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ARE IMITATION AND REPLICATION MIRROR-IMAGE PROBLEMS?

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ABSTRACT

All knowledge is context dependent. The relevant context is the social community where it resides, i.e. the '*epistemic community*' formed as groups of people define and legitimize the knowledge they possess. In the mutual engagement in a common enterprise, epistemic communities develop, maintain and nurture the *codes*, *tools* and *theories* that provide the basis of their practice. Commonalities of code, tools and theory facilitate both voluntary transfer and involuntary imitation of knowledge *within* communities, also ones spanning organizational boundaries. Conversely, knowledge transfer *between* different epistemic communities, whether desired or unintended, is often cumbersome and fraught with difficulties. In order to achieve effective integration and cooperation between its various professional communities and subcultures, firms must therefore undertake investments in boundary-spanning mechanisms. Since these investments are specific to the context in which they take place and to the transactions that they enable, they cannot easily be organized through arm's length contracts. Firms exist because they have a relative advantage over markets in the *integration* of diverse knowledge. However, the associated capabilities need not translate into a relative advantage also in the *transfer* of knowledge, i.e. knowledge exchanged between members of the same epistemic community. Within communities, knowledge disseminates with relative ease both intentionally and through emulation. Knowledge thus acquired can generally be applied also outside the context of the exchange and the effort or investment expended in its acquisition is not transaction specific. The governance mode applied in such exchanges is therefore determined by strategic and contextual factors, including those of traditional transaction cost logic.

INTRODUCTION

For a considerable time, the organization and management literatures were dominated by a rather mechanistic model of language and communication, inspired by the pioneering work of Shannon and Weaver (1949). This 'information processing' perspective of communication assumed the existence of shared codes and syntax and that meanings to be conveyed can be expressed as codified messages. As summarized by Boland and Tenkasi (1995, p. 352), the associated 'conduit model' of communication suggests that

> … communication can be improved by reducing noise in the channel, with noise defined as the possibility for error of contaminating the message on its route from sender to receiver. Noise can be reduced by increasing the channel capacity; by refining the procedures for encoding and decoding messages; by providing more reliable storage and retrieval facilities; or by making the channel of communication more universally available.

Today, these assumptions have been all but abandoned. Although their objectives and emphases differ, the parallel and overlapping theoretical developments of the 'resource-based view' on strategy (Wernerfelt, 1984; Barney, 1986; 1991, Peteraf, 1994) and that of the 'knowledge-based' approach to the theory of the firm (Kogut and Zander 1992; 1993, 1996; Grant, 1996a, 1996b) have been associated with a broad convergence regarding the way in which 'knowledge' – a central concept in both streams of literature – is conceived. Influenced by theoretical advancements in the sociology of knowledge and organizational theory (Lave & Wenger, 1991; Orr, 1996; Brown & Duguid, 1991; 1998), this consensus emphasizes the 'social' and 'path-dependent' nature of knowledge and the economic and strategic significance of 'tacit' as opposed to 'articulated' knowledge.

Following a influential conjecture by Winter (1987), much current literature has focused on the competitive significance of skills based on 'tacit' knowledge which, it is generally assumed, is a main source of valuable, rare and difficult to imitate capabilities. Again following Winter (1987),

this idea is often combined with its converse, i.e. explicit knowledge is by nature easily imitated and can therefore only provide momentary advantage. The conclusion commonly made is that it is easier to appropriate the returns to tacit than to codified knowledge.

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."

The recognition that not all knowledge can be communicated in codified form is a valid and important one. However, the assumption that there are no barriers to the transfer and involuntary diffusion of codified knowledge is seriously misleading. It abstracts from the critical fact that meaningful transfer of even the simplest piece of information requires that the recipient masters the code in which it is expressed and can apply a theoretical frame relevant to its interpretation (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998). Similarly, the current emphasis on the situational and personal aspects of tacit knowledge has tended to obscure the fact that tacit knowledge can be 'shared' in the sense that people that have undergone the same experiential learning process will master the same tacit skills (Boisot, 1995; Sanchez, 1997). It therefore underestimates the potential for imitation and involuntary transfer of knowledge within epistemic communities.

