

DRAFT NOVEMBER 15, 2005
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**THE KNOWLEDGE-BASED VIEW REVISITED:
TOWARDS A DYNAMIC SYNTHESIS**

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INTRODUCTION

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

In spite of its reasonably narrow aim, the knowledge-based approach to the firm is a rather diverse literature. There is no agreement as to precisely what range of observable phenomena should be included in a ‘knowledge-based theory’, nor is there agreement on the definition of many central concepts, such as ‘knowledge’ and ‘capabilities’. Moreover, although most studies are framed in the tradition of evolutionary economics, the competence-based approach does is still some distance away from providing a truly ‘evolutionary’ theory of the firm (Niman, 2004).

This paper addresses both of these shortcomings. Its primary objective is to synthesize parts of the inherited literature by incorporating the issues that it has addressed into a larger and hopefully more coherent framework. In doing so, it attempts to extend competence-based theory in a more evolutionary direction, i.e. towards a theory not only explaining the existence of firms and the determinants of their boundaries, but addressing also the changes in industry composition and structure that result from the creation, growth, and the replacement of old firms by new ones.

In order to more clearly set out the attempted contribution and how the paper builds on available literature, the next section offers a brief review of a number of central models.

The review identifies four distinct types of knowledge governance problems, each with its own characteristics and strategic significance. It also reveals a certain conceptual ambiguity regarding the abstract notions of ‘knowledge’ and ‘knowledge transfer’ employed in defining these problems.

The remainder of the paper sketches an evolutionary synthesis of the inherited literature with the aim to resolve some of its ambiguities and contradictions. It proposes a few building blocks of a dynamic theory of the firm, combining elements of both transaction cost theory and the knowledge-based view. A central component of the proposed synthesis is an explicit social-constructivist and contextual conceptualization of knowledge as residing in groups of practitioners, *epistemic communities*. Section 3 defines and discusses the nature of different types of such communities and the structure of the knowledge they possess.

In section 4, the proposed conceptualization is applied in a stylized evolutionary model, indicating the dynamic relationships between the four knowledge governance problems, indicating some possible consequences for the institutional structure of production in the industry (Coase, 1992).

THE ‘KNOWLEDGE-BASED’ VIEW

Many of the notions regarding the nature of ‘knowledge’ informing the ‘knowledge-based’ theory of the firm can be traced to Winter’s (1987) observation that explicit knowledge is easier and less costly to pass on and replicate than is tacit knowledge, the transfer of which can only take place in face-to-face interaction in master/apprentice-like relationships. According to this argument, firms have an incentive to invest in articulation and codification of their knowledge – especially knowledge that they intend to replicate or frequently transfer from one context to another. However, while articulation facilitates voluntary transfer, it tends, Winter suggested, to also increase the risk of involuntary transfer, imitation.

The idea that voluntary replication and involuntary imitation are mirror image problems has found wide acceptance and has stimulated a rich stream of both theoretical and empirical research. As formulated by Spender and Grant (1996, p. 8), a basic proposition of the genre is that “...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 argues 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 reviewing this influential literature, the reader is struck by the heterogeneity both of its fundamental assumptions and of the conclusions reached. While there is general agreement that certain characteristics of firm organization, such as propinquity, stability of relationships and commonalities of vocabulary provide favorable conditions for knowledge-intensive processes, there is no agreement as to whether these complement more traditional transaction-cost arguments (Nahapiet and Ghoshal, 1998; Nickerson and Zenger, 2004) or supersede them by providing an alternative and more convincing set of explanations to the existence and boundaries of firms (Kogut and Zander, 1992, 1993, 1996; Madhok, 1996; Conner 1991; Conner and Prahalad, 1996).

There is no agreement either as to the nature of the knowledge processes that the proponents of knowledge-based theories believe are more efficiently carried out within firms than across markets. Some emphasize the efficiency of firms in the *exploitation of existing knowledge*; others view their superiority in the *creation of new knowledge*. In some accounts, firms are argued to be superior vehicles for the transfer of (tacit) knowledge *within* epistemic communities, i.e. functional or occupational groups whose members have the same training and professional experience; others emphasize their role in facilitating exchange of specialist knowledge *between* members of different groups, where lack of common expertise makes knowledge-sharing difficult. Combining these two dimensions yields a simple typology of basic knowledge governance problems (Figure 1).

