism* (pp. 55-65). Greenwich, CT: JAI Press.

Sosa, M. E., Eppinger, S. D., and Rowles, C. M. (2004), 'The Misalignment of Product Architecture and Organizational Structure in Complex Product Development', *Management Science,* 50, 1674-1689.

Spender, J.-C. (1996a), 'Making Knowledge the Basis of a Dynamic Theory of the Firm', *Strategic Management Journal*, 17 (Winter Special Issue), 45-62.

Spender, J.-C. (1996b), 'Organizational Knowledge, Learning, and Memory: Three Concepts in Search of a Theory', *Journal of Organizational Change Management,* 9, 63-79.

Spender, J.-C. (1998), 'Pluralist Epistemology and the Knowledge-based Theory of the Firm', *Organization,* 5, 233-258.

Spender, J.-C., and Grant, R. M. (1996), 'Knowledge and the Firm: Overview', *Strategic Management Journal,* 17 (Winter Special Issue), 5-9.

Star, S. L. (1989), 'The Structure of Ill-Structured Solutions: Boundary Objects and Heterogeneous Distributed Problem Solving', in M.N. Huhns and L. Gasser (eds.) *Distributed Artificial Intelligence 2* (pp. 37-54). Menlo Park, CA: Morgan Kaufmann.

Star, S. L. and Griesemer, J. R. (1989), 'Institutional Ecology, "Translations" and Boundary Objects: Amateurs and Professionals in Berkley's Museum of Vertebrate Zoology, 1907-39', *Social Studies of Science,* 19, 387-420.

Steinmueller, W. E. (2000), 'Will New Information and Communication Technologies Improve the 'Codification' of Knowledge?' *Industrial and Corporate Change,* 9, 361-376.

Strauss, A. (1978), 'A Social World Perspective', *Studies in Symbolic Interaction,* 1, 119-128.

Strauss, A. (1982), 'Social Worlds and Legitimation Processes', *Studies in Symbolic Interaction,* 4, 171-190.

Strauss, A. (1984), 'Social Worlds and their Segmentation Processes', *Studies in Symbolic Interaction,* 5, 123-139.

Szulanski, G. (1996), 'Exploring Internal Stickiness: Impediments to the Transfer of Best Practice within the Firm', *Strategic Management Journal,* 17, 27-43.

Tsoukas, H. (1996), 'The Firm as a Distributed Knowledge System: A Constructionist Approach', *Strategic Management Journal,* 17 (Winter Special Issue), 11-25.

von Hippel, E. (1994), ''Sticky Information' and the Locus of Problem Solving: Implications for Innovation', *Management Science,* 40, 429-39.

Weick, K. E. (1995), *Sensemaking in Organizations*. Thousand Oaks, CA: Sage.

Wenger, E. (1998), *Communities-of-Practice. Learning, Meaning and Identity.* Cambridge University Press: Cambridge.

Wilkins, A. L., and Ouchi, W. G. (1983), 'Efficient Cultures: Exploring the Relationship between Culture and Organizational Performance', *Administrative Science Quarterly,* 28, 468-481.

Williamson, O. E. (1975), *Markets and Hierarchies: Analysis and Antitrust Implications.* The Free Press: New York.

Williamson, O. E. (1985), *The Economic Institutions of Capitalism.* The Free Press: New York.

Williamson, O. E. (1999), 'Strategy Research: Governance and Competence Perspectives', *Strategic Management Journal,* 20, 1087-1108.

Winter, S. G. (1987), 'Knowledge and Competence as Strategic Assets', in D. J. Teece (ed.) *The Competitive Challenge - Strategies for Industrial Innovation and Renewal* (pp. 159-184). Harper & Row: New York.

Winter, S. G. and Szulanski, G. (2001), 'Replication as Strategy', *Organization Science,* 12, 730-743.

Zahra, S. A., and George, G. (2002), 'Absorptive Capacity: A Review, Reconceptualization and Extension', *Academy of Management Review,* 39, 836-866.

Zander, U. (1991), *Exploiting a Technological Edge - Voluntary and Involuntary Dissemination of Technology*. Doctoral Dissertation. Stockholm: Institute of International Business at the Stockholm School of Economics.

Zander, U. and Kogut, B. (1995), 'Knowledge and the Speed of Transfer and Imitation of Organizational Capabilities: An Empirical Test', *Organization Science,* 6, 75-92.

Ziman, J. M. (1967), *Public Knowledge: An Essay Concerning the Social Dimensions of Science.* Cambridge University Press: Cambridge.

Zollo, M. and Winter, S. G. (2002), 'Deliberate Learning and the Evolution of Dynamic Capabilities', *Organization Science,* 13, 339-351.