As outlined below, the problems associated with the exchange of specialized knowledge *across* the borders of epistemic communities are different from the ones encountered when knowledge is transferred *within* them. While communication of knowledge between people belonging to the same community who share a common vocabulary, methods of practice and tacit skills is generally unproblematic, knowledge exchange between individuals belonging to different communities is often difficult, time consuming and expensive (Boland and Tenkasi, 1995). Fortunately, cooperation, coordination and joint action between the various occupational specialists of a firm do not require that each acquire the knowledge of the other. As Grant (1996a, p. 114) emphasizes, "… *transferring* knowledge is not an efficient approach to *integrating* knowledge."

The following discussion is based on the premise that knowledge cannot be meaningfully defined without reference to the group of people ('epistemic community') where it resides. The first section of the paper outlines a social-constructivist conceptualization of knowledge as consisting of three interacting elements – theory, tools, and codes – that constitute the objects of a community's socially negotiated 'knowledge', and the mastery of which defines its members.

The paper thereafter outlines some implications of the proposed model. It proceeds on the observation that the problems associated with the *integration* of specialized knowledge are different from the ones encountered when *transferring* knowledge within epistemic communities. The distinction reflects significant differences in the transaction costs associated with the exchange and exploitation of knowledge and has, therefore, fundamental implications for the selection of governance modes for such transactions. It has also implications for the imitability and substitutability of different kinds of knowledge assets, central concerns in the resource based view of strategy. The latter is the focus of the present paper.

EPISTEMIC COMMUNITIES AND THE CONCEPT OF KNOWLEDGE

The premise of the following argument is a view of knowledge as socially constructed and context dependent. The knowledge context is defined by the social community where it resides. Knowledge that is recognized as relevant and useful in one context may be totally meaningless in another. The basis of a community's knowledge is its practice, i.e. its shared understanding of what it does and of how to do it. This understanding comprises the community's collective knowledge base. The processes of developing the knowledge and the community are significantly interdependent: the practice develops the understanding, which can reciprocally change the community's practice and identity (Brown and Duguid 1998, p. 96).

Membership in a community is obtained through the acquisition of its skills through formal training, apprenticeship or in other types of situated learning processes, such as those described by Lave and Wenger (1991) as 'legitimate peripheral learning'. Studies in the sociology of learning typically focus on small work groups or functional departments that are seen to form '*communities of practice*', individuals mutually bound by their engagement in a common enterprise and mastering a shared repertoire of skills (Lave and Wenger, 1991; Brown and Duguid, 1991, 1998; Wenger, 1998).

The formation and survival of such 'communities of practice' are based on close, often face-to-face interaction. However, through training and work experience, the members of such local communities are typically members also of larger professional communities which span organizational boundaries. As DiMaggio and Powell (1983, p. 152) point out, , '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.

The semantic conventions in the inherited literature are ambiguous and it is useful, as Brown and Duguid (2001b) suggest, to more clearly distinguish than is usually done such larger communities from the smaller work groups for which the term 'community of practice' was originally applied.[1] Following recent usage (Steinmueller 2000; Cowan *et al*. 2000; Edwards 2001), I propose use '*epistemic community*' as a generic term, regardless of the geographical concentration and intensity of mutual contact between members.

Epistemic communities 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 (Wenger 1998). Epistemic communities are where knowledge resides and articulation and knowledge creation can take place.

The capabilities of a community, i.e. the range and efficiency of the tasks it can perform, are determined by the dynamic interaction of three elements: *codes*, *theory*, and *tools*. 'Codes' refer to all symbolic means through which community members communicates 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.). 'Theory'

[1] 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.

refers to the cognitive frames that help them interpret and make sense of the messages. It includes tacit cultural elements and 'mental maps' but also formal theoretical models of the causalities deemed relevant to the practice. 'Tools', finally, denotes 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. Codes, theories and tools include both tacit elements and explicit cognitive schemata, ranging from simple rules of thumb to explicit scientific theory.

