Pergamon

Journal of High Technology
Management Research 12 (2001) 25–38

THE JOURNAL
OF HIGH
TECHNOLOGY
MANAGEMENT
RESEARCH

Decentralizing knowledge
Managing knowledge work in a software engineering firm

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Received 15 January 2000; received in revised form 2 March 2000; accepted 12 April 2000

Abstract

The present paper outlines the philosophical background as well as a practical case of so-called decentralized management of knowledge work. It is argued that top-down perspectives on knowledge have dominated management initiatives in this area, at the expense of naturally occurring, or emergent work patterns of R&D organization. A model of management based on semiorganized individual knowledge exchange or "brokerage" is proposed as a solution. This alternative is exemplified in a case study from a software engineering firm. The paper proposes a number of principles that may be used to guide the development of similar models elsewhere. © 2001 Elsevier Science Inc. All rights reserved.

Keywords: Knowledge work; Decentralized organization; Epistemology; Broker

1. Introduction

The recent upsurge in management writings on the management of knowledge in organizations has put many taken-for-granted doctrines on the spot. For one, human resource management has come under direct and indirect fire for its implicit top-down perspective on change and competence development (Welbourne & Andrews, 1996). In the area of leadership studies, the classic leader par excellence has been brought down from the heights

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PII: S1047-8310(00)00037-7

of the corporate ivory tower to the top-management team, or to middle management, where multiple role-taking, reflexivity, knowledge brokerage, and the affecting of initiative are now far more important than personality traits and "unity of command" (Lyles & Schwenk, 1992; Nonaka & Takeuchi, 1995). In the midst of this, the rubric of "knowledge management" (KM) has emerged to put a strong emphasis on managing the process of knowledge development and knowledge work[1] in companies. KM has often addressed these issues from a top-down management ethos and thus catered more to management action and legitimization per se than to the local knowledge creating/sharing practices most likely to affect competitive advantage in the company (cf., Nonaka & Takeuchi, 1995; Swan et al., 1999). To us, it seems as if the original vision of knowledge creation laid down by Nonaka and Takeuchi has yet to contribute directly to the practices of managing knowledge work.

In the vein of such an argument, the present paper addresses one aspect of this issue that needs to be fully explored, namely the question of how to effectively develop a KM initiative that is suitable to a highly unstructured research and development context, without reducing the fruitful complexity of that context. The paper aims at outlining a model that has the potential to affect sustainable knowledge development outside of centralized (i.e., top-down) management initiatives. We believe the development of such a method to be pertinent, since many decentralized knowledge-intensive companies (KIPs), who are "thriving on complexity" and have managed to capitalize on a flexible, relatively centerless, and highly relational corporate structure, are now buying into KM tools that are built around the idea of *centralizing*, *specifying*, and *decomposing* knowledge (Swan et al., 1999). Consultancy and commercial software products in the area of KM suggests that "capitalizing on knowledge" necessarily means turning back the clock for management theory about 40 years. Knowledge becomes "a resource" that must be "mined" and "commodified" for it to contribute to corporate growth. State of the art in KM theory seems to be much ahead of KM application. Still, this situation has stimulated reactions to centralized theories of knowledge to emerge outside of the field of philosophically inspired management scholars, in actual management praxis.

We will initially outline a number of such critical, albeit scholarly critics, who calls for decentralized theories of the management of knowledge work as well as the philosophical origins of these voices. Against that backdrop, we will describe a case taken from Ericsson Software Technology (EST); a software engineering firm within Ericsson, where a KM initiative developed that conformed to the company's decentralized knowledge creation process. This initiative was based on a knowledge brokerage model, and grew out of a need at EST for KM to be "as decentralized as the organization itself." This case will be analyzed in terms of its contribution both to theories of corporate knowledge and to management practice. Finally, the paper will outline a number of problems and possibilities for "decentralized management of knowledge work," especially with respect to individual and group level imperatives for action as well as implications for leadership in such settings.

[1] Very simplified, knowledge work may be said to be the organized conversion of skilled mental labour into commercial products of some kind, and KM be the governance of this process.

2. Centralized and decentralized theories of knowledge

The traditional theory of knowledge, as conceived of by philosophers of knowledge, typically took its inspiration from an Aristotelian axiomatic/deductive stance. The characteristics of knowledge or "true justified belief" had to be derivable from theorems or axiomatic statements that were themselves true (Fuller, 1993). This essentially top-down type epistemology originated in the Aristotelian notion of Prior Analytics (syllogistic logic), and was reproduced as a central part of western philosophical discourse, e.g., in the early Wittgenstein's *Tractatus Logico Philosophicus*, in the area of logical semantics, and in models for theory testing (cf. Glymour, 1980; Newton-Smith, 1981; Wittgenstein, 1922). The behavioral and social sciences broke free from philosophy in the late 19th to early 20th century, and a parallel stream of centralized-axiomatic thinking made its imprint on the early empirical human sciences, first in behavioristic psychology, and later in Parsonian functionalist sociology as well as in the so called "cognitive revolution" of Herbert Simon and others (e.g., Parsons, 1949; Simon, 1964). These schools share with traditional, Aristotelian philosophy the search for general principles for describing knowledge development, and for evaluative statements regarding knowledge viz. *justified* belief.

