

INTRODUCTION

Contributions to knowledge theory from sociology and philosophy to the relatively new fields of information economics and strategic management are not new. However, there is frequently a lag of several years, or even decades, between the diffusion of a theoretical perspective and corresponding methodology, which is developed in the social sciences, to the study of knowledge in the areas of economics and management.

The aim of the present paper is to discuss the origins of some key concepts in the study of knowledge in the field of strategic management and identify some current controversies surrounding these terms. As a way of surmounting such difficulties we will trace the evolution of these theories through the sociology of scientific knowledge (SSK) literature. Finally we will demonstrate how recent developments in this subdiscipline have created perspectives which are compatible with both resource-based theory and Schumpeterian economics. Furthermore we suggest that these frameworks can offer potential advances in understanding organizational knowledge strategy.

CURRENT CONCEPTS OF KNOWLEDGE IN STRATEGIC MANAGEMENT

Perhaps the most dominant theoretical construct used in discussing knowledge at present is Polanyi's epistemological notion of tacit knowledge and his famous maxim that "...we know more than we can tell" (Polanyi, 1967: 4). As an atomic-chemist turned philosopher, Polanyi sought to answer the old question of how scientific discovery is possible (Polanyi, 1967). He regarded positivist accounts of science, being solely directed by the results of empirical research, as absurd when compared with his own experience as a scientist and subsequently devoted the last thirty years of his working life to epistemology (Polanyi, 1962). His answer to the problem of scientific discovery was that the research process was driven by tacit knowledge, which remained in the subconscious and could enable the scientist to foresee possible discoveries. For Polanyi, explicit knowledge in the form of what can be seen, read or communicated only takes on meaning within the context of tacit knowing. Even mundane acts are dependent upon tacit knowledge such as recognising one's own raincoat or riding a bicycle because the individual is unable to give every detail of how the act was performed (Polanyi, 1962; Polanyi, 1967).

Polanyi's tacit knowledge thesis is now widely cited in literatures as diverse as OECD collections on the growth of the knowledge-based economy (Foray and Lundvall 1996) to practitioner-oriented books on knowledge-management and innovation (Nonaka and Takeuchi, 1995; Sveiby 1997). The growing popularity of the tacit knowledge concept can be demonstrated with a citation analysis of Michael Polanyi's work in several popular general management and technology management journals since 1980 (Fig.1)

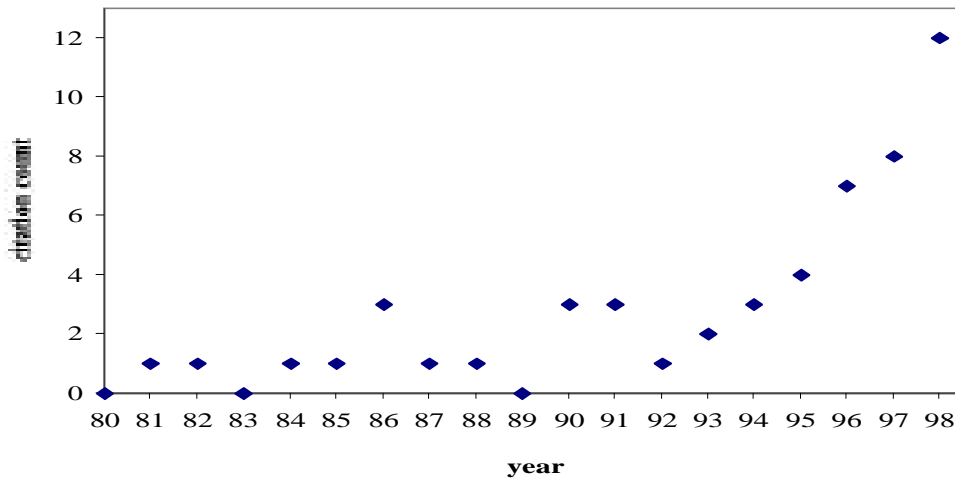


Figure 1. Chart of citation frequency of Michael Polanyi's *Tacit Dimension* or *Personal Knowledge* in articles published in the *Academy of Management Review*, *Administrative Science Quarterly*, *Organization Studies*, *California Management Review* and *Research Policy* (Data from The Dialog Corporation, Social Sciences Database).