	Exploitation of existing capabilities	Creation of new capabilities
Knowledge exchange <i>within</i> epistemic communities	<i>Replication</i> Kogut & Zander 1993 Winter & Szulanski 2001	<i>Articulation</i> Cowan <i>et al.</i> 2000 Håkanson 2003
Knowledge exchange <i>between</i> epistemic communities	<i>Integration</i> Grant 1966a; 1966b	<i>Combination</i> Nickerson & Zenger 2004 Nahapiet & Ghoshal 1998

Figure 1. Typology of knowledge governance problems

Four types of knowledge governance

Replication

Kogut and Zander (1993) in a celebrated article¹ focus on the *replication* of knowledge, as in the case of transfer of manufacturing technology between production plants in different countries.² Firms, they argue, specialize in the internal transfer of tacit and idiosyncratic knowledge. Their ability to internally replicate knowledge in new locations more cheaply than this can be accomplished through licensing or other market transactions accounts for the emergence of the multinational corporation. The cost of internal transfer relative to transfers governed by arm's length contracts therefore determines the boundaries of firms.

Integration

Grant (1996a, 1996b) too focuses on knowledge application rather than knowledge generation. Following Demsetz (1988), Grant's analysis is based on the observation that the production of goods and services requires the coordination of many individual specialists:

¹ Tallman, 2003; Verbeke, 2003; Kogut and Zander, 2003.

² The authors elsewhere (Kogut and Zander, 1992; 1996) discuss also the creation and recombination of knowledge as well as its transfer between functional groups (such as from R&D to production). However, their discussion makes only passing reference to the qualitative differences between these processes.

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.)

But whereas Kogut and Zander (1993) underscore the ability of firms to cheaply replicate existing knowledge, Grant emphasizes the role of firms for the *integration* of specialist knowledge.³ In his conceptualization, firms exist as institutions because they create conditions, such as propinquity and ‘low-powered’ incentives that facilitate the integration and coordination of specialist knowledge (Grant, 1996, p. 112).

Combination

Following another lead provided by Kogut and Zander (1992), a number of authors (Grant, 1996b; Nahapiet and Ghoshal, 1998; Galunic and Rodan, 1998; Nickerson & Zenger, 2004) discuss the relative advantages of firms in the generation of knowledge, rather than in its exploitation. In line with Schumpeter’s (1934) classical definition, these authors view innovation as the result of new *combinations* of specialized knowledge. Firms, they argue, are superior to markets in coordinating the activities required to create new configurations of knowledge in the form of ‘architectural innovations’ (Abernathy and Clark, 1985; Henderson and Clark, 1990), requiring integration of knowledge across disciplinary and functional boundaries.

The conceptual underpinnings for this proposition vary. In line with Kogut and Zander (1992; 1996), Nahapiet and Ghoshal (1998) stress the ability of firms to support the creation of ‘social capital’, in which concept they include structural (e.g. access to people and information), cognitive (e.g. common language) and relational (e.g. trust and mutual

³ Referring to the problem of knowledge integration, Kogut and Zander (1992, p. 389) note that “the vertical transfer of technology, as when a product is moved from development to production, poses additional problems insofar that the shared codes of functional groups differ.” Although more difficult, the authors do not seem to view these problems as qualitatively different from those associated with replication. Firms resolve both by providing “...a set of higher-order organizing principles [which] act as mechanisms by which to codify technologies into a language accessible to a wider circle of individuals” (Kogut and Zander, 1992, p. 389).

obligations) dimensions. Nickerson and Zenger (2004) agree that ‘consensus-based hierarchies’ may be superior on solving very complex problems with a high degree of interaction among individual design solutions. However, they add the critical observation that such governance is also associated with costs and drawbacks:

The costs associated with supporting extreme levels of knowledge transfer are substantial and become unwarranted as problems diminish in complexity. Further, low-powered incentives constrain the motivation to develop specialized knowledge and dampen incentives for solution search. The scope of investment in shared language and socialization and the efforts involved in the transfer of knowledge can be excessive when problems are only moderately complex... Moreover, social attachments and idiosyncratic language that accompany consensus-based hierarchy can increase the cost of search by generating search heuristics that are limited in the knowledge sets that they incorporate. (Nickerson and Zenger, 2004, p. 627)

Thus, in contrast to the many contributions which highlight the benefits of hierarchy over market governance, Nickerson and Zenger (2004) explicitly point out its possible limits, noting that a truly knowledge-based theory of the firm requires ‘a theory of alignment’, e.g. “a theory that predicts when hierarchies are preferred to markets or when markets prevail” (Nickerson and Zenger, 2004, p. 618).

Articulation

The final quadrant in Figure 1 refers to knowledge creation within occupational communities (Cowan *et al.*, 2000). As argued elsewhere (Håkanson, 2003), this takes place primarily through *articulation* of the tacit knowledge informing craftsman-like practice into explicit codes, tools and theory. Investment in articulation is undertaken in search of benefits, such as those associated with innovation, division of labor, and replication and control. Articulation implies knowledge creation – 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 (Resnick, *et al.*, 1991; Boisot, 1995).