Current challenges to the tradition of centralized notions of knowledge are legion. They may be found in chaos and complexity theory, e.g., in theories of self-organizing systems with applications in microworld modeling and artificial intelligence using cellular automata models (Axelrod, 1997). In the cognitive sciences we find so-called "distributed theories of mind" that emphasize the nonlinearity and nonpredictiveness of mental processes (and indeed of the evolution of the brain itself). In computer science, we find "soft system programming" that draws on fuzzy set theory and neural networks as being the essential counter-point to centralized "programming epistemologies," exemplified by ADA and Prolog (Klir et al., 1997).

The emergence of KM has similarly followed two paths. The application-heavy, IT-oriented approaches, which emphasize the acquisition and storage of organizational knowledge, are ubiquitous. Typical examples include Knowledge Yellow Pages, data warehousing, document management, decision support systems, search tools for intranets, and knowledge benchmarking (see Schüppel, Müller-Stevens, & Gomez, 1998 for an overview). On the other hand, we have management models that grew out of action research (e.g., Schön, 1983) and the knowledge creation school of Nonaka and Takeuchi (1995). These emphasize learning by example, tacit knowledge, contemplative interaction, coaching, and the importance of arenas for knowledge sharing and integration. Sarvary (1999) connects these two approaches with a number of hypothesized general design characteristics for KM systems (Table 1). It is tempting to assume that these two approaches to KM correspond at a basic epistemological level with the centralized/decentralized divide in the philosophy of knowledge. We would argue that the most prevalent form of KM today, the IT-application heavy one, unreflectively works from the former of these approaches, mainly by dint the sticky constraints to actual knowledge creation embedded in datawarehouses, search fields, and Knowledge Yellow Pages. On the other hand, these centralized notions are considerably easier to convert into ready made "actionable" KM templates, and they may therefore be more attractive to oversubscribed managers. The implicit argument from the point of view of management may be

Table 1
Centralized versus decentralized approaches to KM

Centralized	Decentralized
Top-down implementation	Bottom-up implementation
Based on IT	Focusing on people interacting
Generalizable solutions	Unique solutions
Knowledge is gathered and shared centrally	Knowledge is gathered and shared in an "open market"
People are pushed to share knowledge	Reactive and adaptive
Expensive	Cheap

that it is difficult to derive head-on management of knowledge work from decentralized notions of knowledge. There are however a number of insights from recent organizational research that offers an alternative, decentralized reference point applicable to KM initiatives; initiatives closer to the actual, grass roots process of knowledge creation.

Hedlund (1994) discusses certain organizing principles for knowledge creation that are based on a Japan-influenced "heterachical" notion of corporate activity, i.e., where the company structure emerge around strategic apexes that shift over time. Hedlund favours a combination rather than a division of human resources, lateral rather than vertical communication in the company, and specifically lower/middle communications rather than top-down. This decentralized notion of communication and knowledge creation translates into a couple of distinct organizing principles. In terms of leadership this means transforming the role of the top manager into one of a catalyst rather than a detached resource allocator/monitor. In terms of organizational strategy and design, this implies a shift from semi-independent diversification to knowledge-based competition. These principles are addressed on an epistemological level by Tsoukas (1996), who emphasize the conception of the firm as a distributed knowledge system. That is to say that the knowledge created and utilized by the company cannot be known by a single mind. Instead, individuals tend to follow rules uniquely and in response to local situations. Management activity and strategy must therefore be open-ended (in some respect goal-free), and take their task the coordination of purposeful individuals and ultimately markets. The organizing principles for knowledge work that may be derived from Tsoukas' argument is that lower-level managers must learn to facilitate worker's unique interpretations of their local circumstances and find ways to interrelate this knowledge. Miles, Miles, Perrone, and Edvinsson (1998) operationalize similar notions in what they call "the cellular organization". The cellular organization is the evolutionary outcome of the pull of market forces and the push of excess know-how in firms. According to Miles et al., the development towards this type of organization has three steps: (1) increasing expectations on employees to perform entrepreneurial tasks, (2) increased importance assigned to self-organization, and (3) increasing use of employee ownership as a management principle. The principles of the cellular organization for organizing knowledge work thus are workers dissemination of *entrepreneurial responsibilities* to *spontaneously reorganize themselves* in order to make an optimal contribution to the company and a concomitant *ownership* of what they thereby create.

But what does the literature tell us with respect to the institutional conditions that such an organization must meet? Prusak and Cohen (1998) possibly comes closest to formulating a

concrete set of such institutional principles in their outline of how a "knowledge market" may be constituted to achieve similar conditions. The assumption of Prusak and Cohen is that the movement of knowledge in an organization is guided by forces similar to those governing the markets for more tangible goods. In order to make the most out of this type of market, we then have to understand its workings and stimulate its core mechanisms. Actors pertinent to a knowledge market are knowledge buyers (who have a need for specific knowledge), sellers (who have it), and brokers (who knows the who, what, and when of the system and act as intermediaries between the buyers and the sellers). For the knowledge market to function, one needs, apart from the actors above, a pricing system which may be informal or pre-capitalist (e.g., "gift-giving"). For the pricing system to work, there has to be a certain amount of trust in the organization, and there has to be a sense that reciprocity and repute (money analogues) come to them who "sell" knowledge. There also has to be market signals in existence that indicates where brokers or sellers are located as well as prices. Core to institution building of this kind would thus be the creation and definition of a knowledge market value through the recognition, promotion, etc. of engagement in knowledge exchanges.