Although the data in Figure 1 are restricted to five journals, it can be seen that there has been a resurgence of interest in Polanyi's philosophy of tacit knowledge throughout the 1990's, some thirty years after Polanyi's original publication. Polanyi's rediscovery by the management literature and reasons for this resurgence of interest are worthy of a comprehensive literature review, which is beyond the scope of this paper. However, one particular thematic observation, which has been appreciated by both academics and practitioners, can be intuitively explained by the existence of tacit knowledge. Essentially this observation is that knowledge is frequently localized and often difficult to transfer from one location to another. Indeed, Polanyi noted this problem in the management context with the example of a Hungarian light bulb factory, which had been working successfully in Germany, failing to produce a single functioning product

due to insufficient transfer of knowledge from Germany to Hungary (Polanyi, 1962). Localized knowledge such as this has been termed sticky (von Hippel, 1990) or uncodified (Boisot, 1995) but most commonly it is called tacit (Spender, 1993; Nonaka & Takeuchi 1995; Lamberton, 1997; Steen *et al.*, 1998).

Tacit knowledge is an attractive idea for strategic management scholars and practitioners. Primarily this is because it suggests that if a firm's competitive advantage is based upon capabilities which include tacit knowledge, then that competitive advantage is likely to be sustainable because of the problems with imitating something which cannot be explained in words or documents (Sanchez, 1997). In a recent Strategic Management Society publication entitled *Strategic Learning and Knowledge Management* (SLKM), four of the ten research articles use a tacit/explicit framework for knowledge while one uses a similar codified/uncodified taxonomy developed by Boisot (1995) where codified knowledge takes the form of information in the form of speech or writing. Significantly, these articles include important ambiguities on what is actually meant by the term "tacit knowledge". For example, some discussion appears to involve logical contradictions.

...the act of codification leaves behind some tacit knowledge with the transmitter who always knows more than she can ever say...Firms routinely claim ownership of their employee's tacit knowledge and ...seek to extract tacit knowledge from the employee prior to departure while asking for a commitment to secrecy thereafter. .. (Boisot *et al.*, 1997: 68-74)

Other writers offer intuitively helpful but nonetheless obscure explanations.

Personal knowledge, which is uncodified and undiffused, is held by individuals or small groups of people. It is described by other authors as tacit, or embedded knowledge. This knowledge is characterized by causal ambiguity, it is acquired by observation and experience, e.g. the training of a Buddhist novice. (Hall, 1997: 47).

To punctuate this controversy it is important to note that a few other authors see tacit knowledge as a theoretical "red herring". Indeed the editors of SLKM take this position somewhat emphatically in a critique of Polanyi's "ice skater" example of tacit knowing.

We propose that there is no existent theoretical justification warranting extension of a concept of a skater's knowledge, that exists but cannot be articulated, to a manager engaged in work of a higher mental order or to the work of an organization. (Sanchez & Heene, 1997: 8)

Sanchez elaborates on some difficulties with the "tacit knowledge for competitive advantage" thesis in a chapter section called "beyond tacit knowledge" in the same volume (Sanchez, 1997). Essentially these are as follows:

1. *Problems of Comprehension.* The suggestion that tacit knowledge is incomprehensible to a firm's potential competitors whilst explicit knowledge is easily imitated cannot be presumed. The idiosyncrasies of the languaging process can make explicit knowledge opaque to an outsider.
2. *Differences of Valuation and Value.* Even if a firm's explicit knowledge can be understood technically by another firm, it may not be possible for the competitor to understand the relationship between the knowledge and the firm which is the source of strategic value.
3. *Time Dependency of the Value of Knowledge.* Explicit knowledge can be a source of competitive advantage if it is acquired at the right time. An example of this idea could be a firm that uses articulated knowledge to create an entrenched position in the industry.
4. *Problems of Knowledge Migration.* If tacit knowledge is kept in the heads of employees, then employee turnover represents significant problems for the firm.
5. *Problems of Limited Leveragability.* If a firm is reliant upon tacit knowledge for its competitive advantage then the only way that this competence can be transferred within the firm is by physically relocating "competence carriers". This is in contrast to some global information systems such as AT&T's which leverage explicit knowledge created through learning-by-doing in each of its plants worldwide.

Arguments such as these are difficult to refute and make the strategic application of tacit knowledge even more problematic. So, it would appear that there are two major contentious issues in the tacit knowledge debate. Firstly, it remains unclear as to whether tacit knowledge is truly cognitive subception as Polanyi suggests (Polanyi,

1967) or, as Eliasson puts it, tacit knowledge is simply "...tacit to those who don't understand" (Lamberton, 1997). Secondly, Sanchez's critique indicates that tacit knowledge is far from being a "magic bullet" for sustainable competitive advantage.