In spite of its pervasive importance, articulation and the associated governance problems have been largely ignored in knowledge-based theories of the firm. The reason, one suspects, is the current fascination with the tacit component of knowledge and the belief that because it is inimitable, ‘tacit knowledge’ is a critical source of sustainable competitive advantage (see, e.g., Winter, 1987; Kogut and Zander, 1992, 1993; Grant, 1996b).⁴ The benefits of articulation are largely ignored in the literature.

Conclusions

As outlined above, available accounts of knowledge governance focus on specific types of governance problems and are therefore fragmentary to the overall problem. However, prior studies provide the basis for the synthetic perspective sketched in this paper. As its basis, it adopts a slightly less abstract conceptualization of ‘knowledge’ than has been customary, i.e. as beliefs developed, validated and applied in *epistemic communities*, groups of people pursuing a shared enterprise or practice.

EPISTEMIC COMMUNITIES

The argument outlined in the following pages is premised on the conviction that all knowledge is socially constructed and context dependent. The knowledge context is defined by the social community where it resides.⁵ Knowledge that is recognized as relevant and useful in one context may be totally meaningless in another.

Within communities, producing, warranting, and propagating knowledge are almost indivisible. Between communities, as these get teased apart, division becomes prominent and problematic. Hence, the knowledge produced doesn’t readily turn into something with exchange value or use value elsewhere. (Brown and Duguid 1998, p. 99)

⁴ In spite of its centrality to the theoretical arguments of ‘the knowledge-based view’, the concept of ‘tacit knowledge’ is rarely unambiguously defined but is often invoked as shorthand for “stickiness” (von Hippel, 1994; Szulanski, 1996). An important exception is Nickerson and Zenger (2004) whose argument centers on the ‘complexity’ of the problems confronting firms and the degree of interdependence between specialist knowledge sets. Firms, they argue, are superior to markets in solving problems that cannot be decomposed into independent sub-problems, each drawing on only one set of specialized expertise. Their approach offers a both more rigorous and more relevant definition of knowledge ‘tacitness’ than that commonly employed (cf. Fleming and Sorenson, 2004).

⁵ 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.

Accepting – without going into the underlying epistemological assumptions – Plato’s classical definition of ‘knowledge’ as ‘justified true belief’⁶, I shall assume that knowledge obtains economic significance through *application* in the performance of an economically meaningful activity, i.e. the exercise of a skill that it informs. When engaging in a common enterprise, groups of people develop, maintain and nurture the knowledge informing the skills of their practice (Lave and Wenger 1991; Brown and Duguid 1991, 1998, 2001a, 2001b).

Through its practice, a community develops a shared understanding of what it 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 – in all a ‘world view’ (Lave and Wenger, 1991). This understanding comprises the community’s collective epistemic base (Mokyr, 2002). The processes of developing the knowledge base and the formation of the community are significantly interdependent: the practice develops the understanding, which can reciprocally change the community’s practice and their members’ view of themselves (Brown and Duguid 1998, p. 96).

In Wenger’s (1998) analysis of insurance claims processors or Orr’s (1996) studies of service technicians, small work groups or functional departments are seen as forming individual ‘*communities of practice*’ whose membership is defined by engagement in a common enterprise and mastery of a shared repertoire of skills (Lave and Wenger, 1991; Brown and Duguid, 1991, 1998; Wenger, 1998). Mutual engagement requires interaction and is therefore favored by geographical proximity and sometimes communities cluster in specific regions, where the acquisition of their skills is favored by the presence of organizations providing appropriate learning and employment opportunities (Håkanson, 2005). Examples include the engineers developing the technologies underlying the flat panel display industry (Murtha *et al.* 2001), and the cellular telephony clusters of northern Jutland (Dahl *et al.*, 2003)

⁶ Plato’s definition is not unproblematic (c.f. Gettier 1963) but will have to do for the present purpose.

However, 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). Indeed, most professional communities extend beyond individual organizations and localities. ‘Normative isomorphism’ through selection, socialization and vocational training leads to a professional...

... pool of almost interchangeable individuals who occupy similar positions across a range of organizations and possess a similarity of orientation and disposition that may override variations in tradition and control that might otherwise shape organizational behavior. (DiMaggio and Powell 1983, p. 152)

The semantic conventions in the inherited literature are ambiguous and it is useful, as Brown and Duguid (2001b) suggest, to distinguish such larger communities from the smaller work groups for which the term ‘community of practice’ was originally coined.⁷ Following recent usage (Steinmueller 2000; Cowan *et al.* 2000; Edwards 2001), I propose to use the term ‘*epistemic community*’ to denote groups of people mastering the tools, codes and theories of a common practice regardless of their geographical location and the intensity of mutual contact that they may maintain. In many accounts,⁸ ‘epistemic communities’ are defined as communities of practice engaged in deliberate knowledge creation. For the present purpose, that distinction is not so important since to various