KNOWLEDGE EXCHANGE WITHIN EPISTEMIC COMMUNITIES

Members of the same epistemic community 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 tools. These commonalities are not limited to explicit aspects; engagement in the same practice provides similar types of experiential or tacit knowledge. In consequence, knowledge transfer between individual members of the same epistemic community can often be accomplished with relative ease regardless of their geographical location or organizational memberships. Indeed, within epistemic communities, the communication of articulated knowledge rendered in standardized code can usefully be analyzed largely as an information processing problem, with emphasis on the existence of shared syntax (Boland and Tenkasi, 1995; Carlile, 2002).[2]

Whereas the transfer of codified knowledge within a community can take place with ease regardless of the distance between sender and receiver, tacit knowledge elements can only be acquired through personal experience, often over long periods. This generally requires some form of master-apprentice relationship or on-the-job training and is therefore dependent on geographical proximity between the learner and her master and/or place of work.

[2] There is a caveat to this proposition: Differences in language and syntax exist not only *between* different epistemic communities but also *within* them, as local groups of practitioners develop idiosyncratic coding schemes (Allen 1977). These enhance the efficiency of communication among community members but impede communication with 'outsiders'. Like other aspects of organizational culture, local codes tend to be taken for granted and their mastery is largely tacit. Idiosyncratic codes frequently aggravate the problem of communication across organizational boundaries: "There is a great deal of overlap among the coding schemes of different organizations operating within the same culture. On the other hand, the nonoverlapping areas, however small, can potentially operate to produce semantic noise, and they can be even more troublesome because it can go undetected" (Allen 1977, p. 139). However, although oftentimes frustrating when they are encountered, the significance of these types of communication barriers should not be exaggerated.

Although tacit knowledge is, by definition, rooted in the personal experience of the individual, members of the same epistemic community have been exposed to the same type of experience. The tacit knowledge that it provides is therefore not private but shared within the community, whose members are sometimes geographically widely dispersed (Amin and Cohendet, 2004. Hence, even when the knowledge applied in the production of a particular artifact is highly tacit, this may not prevent its (perhaps involuntary) diffusion. Contrary to a common assumption, the ease of imitation is not so much dependent on the degree of articulation of the knowledge in question as on the extent to which the relevant epistemic community extends beyond the boundaries of individual firms or geographical localities. In many industries, also ones characterized by highly tacit knowledge and practices, the mere demonstration that a particular product design is feasible, as evidenced in a functioning physical product or other artifact, is sufficient to induce and permit rapid imitation.[3]

Being incidental to their primary purpose, the knowledge embodied in artifacts often has strong tacit elements. Nevertheless, an observer belonging to the relevant epistemic community and versed in the appropriate practice can often through observation and reverse engineering 'decode' the artifact and lay bare the knowledge used in its design and production.

KNOWLEDGE EXCHANGE BETWEEN EPISTEMIC COMMUNITIES

Transfer of articulated knowledge is unproblematic as long as the recipient is in possession of the code required to decipher the message and the theoretical frames that give it meaning. However, like the knowledge they express, many codes are specific to certain epistemic communities, reflecting the nature of their practice and their beliefs and values:[4]

> Scientific disciplines observe semantic traditions and meanings that vary between their respective contexts. Thus "…interpretation and understanding of scientific concepts is only possible by referring to the specific 'community' – together with the historical and sociological conditioning of that community – which has produced it." (Zolo 1989, p. 170 in Lane and Lubatkin 1998, p. 464)

[3] Such imitation need not imply a one-to-one correspondence in capabilities. As Zander (1994, p. 22) notes, "... imitation does not require the exact copying of existing know-how... innovations can be introduced and manufactured in different ways."

[4] Already in the 19th century, the different practices and associated value systems of scientists and engineers were reflected in the codes employed. "In the physical sciences the highest prestige went to the most abstract and general – that is to the mathematical theorists from Newton to Einstein. Instrumentation and application generally ranked lowest. In the technological community the successful designer or builder ranked highest, the "mere" theorist the lowest… These values influence not only the status of occupational specialists, but the nature of the work done and the 'language' in which that work is expressed" (Layton 1971, pp. 576 ff.).

Transfer of knowledge between epistemic communities is therefore cumbersome, expensive and prone to failure. This is evidenced not only by the overall dismal experience of technology transfer programs to developing countries; in the strategy literature, the same phenomenon is reflected in the important concept of 'absorptive capacity' (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998; Zahra and George, 2002).