Perhaps the main problem with using "tacit knowledge" to understand knowledge in organizations is that it is a theory of cognition where the unit of analysis is the individual person. Furthermore, such theories of individual cognition do not readily translate into an explanation of knowledge at the level of the firm (Cook and Yanow, 1996; Araujo, 1998). In this respect, the use of the "know what", "know how", "know why" or "know that" taxonomy (Machlup 1980; Sanchez, 1997) which has grown out of Gilbert Ryle's (1949) *The Concept of Mind*, also faces shortcomings at the organizational level of analysis. What is required, therefore, is a framework for knowledge that has been designed to analyze organizations. Ideally, such a framework should retain features of the "tacit knowledge" thesis, which can explain the localized or embedded nature of knowledge. However, the theory should also suggest empirical study, which can develop and test theory. Possibly the biggest problem for those who wish to investigate "tacit knowledge" in organizations is a satisfactory method for the analysis of something which, by its very definition, is ineffable (Steen *et al.*, 1998).

The idea of embeddedness has been developed and empirically investigated within the field of Economic Sociology with notable contributions from academics such as Granovetter¹ and DiMaggio (Smelser & Swedberg, 1994). Although the Economic Sociology literature would appear to be a rich and underutilized resource for understanding Strategic Management, the deployment of Michael Polanyi's tacit knowledge theory does not appear to have occurred to the same extent. However, the Sociology of Scientific Knowledge (SSK) literature has made significant use of tacit knowledge and many of the controversies surrounding tacit knowledge in Strategic Management are mirrored in SSK. The SSK field should not be considered to be "out of bounds" or irrelevant to Strategic Management. One reason is that many firms compete on the basis of science-driven R&D but another reason is that SSK has satisfactorily

demonstrated that there is nothing sacrosanct about scientific knowledge, which elevates it above any other organized human endeavor (Law, 1992). If Michael Polanyi's (1962) theory of Scientific Knowledge can be applied to Strategic Management then more advanced theories of science should be applicable also.

THE DEVELOPMENT OF "TACIT KNOWLEDGE" IN THE SOCIOLOGY OF SCIENTIFIC KNOWLEDGE (SSK) LITERATURE

Polanyi's concept of tacit knowledge was arguably popularized through Thomas Kuhn's seminal work, *The Structure of Scientific Revolutions* (Kuhn, 1996). Kuhn suggests that the way in which objects are interpreted, which allows members of a group to function as an organization (in Kuhn's terminology, a paradigm) can be regarded as knowledge. However, this type of knowledge is atypical in the sense that "...we have no access to what it is we know...the knowledge embedded in the stimulus to sensation route remains tacit" (Kuhn, 1996: 196). Such claims about the possibility of circles of scientists sharing the same paradigm and the importance of tacit knowledge, which underpins the paradigm, attracted a lot of attention from sociologists and historians of science.

Some studies attempted to identify such thought collectives using questionnaires or bibliometric surveys (Crane, 1969). However, despite their operational attractiveness, it soon became apparent that these methods did not necessarily identify groups of scientists who shared a common conceptual map. In a landmark study on tacit knowledge and scientific networks Collins (1974) claimed that studies which used bibliometric and questionnaire-based research techniques to identify knowledge clusters had largely missed the point. According to Collins (1974), knowledge is a capability and thus creates the capacity to do something. Furthermore, one can only identify groups that had successfully shared tacit knowledge by their ability to perform common activities, in this case building a particular type of laser. Possibly the most important observation from this study was that groups who attempted to learn to build a laser from

¹ Interestingly, the concept of embeddedness, used by Granovetter, was inspired by the economist Karl Polanyi (brother of Michael). Karl Polanyi's own influences appear to have included Marx, Weber and Bücher (Smelser & Swedberg 1994).

people who “had all the particulars”, but had not themselves built one, invariably failed. Conversely all laboratories which acted as sources of knowledge had completed the task of building an operating laser. No-one could act as an agent for knowledge transfer unless they were themselves practiced in the skill.

This finding has been recently summarized as “Collins’s Law” or *the intrinsic inutility of statements* (Callon, 1995). The implications of Collins’s Law for strategic knowledge management are profound and suggest that a wholly information technology-based approach to knowledge management may be completely misguided. Huge databases of “particulars” will not necessarily act as effective repositories for corporate knowledge.

Like the current management literature, Collins used the concept of tacit knowledge to explain why laser technology could only be learnt from successful groups rather than through documents (Collins, 1974). However the controversies which have dogged the concept in strategic management have already occurred previously in SSK (reviewed by Cambrosio & Keating, 1988). Further empirical study, in this case involving the transfer and development of cell culture biotechnology, suggested that such tacit/explicit taxonomies of knowledge deployed by those studying knowledge and technology were artificial and inadequate (Cambrosio & Keating, 1988). When observed in practice, tacit knowledge was really not ineffable at all. Such “tricks of the trade” or “rules of thumb” were discussed explicitly, but their meaning was dependent upon the network of relations within which the scientists worked. A similar idea can be found in Brown and Duguid’s “communities of practice” (Brown & Duguid, 1991). It would seem, therefore, that the apparently cynical suggestion of tacit knowledge being only tacit to those who don’t understand might be partly correct.