⁷ Dougherty, following Douglas’ (1987) retranslation of Fleck’s (1935/1979) ‘Denkkollektiv’ (‘thought-collective’), uses the term ‘thought worlds’ to denote the beliefs and perceptions common to members of functional departments. Boland and Tenkasi (1995) use the phrase ‘communities of knowing’, Bechky (2003a; 2003b) prefers ‘occupational communities’ while Grant (1996) and Carlile (2002) discuss ‘expert knowledge’ primarily in terms of business functions. 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, Brown and Duguid (2001b, p. 205) propose the term ‘networks of practice.’ The latter term has the advantage of emphasizing the instrumental aspects of knowledge: ‘networks of practice’, like ‘communities of practice’ develop over time in the common pursuit of a shared enterprise; they exist because they have a task to accomplish. On the other hand – as the authors note – the reference to ‘networks’ is potentially misleading in that it implies a certain regularity of contact that need not apply.

⁸ The concept was first proposed by Holzner (1968) to denote “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). It was similarly applied also by Knorr Cetina (1981) and Amin and Cohendet (2004, pp. 74-78) to denote groups of people involved in the deliberate production of knowledge, such as scientists or R&D engineers. It is also 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).

degrees *all* communities of practice engage in learning and knowledge creation – both by deliberate intention and by accident (Lave and Wenger, 1991).

Epistemic Communities as Interpretation Systems

Epistemic communities form ‘interpretation systems’ (Daft and Weick 1984). They exist in order to help their members interpret the world and provide meaning to their activities. Their ‘practice’ is always (negotiated) social practice and includes both explicit and tacit components (Lave and Wenger, 1991; Wenger 1998). Epistemic communities are where knowledge resides and articulation and knowledge creation can take place.

Epistemic communities are defined and delineated by the generation and maintenance of shared *coding schemes* (vocabulary, codes) and *cognitive frames* (theories, mental maps) that help the community and its members define and solve problems and ‘get the job done’ (Håkanson, 2003). Communities are also characterized by their inherited technology, much of which is typically embedded in *physical artifacts* of various kinds.

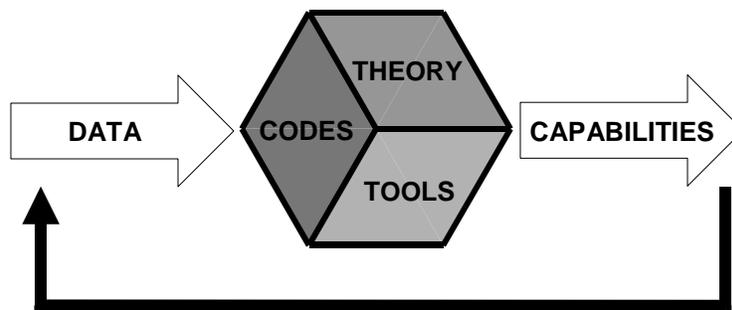


Figure 1. The functional elements of epistemic communities (adapted from Daft and Weick, 1984)

The capabilities of a community, i.e. the range and efficiency of the tasks it can perform, are determined by the dynamic interaction of these three elements, here labeled *codes*, *theory*, and *tools* (Figure 1). I use the concepts broadly. Thus ‘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.).⁹ ‘Theory’ refers to the *cognitive frames* that help it interpret and make sense of the messages.¹⁰ It includes tacit cultural elements and ‘*mental maps*’ but also formal *theoretical models* of the causalities deemed relevant to the practice. ‘Tools’, finally, is used to denote the *physical artifacts* that the community employs in the execution of its tasks or the development of its knowledge, including its physical “memory”, i.e. the records and artifacts in which its experience has been codified or embodied and on which it can draw in performing its tasks.

Some codes, some theories and the use of some tools are generally learnt as part of a typical primary school curriculum, for example the rules and conventions of writing the local language and the skills of using a pencil. The mastery of others is specific to particular epistemic communities and is acquired through a combination of advanced general education, specialized training programs, apprenticeship or trial-and-error experiential learning in actual practice. They include both tacit elements and explicit cognitive schemata, ranging from simple rules of thumb to explicit scientific theory.