Knowledge Integration

Firms consist of a multitude of epistemic communities, each with its own vocabulary, set of theories and tools (Brown and Duguid, 1991). This, as Amin and Cohendet, (2004, p. xiv) note, creates

> … a new governance problem… concerning how the division of work (which distributes functions and duties between actors) and the division of knowledge (which distributes the capacity of interpretation and learning between these actors) within firms can be aligned.

The day-to-day operations of most firms would be hopelessly unmanageable if coordinated action between members of different occupations required that each acquire the knowledge of every other. Fortunately, this is not the case. Rules and directives, planned sequencing of activities and standard routines help firms economize on communication and knowledge transfer (Grant, 1996a, pp. 114 f.). Indeed, quite complex organizational routines operate on the simple basis that the output of some specialized activity provides the cue for the next to start (Nelson and Winter, 1982).

Even activities involving higher order forms of interdependence (Thompson, 1967), such as new product development and other unstructured problem solving, can be accomplished without the participants to the endeavour mastering the skills of one another. However, a mode of interaction must be established that permits knowledge of specialized communities to be *integrated* with one another (Grant, 1996a). As elaborated by Boland and Tenkasi (1995), mechanisms must be found that enable communities to overcome the degree of incommensurability of their specialized vocabularies, instruments and theories without sacrificing their respective integrity and distinctiveness. Successful knowledge integration is characterized by a "process of perspective taking in which the perspective of another can be taken into account as part of a community's way of knowing" (Boland and Tenkasi, 1995, p. 356).

Knowledge integration does not take place in a void. As Grant (1996a, p. 115 f.) emphasizes, it depends on the existence of 'common knowledge,' including not only common language and

mastery of basic symbolic means of expression (literacy, numeracy, familiarity with standard software, etc.), but also other shared meanings, mutual "recognition of individual knowledge domains" and awareness of available knowledge repertoires. The existence of a common knowledge infrastructure is an important prerequisite for efficient knowledge integration. Its strengthening through company-wide training programs and the nurturing of organizational cultures is an important means to increase the effectiveness of collaborative communication.

However, knowledge integration and 'perspective taking' – both in routine activities (Bechky, 2003a, 2003b) and in infrequent and complex tasks, such as those associated with the development of new products (Carlile, 2002), – also rely on more specific mechanisms. In the literature, two main such mechanisms have been identified: *boundary-spanning individuals* and *boundary objects*.

'Boundary-spanning individuals' (Vincenti, 1990, p. 84), 'translators' (Brown & Duguid, 1998, p. 103) or 'knowledge brokers' (Wenger, 1998, p. 104 ff.) are individuals who belong to more than one community and who are therefore able to translate knowledge generated in one community into a form intelligible to the participants in another (Figure 4). These are typically people

> …who have themselves *moved* across the relevant inter-institutional, international, interfunctional or interdisciplinary divides, and thereby learned to think in the languages and cultures of the other side… It would be rare indeed to obtain the required knowledge, culture or language skills – say, simply by reading relevant cultural/linguistic grammars or guidebooks – without face-to-face personal interactions" (Hoch, 1990, p. 342).

However, 'deep' professional skills of this kind take a long time to develop, typically a decade or more and most people therefore acquire expertise only in one area (Simon, 1981). Hence, boundary-spanning individuals are in short supply and their employment can be quite costly.

But there are also less expensive ways of achieving coordination. Recent research has noted the importance of *boundary objects* (Carlile, 2002; Bechky, 2003; Star, 1989; 1993), i.e. "…objects that 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). They are significant because they facilitate coordinated action without requiring members of different communities to align their understanding of each other's knowledge:

Modern computer and information systems are pervasive examples of boundary objects. Their effects are important not only because they facilitate integration and new combinations of knowledge, but also because they create inducements to articulate knowledge in standardized code.[5] Many boundary objects benefit from simultaneous physical manifestation. This is often the case with drawings, prototypes and physical products – probably the simplest, but commonest and most pervasive forms of boundary objects (Bechky, 2003a).