ACTOR-NETWORK THEORY

How else can the localized and “sticky” character of knowledge be explained if not by the existence of tacit knowledge? Intuitively, some sort of network description would appear to be a useful starting point and again SSK can provide an interesting alternative in Actor-Network Theory (Latour, 1987; Law & Callon, 1988; Law, 1992; Callon,

1994; Callon, 1998). One of the consequences of Actor-Network (AN) descriptions of organizations is that cognitions are the last place to look when explaining organizational knowledge (Latour, 1987). Such downgrading of the importance of cognitions is an important step in overcoming the problematic link between the organizational and individual levels of knowledge. From a disciplinary perspective, knowledge as cognition is a difficult principle to remove from management studies due to its relationship with disciplines such as psychology and economics. Nonetheless, Latour (1987) is emphatic in his suggestion that cognitive explanations of organizational knowledge are not only problematic but also unnecessary. Indeed, Latour (1987: 247) advocates a "...ten year moratorium" on cognitive explanations of science and technology.

It is important to emphasize that these actor networks are different from the conventional description of networks as carriers of information such as telecommunications networks or even social networks (Callon, 1994). The network of interactions between actors, which include people, technology, documents and statements, shapes knowledge as a capability (Law, 1992). The Microsoft Corporation is widely considered to be a knowledge-based company but what would happen if we randomly rearranged the associations between all of the technology, the embodied skills of staff and documents? Arguably the information or particulars that made up Microsoft are still there but knowledge in the sense of being able to do something would probably cease to exist. One of the main differences between AN and other network theories of organizations is that non-human actors play a role in shaping the AN organization. For example, the Tioxide company, which was recently floated by the chemicals giant ICI, was built around a particular technology for producing paint pigments (Hanson *et al.*, 1997). However, it can be argued that this technology became so dominant in Tioxide that it prevented organization change when the technology became obsolete due to government restrictions on marine disposal of waste by-products.

The AN explanation for "sticky" knowledge is that such diverse and complex webs of actors are not easily recreated in other locations. Diversity and complexity are only part of the problem as associations between the actors are frequently achieved with

difficulty, often through negotiation or repeated interaction. There are interesting similarities between AN theory, Schumpeter's notes on the structural relationships within capital and resource-based theory, where resources combine to create organization capabilities, which indicate that some sort of fruitful convergence may be possible (Schumpeter, 1953; Wernerfelt, 1995). Comments from information economists such as Lamberton suggest that there may be more similarities than differences.

...I am thinking of information, not in terms of discrete items but more like jigsaw puzzles, which would belong amongst Shackle's "fragments [that] fit together into a brilliant arrestingly suggestive mosaic, but...do not compose a pattern of unique inevitable order". Perhaps reengineering these puzzles, either internally or in their relations to a changing environment is innovation; and coping with these puzzles designed by others is diffusion. But to adapt Schumpeter's words the processes "will differ greatly according to the composition of the [information] stock we have to work on" (Lamberton, 1999)

SOME IMPLICATIONS OF ACTOR-NETWORK THEORY

If the firm can be conceptualized as an actor network then we can begin to ask questions about competitive advantage, which are very different from those implied by the theory of tacit-knowledge based competitive advantage. In AN terms, Collins's Law or *the intrinsic inutility of statements* can be equally applied to people and instruments. In other words, it is impossible to mobilize the elements independently of each other (Callon, 1995). Thus any discussion of transferring knowledge using individual competence carriers is as problematic as transferring knowledge through documents. The ease of transferring knowledge within the organization is dependent upon the complementarity and mobility of actor networks. The issue of imitability by competitors can be addressed in a similar way. Competitive advantage is dependent upon a combination of the uniqueness of the elements that make up the actor-network, the complexity of the network and the degree of difficulty in consolidating the links in the network. Knowledge management, from an actor network perspective must be a holistic activity, which combines strategic management, human resource management, technology management, marketing, and information technology.

Finally, we offer a cautionary note on knowledge management. It is usually assumed that an efficient market for knowledge within an organization is desirable for leveraging knowledge assets. However, increasing returns created by such markets may “lock-in” an actor-network and make it irreversible (Callon, 1995). Potentially, knowledge management can not only create core-competencies but also core-rigidities. Managers, including knowledge managers, do not stand outside of actor-networks but are themselves both created and limited by organization. Tolerating a certain degree of disorder and ambiguity may therefore be an essential part of successful knowledge management. After all, as Arrow noted many years ago, if an innovation is truly an innovation it is impossible for a finite observer to precisely forecast it (Dosi, 1996).

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