Epistemic communities and knowledge governance

In the present context, epistemic communities are significant because membership affects both the *ability* and the *incentives* to exchange knowledge. Indeed, community membership is (by definition) a precondition for knowledge exchange. Mastery of the explicit codes, theory and tools of a community *enables* the members of a community to

⁹ One of the things required of new members of a community is the mastery of the local language: “[K]nowing how to act within a domain of action is learning how to make competent use of the categories and the distinctions constituting that domain... [To] engage in collective work is to engage in a discursive practice, namely in the normative use of a sign system which is directed at influencing aspects of the world and whose key categories and distinctions are defined through their use in discourse” (Tsoukas and Vladimirou 2001, p. 978). However, as White (1990) has pointed out, effective use of language also requires (generally tacit) agreement as to what level of imprecision is acceptable: “Part of maintaining a community is maintaining the agreement not to speak or ask about the ways in which its language means differently to for different members. And those differences can be so enormous that in listening to the talk one is often surprised that it can go on at all.” (White 1990, p. 36 in Weick 1995, p. 107)

¹⁰ Cognition is the most socially-conditioned activity of man, and knowledge is the paramount social creation. The very structure of language presents a compelling philosophy characteristic of that community, and even a single word can represent a complex theory.... every epistemological theory is trivial that does not take the sociological dependence of all cognition into account in a fundamental and detailed manner.” (Fleck 1935, p. 42 in Douglas 1987, p. 12)

transmit and receive codified knowledge as ‘information’. 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. Thus, both through voluntary sharing and through involuntary imitation, community membership provides potential access to all knowledge available to the community.¹¹

Second, epistemic communities provide identity to their members, thereby influencing their readiness and *motivation* to share knowledge (Lave and Wenger, 1991; Brown and Duguid, 1991; Fiol, 1991; Kogut and Zander, 1996; Nahapiet and Ghoshal, 1998; Wenger, 1998; Osterloh and Frey, 2000). As emphasized by Lave and Wenger (1991, p. 53) “... identity, knowing, and social membership entail one another.” The assumption that knowledge is socially constructed implies that ‘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 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).

For both cognitive and motivational reasons, knowledge exchange *within* professional epistemic communities is generally unproblematic; it can be accomplished with ease regardless of geographical distance or organizational memberships. Members have simi-

¹¹ This helps to explain Zander’s and Kogut’s (1995) unexpected finding that the hazard of imitation of manufacturing technologies was unrelated to their degree of tacitness.

lar backgrounds in terms of interests, formal training and practical experience. They interpret their common practice in similar ways and share mastery of its tools. As already noted, these commonalities are not limited to explicit aspects; engagement in the same practice provides similar types of experiential or tacit knowledge. In consequence, knowledge exchanges associated with replication and articulation do not typically require hierarchical governance; they can efficiently be accomplished both through market transactions and in informal network bartering (von Hippel, 1987; Schrader, 1991).

More difficult, and of more immediate theoretical significance are the governance problems associated with the exchange of knowledge *across* professional epistemic communities; as convincingly argued in the contributions already referred to (Grant, 1996a, 1996b; Napiet and Ghoshal, 1998; Nickerson and Zenger, 2004), integration and combination of knowledge often require or favor hierarchical governance. The reason, I shall argue, is that firms constitute special forms of epistemic communities, the creation of which requires transaction specific investments unlikely to be realized under market governance.

Firms as Epistemic Communities

As emphasized by Grant (1966a), a primary reason for the existence of firms is that they provide the means for knowledge integration and coordinated action without requiring people of different occupational backgrounds to share or understand each other's knowledge and world-views. In other words, the significance of firms for knowledge governance is their ability to form epistemic communities in their own right, spanning heterogeneous occupational and functional groups. Like other epistemic communities, those formed by firms and other organizations are defined by the uniqueness of the codes, theories and tools that their members share: common vocabulary, organizational culture and boundary objects (Figure 2).

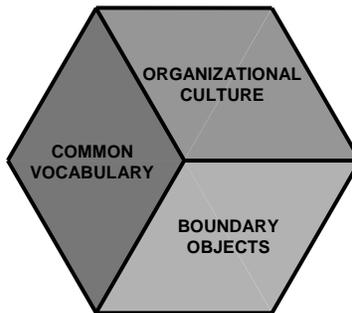


Figure 2. Firms as epistemic communities

Common vocabulary

One of the elements most often discussed in the literature is the ability of firms to provide their members with a common language or code (Arrow, 1974). As Grant, (1996a, p. 115) points out, this may include also the ‘common knowledge,’ of natural language and other basic symbolic means of expression (literacy, numeracy, familiarity with standard software, etc). 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). 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,¹² but may, of course, be a means to appropriate private knowledge rents (Kogut and Zander, 1992).

¹² Polanyi, too, emphasizes the dependence of codes on cultural tradition: “In learning to speak, every child accepts a culture constructed on the traditional interpretation of the universe, rooted in the idiom of the group to which it was born...” He also notes how this impedes communication across epistemic communities. “Different vocabularies for the interpretation of things divide men into groups which cannot understand each other’s way of seeing things and acting upon them. For different idioms determine different patterns of possible emotions and actions.” (Polanyi 1962, p. 112)

Organizational culture

The term 'organizational culture' is here used as a shorthand to indicate both articulated and not so well articulated theories, beliefs and cognitive maps that guide organizational decision-making by providing the shared knowledge infrastructure necessary for efficient knowledge integration (Grant, 1966a, p. 115 f.). 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.