In order to achieve effective cooperation among its various communities and subcultures, firms need to undertake investments in boundary-spanning mechanisms.[6] These include the establishment of an organizational infrastructure, including a broad area of common knowledge among members and a recognized delineation of occupational (and individual) knowledge domains (Bechky, 2003a). They also include the identification and employment of knowledge-spanning individuals and the establishment of boundary objects, both intentional ones, such as a budget and cost accounting system, and ones that are incidental to other purposes, e.g. drawings, prototypes and final products. These investments are specific to the context in which they take place and to the transactions that they facilitate and are therefore subject to the familiar risks of opportunism and hold-up (Williamson 1975; 1985). The need for such investments therefore determines the boundaries of the entrepreneurial firm (Alvarez and Barney, 2004) and influences also those of firms in later stages of development.

It is important to note that dedicated, firm-specific mechanisms for knowledge integration arise not from the 'tacitness' of the expertise employed but from the partial incommensurability of the knowledge entertained by the different epistemic communities, on whose joint efforts the activities of firms depend. There is no reason to assume that firms are more privileged in the integration of

[5] Kogut and Zander (2003, p. 513) relate the story of how a common CAD system acted as a catalyst in enabling a Swedish MNC to achieve the degree of global product standardization that its U.S. subsidiary had for almost a decade successfully resisted. (Probably to avoid offending the sensibilities of JIBS' American readership, Kogut and Zander portray the story as involving a French subsidiary – the French being notorious for their refusal to accept the wisdom of other nations, witness the country's position on the war on Iraq.) While the story of the subsidiary's stubborn refusal to conform to a Swedish way of engineering is difficult to reconcile with the idea that "firms specialize in the internal transfer of tacit knowledge" (Kogut and Zander, 1993, p. 625), it does illustrate the vital role of boundary objects in bridging the epistemic communities of firms.

[6] Kogut and Zander (1996) suggest that 'identification' ensures that individuals act in line with the objectives of the firm. In contrast, the literature on the sociology of knowledge tends to assume that people identify more closely with the more specialized communities from which they derive their professional or occupational roles. In this case, it is the objective of the hierarchy to provide appropriate incentive schemes. Whatever the approach, however, a theory of the firm should attend not only to the *incentives* for cooperation but also the conditions that *enable* it to take place.

tacit knowledge than of more explicit varieties. Firms are institutions for integrating *both* tacit and explicit knowledge (Grant 1996a, 1996b).

CONCLUSION

The 'resource-based view' of strategy is based on the remarkably trivial observation that in order to do something successfully (such as staying in business), you need the skills to do whatever it is that you would like to do and you need to possess the physical resources necessary for the activity in question. In order to be more successful than others (earning above-normal profits), emulation of the skill by others and/or their acquisition of the required resources must be difficult. Following the influential conjecture by Winter (1987), much current literature has focused on the former, especially on the advantages conferred by skills based on 'tacit' knowledge which, it is now generally assumed, are difficult or impossible to imitate.

Implicit in this argument – although this is rarely spelled out – is the assumption that tacit knowledge in is both 'rare' and difficult to imitate. However, much tacit knowledge is common to all practitioners of a particular trade or occupation, and is therefore not rare. Moreover, among such practitioners, new skills can often be emulated with relative ease. The 'absorptive capacity' possessed by members of an epistemic community regarding knowledge created by their peers is typically high. This helps to explain Zander's and Kogut's (1995) finding that the hazard of imitation of manufacturing technologies is independent of their degree of tacitness.

This does not preclude that there may certainly be instances where the explicit and implicit assumptions regarding the imitability of tacit knowledge hold true. However, competitive advantage is typically not created by the possession of tacit knowledge in individual functions or activities. It accrues to firms that manage to *integrate* the knowledge of their epistemic communities in a more efficient way than do their competitors. Such integrative capabilities are often both tacit and idiosyncratic to organizational context and are therefore difficult to imitate.

Firms gain competitive advantage, first, by accessing and nurturing the epistemic communities where critical knowledge is available or is being created, and, second, by their abilities to integrate and exploit this knowledge (Teece, 1998). A richer understanding of the determinants and effects of both (voluntary) replication and (involuntary) imitation requires that a distinction be made between the conditions that influence the knowledge integration *between* epistemic communities, on the one

hand, and those that affect knowledge transfer *within* such communities, on the other. The question as to whether or not – or to what extent – knowledge has been codified into fixed, standardized form is only one aspect of its ease of dissemination.

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