Boundary objects

Like other epistemic communities, firms and other organizations are supported not only by intangible codes and cognitive schemata but also by tangible physical artifacts that bridge the epistemic boundaries of specialized occupational and functional groups (Carlile, 2002; Bechky, 2003; Star, 1989; 1993). Such *boundary objects* "...both 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 across borders and maintain some sort of constant identity" (Bowker and Star 1999, p. 16). Boundary objects facilitate coordinated action without requiring members of different communities to align their understanding of each other's knowledge:

Perspective-taking is never a one-to-one mapping of meanings. Members of the same community of knowing will not have full consensus, and members of different communities cannot simply adopt the meaning of another. ... [B]oundary objects do not convey unambiguous meaning, but have instead a sort of symbolic adequacy that enables conversation without enforcing commonly shared meanings. (Boland and Tenkasi, 1995, p. 362)

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).

Implications

The formation of firms as epistemic communities does not come about automatically but requires investment and effort 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 employees acquire in their jobs can be exploited in other firms. However, many of the physical and intangible assets needed to establish the firm as an epistemic community are situational and cannot readily be transferred to applications outside the organizational context where they were created. Such transaction specific investments are difficult to realize under market forms of governance.

Arrow (1974, p. 56), discussing the role of firm specific codes, notes 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. It follows that organizations, once created, have distinct identities, because the costs of changing the code are those of unanticipated obsolescence... (Arrow, 1974, p. 55)

Conversely, and this is, in fact, often the very reason they are undertaken – such investments can provide unique and difficult-to-imitate capabilities. For firms, as Grant perceptively argues,

... 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, 1966b, p. 380)

For employees, of course, 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).

TOWARDS A DYNAMIC MODEL OF KNOWLEDGE GOVERNANCE

The kernel of the knowledge-based critique of transaction-based theory is the simple but fundamental observation that in order for transaction-cost logic to apply, there must be something to transact. Incentives to behave opportunistically (or cooperatively) are only relevant to the extent that such behavior is matched by the requisite ability. Without access to some valuable asset to cheat about, the readiness or desire to do so is little but a character flaw and lacks economic significance. The fundamental question that the theory of the firm needs to address, therefore, is the relative role of *incentives* and *transaction costs*, on the one hand, and *capabilities* and *production costs*, on the other, in explaining the choice of governance. As outlined above, the literature suggests that these roles vary in predictable ways between the four archetypes of knowledge governance problems.

Although some of the detail remains to be worked out, the extant literature provides a good understanding of each type of knowledge governance situation. However, little attention has been given to the *interrelationships* between different kinds of knowledge governance problems and to their relative *significance*. The conceptualization outlined below attempts to address these issues. While accepting that each of the four types of knowledge governance can be analyzed in isolation from the others, it advances the proposition that there are also important linkages between them. As schematically depicted in Figure 3, these linkages introduce a dynamic aspect and suggest the possibility of a more evolutionary conceptualization of the knowledge-based view.

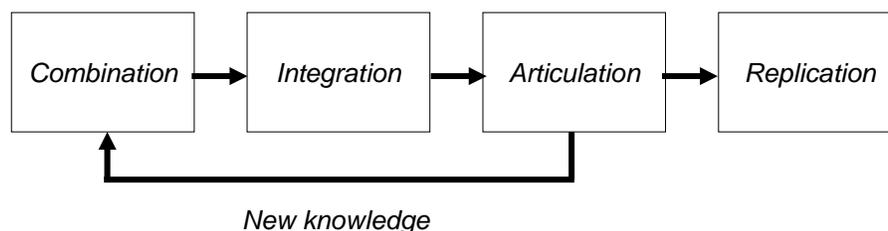


Figure 3. A dynamic model of knowledge governance

Combination

In line with evolutionary theory in the Schumpeterian tradition, entrepreneurial new business formation is associated with innovations, i.e. new *combinations* of existing knowledge and physical assets. In assembling such combinations, the entrepreneur must decide on the contractual forms by which each will be obtained (Alvarez and Barney, 2004). Inherited transaction cost logic suggests that knowledge assets that are well defined, either because they are highly codified or because they are embedded in physical artifacts, will typically be managed through non-hierarchical governance. More intriguing are the contractual problems associated with the acquisition of specialized expertise, the precise value and use of which can typically not be ascertained in advance because innovation processes are often characterized by uncertain and dynamic interdependencies between specialist knowledge sets. As Nickerson and Zenger (2004) argue, these situations involve several kinds of contractual hazards that favor hierarchical governance solutions. Moreover, hierarchical governance also helps avoiding the ‘mundane transaction costs’ of creating and maintaining transactional interfaces in the fluid and fluctuating conditions that characterize many innovation processes (Baldwin and Clark, 2003)¹³.

¹³ Although rarely made explicit, a fundamental issue underlying the literature is the definition of what kind of knowledge transfers constitutes ‘transactions’. According to Williamson’s (1985, p. 1) highly abstract notion, “a transaction occurs when a good or service is transferred across a technologically separable interface. One stage of activity terminates and another begins.” Although not usually formulated in this way, a crucial problem in the knowledge-based approach is the definition of what constitutes a ‘technologically separate interface’, a problem about which Williamson’s discussion provides little guidance. In their search for a more rigorous definition, Baldwin and Clark (2003) point out that in order for a transfer (of knowledge, for example) to qualify as a ‘transaction’, three conditions must be met: (1) The transacting parties must record the fact that a transfer has occurred, (2) they have to agree on what has been transferred, and (3) some sort of exchange (in money or in kind) must be involved. Within firms – and this is an important reason for why they exist – most knowledge transfers take place without being counted, standardized, or paid for. The reason, Baldwin and Clark note, is that the creation of transactional interfaces is often costly. The relevant costs are typically not those associated with agency or opportunism, but the ‘mundane’ costs of “...defining what is to be transferred, of counting the transfers, and of valuing and paying for the individual transfers. These costs... are determined by the material, energy, and information flows embedded in the underlying system of production. At some points in the system, transfers are simple, and therefore, easy to standardize, easy to count and easy to value. Mundane transaction costs are low at these points. At other places, transfers are complex, hence impossible to standardize, impossible to count, and impossible to value” (Baldwin and Clark, 2003, p. 4).

Integration

In all but the most trivial cases, the commercial exploitation of a new product or service requires the coordinated effort of individual specialists with different kinds of functional and occupational expertise (Demsetz, 1988; Grant, 1996a, 1996b). 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". As argued above, a common way to achieve effective '*perspective taking*' is the formation of boundary-spanning epistemic communities, such as firms and other organizations, where common cognitive maps, common vocabulary and various kinds of boundary objects can be developed.

The creation and maintenance of organizational epistemic communities require transaction specific investments, which are likely to increase with the range and diversity of the knowledge they help to integrate. Firms therefore have an incentive outsource products and services whose use does not require in-depth knowledge of their production. For reasons outlined below, the proportion of knowledge that can be obtained in embedded form tends to increase over time. This helps to explain the observed tendency towards disintegration that can be observed in many mature industries (Langlois, 2003).

Articulation

The ability to integrate the knowledge residing in a firm's various functional and occupational epistemic communities is often both idiosyncratic to organizational context and at least partially tacit. Superior integrative skills are therefore difficult to imitate and may confer competitive advantage (Grant 1996a). However, precisely these characteristics also mean that organizational processes that depend on the efficient exchange of knowledge between epistemic communities are often unreliable and prone to failure (Dougherty, 1992). Firms therefore have an incentive to improve the precision and reliability with which critical production processes and organizational routines can be performed. The quest for such control is an important motive for firms to invest in the articulation – the conversion of tacit into explicit knowledge – and codification – the

rendering of explicit knowledge in standardized fixed form (Beniger, 1986; Yates, 1989; Håkanson, 2003). Articulation and codification are often undertaken as a means to improve control and replicability, but have other fundamental consequences as well. Two of these are of particular significance in the present context: *knowledge creation* and increasing division of cognitive labor through *task modularization*.

Knowledge creation

Articulation takes place within epistemic communities and involves – in varying proportions – the development of new theory, new codes and new tools. As indicated in Figure 3, this new knowledge (theory, codes and tools) may subsequently – in new or in existing firms – be innovatively combined and recombined with other elements, starting the cycle anew.

Modularization

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, therefore, articulation involves *classification, standardization and naming* (Bowker and Star, 1999) as well as the *creation and definition of interfaces* between activities of the practice. It therefore facilitates the *division of labor* and the exploitation of benefits of *specialization* (Håkanson, 2003).

Through the standardization of interfaces and transfers, articulation dramatically reduces the ‘mundane transaction costs’ associated with “standardizing, counting and compensating”. As Baldwin and Clark (2003) perceptively note, this has several primary benefits: From an economic point of view, transforming non-transactional transfers of knowledge into transactions is a means to improve incentives and to avoid problems of opportunism. From an engineering point of view, it creates new possibilities to manage

and maintain complex production systems involving extensive division of cognitive labor:

Standardizing interfaces and counting what flows across an interface are classic ways of managing complexity and coordinating large decentralized systems. And local compensatory “payments” or feedback are a brilliant device for maintaining resource balance (homeostasis) in a complex system; for providing prompt diagnosis, repair and triage; and for constructing a fault-tolerant, robust and incrementally extensible network. (Baldwin and Clark, 2003, p. 15)

The creation of transactional interfaces is a consequence of design decisions. These, in turn, depend to a significant degree on the degree of articulation and codification of the knowledge on which they are based. Improved theoretical understanding of the technologies supporting a system of production increases the number of potential transactional interfaces within it. This makes the specialization of cognitive work more feasible and increases the likelihood of the system’s institutional disintegration (Garud and Kumaraswamy, 1995; Sanchez and Mahoney, 1996; Langlois, 2003). The model therefore holds promise to link micro-level knowledge governance processes to the evolution of industry composition and structure that result from the creation, growth, and the replacement of old firms by new ones.

Replication

In a world of Schumpeterian competition, the ability to replicate unique capabilities before obsolescence and imitation erode their value is a key strategic capability. Theoretical arguments and empirical evidence lend good support to the proposition that – all things equal – the cost and difficulty of capability replication decrease with the degree of articulation and codification of the underlying knowledge. Technology transfers that can be effected through the mere transmission of an artifact or a set of blueprints are clearly much less expensive than ones requiring the personal engagement of experts for design modifications or on-the-job training. The attractiveness of investing in codification, standardization and modularization increases with the frequency of transfer: the sooner and the more often a firm attempts to transfer its technology to a new site, the stronger its inducements to incur the costs and effort of its articulation (Zander and

Kogut, 1995; Simonin 1999)¹⁴. The desire for increased profits through rapid and reliable replication is the motive-force for articulation, codification and the creation of new capabilities through the development of new codes, new tools and new theory (Winter and Szulanski, 2001; Teece, 1977; Contractor, 1981).

SUMMARY AND CONCLUSION

For both economists and management scholars, ‘knowledge’ has been a notoriously difficult concept to define and operationalize (Machlup, 1980). The problem is aggravated by the fact that, in everyday usage, the word ‘knowledge’ takes on a whole set of different meanings and that in the English language, ‘knowledge’ denotes both the ‘substantial knowledge’ of facts and relationships and the ‘procedural knowledge’ of skills and capabilities. Perhaps in response to these difficulties, much recent theorizing has tended to adopt highly abstract notions of knowledge, blurring the difference between ‘cognitive knowledge’ and ‘capabilities’, concentrating instead on the (often ill-defined) distinction between its ‘tacit’ and ‘explicit’ characteristics. Employing a social-constructivist view of knowledge – defining ‘knowledge’ in terms the specific codes, tools and theory that individual epistemic communities recognize as conducive to their practice – this paper attempts to strike a middle ground in terms of abstraction, while upholding the distinction between procedural ‘skills’ and the cognitive ‘knowledge’ which informs them.

¹⁴ According to Kogut and Zander (1993), there is a causal relationship between a technology’s degree of codification and the probability that its transfer to foreign countries will take place through licensing rather than foreign direct investment. In their empirical test of this proposition, the characteristics of technologies as measured in 1989 are used to explain decisions regarding the mode of their foreign exploitation that were made, in some cases, two or three decades earlier. However, the implicit assumption that the tacitness of technologies remains constant over time is unconvincing. The statistical association observed can be better explained by traditional transaction-cost logic, which suggests a reverse order of causality: The completion of agreements involving the sale of tacit or incompletely codified knowledge is difficult. The wish (regardless of reason) to complete a licensing agreement therefore provides a powerful incentive to invest in the articulation and codification of the technologies involved. Technologies licensed to third parties can therefore be expected to be, on average, more completely codified than those exploited only internally. Analogously, the statistical relationship between the ‘codifiability’ and ‘teachability’ of manufacturing capabilities and the probability of early (voluntary) transfer reported in Zander and Kogut (1995) cannot be taken as evidence of causality unless, again, one assumes that the degree of tacitness of technologies is constant over time. A more probable interpretation is that rapidly transferred technologies are more completely articulated because firms have had more time and stronger incentives to invest in their codification.

The proposed conceptualization offers a means to reconcile and synthesize the literature on knowledge governance. It also suggests a number of simple, but orderly and logical linkages between the four basic knowledge processes of *combination*, *integration*, *articulation* and *replication*. The paper combines the four into a dynamic model of firm and industry evolution, relating the knowledge processes of firms to the division and specialization of cognitive work and to the nature of the transactions that link individual epistemic communities. It attempts to reconcile and synthesize a number of theoretical traditions in the literature. In so doing, it throws new and important light on the dynamic relationships between firm level knowledge governance and industry organization. Moreover, the model appears to lend itself quite naturally to the derivation of testable propositions that can be subjected to empirical verification. Much work remains to be done.

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