These principles (and mechanisms) for a decentralized management of knowledge work are to a certain extent hypothetical and builds largely on assumptions regarding the creation of knowledge in social groups being at odds with the planning and execution of corporate policy in a machine bureaucracy. One might suspect that the reality of implementing a knowledge strategy must include both these types of processes, albeit a drift will be noticed towards the former set of principles should they turn out to be correct. In the following case study, we will present the unfolding of a knowledge strategy in a software subsidiary within Ericsson. The events both lend support to, as well as challenge and extend the above notions of decentralized knowledge creation and work management.

3. Knowledge brokerage at EST

The case study describes a decentralized approach to the management of knowledge work, although we will refer to this process with the more general term *knowledge management*. The process under study may be said to be decentralized, both in the organizational sense of being a grass-roots initiative, as well as it having been built on individual knowledge brokerage and networking, rather than the more common data warehouse metaphor. In outlining the case, we will emphasize how the needs of the organization, with respect to management of knowledge work, stimulated this more human-based initiative, as opposed to the knowledge database solution developed earlier on in the company.

3.1. Approach

This case study describes, on the basis of interviews with a number of people at EST and company documentation, how a needs-driven knowledge creation process within EST was developed. The study was performed by three researchers working from the general question of how decentralized KM initiatives may be implemented; their constraints and effectiveness, and where the study below was used as a *case instance* of this general issue. Interviewees

were chosen from among the people involved in the development of the program as well as from people only marginally involved. Interviews were conducted in an open manner on four occasions, and questions pertained to the history, institutional framing, detailed implementation of the program as well as its effects. Detailed interview notes were taken during these meetings, and were co-coded by the interviewers for three themes: (1) issues specific to the implemented broker model, (2) issues pertaining to the general company setting, and (3) issues relating to networking and human interaction/knowledge exchange.

3.2. Company background and business context

EST is a company within Ericsson with the mission to develop software applications for telephony switches, mobile phone management systems as well as to establish product requirements for software. EST consists of several business centers spread around Sweden, where each center is divided into several business units, each working with one to three products. These units in turn have about 20–30 employees. The number of EST employees has increased since 1993 from 200 to 800 people in 2000. About 60–80 projects are being conducted at any one time at EST. As EST is producing customized products rather than standardized ones, the demand for knowledge and competence may vary rapidly in the specific units. Hence, there is an emergent demand for connecting company knowledge with project needs in an agile and fast-paced way. One of the goals of the company has been to climb the ISO 9000 and the Capability Maturity Model (CMM) ladder, CMM being a model for quality assurance of software program code. With these initiatives underway it became necessary to find a way to coordinate and leverage the company's competence and knowledge between the many projects and units. In order to achieve this, EST decided in early autumn 1997 to implement a database KM method called "Experience Factory" (Basili, Caldiera, & Rombach, 1994).

3.3. Stage 1: developing the Experience Factory

The Experience Factory is focused on process improvement. It is an organizational function as much as a database, which collects, analyzes, generalizes, formalizes, packages, stores, retrieves, and reuses collective experience of software engineers (Basili et al., 1994). Concretely though this approach is best described as a tool-centered database for information storage and inference, which used a diverse set of inputs from project workers, and was designed to give cost estimation and fault predictions for software engineering. The Experience Factory database includes lead-time data, productivity data, measurements of software faults, etc., and was developed at EST in parallel with large corporate spanning databases. The implementers spent a little more than 1000 person-hours to develop the Experience Factory, and the perception was that the database was going to be very large and complex. The challenge posed by the actual development of the database made it hard for the implementers to form a holistic perspective of the initiative; the technology itself posed too many tough challenges for the question of its place in the social structure or culture to be addressed in any serious way. Alas, when the database specification was presented, most of

the intended users of the technology saw problems with this new database similar to those already encountered in existing ones.

3.4. Stage 2: researching the shop floor — new insight and concepts

During this period, the Experience Factory Project Manager supervised a thesis at the local university college that tried, through an ethnographic "corridor study", to tease out what knowledge the workers at EST really sought and how knowledge was actually exchanged between them. In the course of the study, a number of parallel interviews were done by the Experience Factory team that addressed similar issues of knowledge exchange. These two studies put the viability of the Experience Factory into question. After the corridor study and the interviews, the team at EST concluded that at least two important elements of the knowledge exchange process were missing in the factory approach, while being present in "corridor-based" knowledge exchange. These were:

- *Physical context of the exchange*. The context needed to be personal and physical as opposed to data-based and virtual;
- *The situational nature of the exchange itself*. The exchange needed to arise from spontaneous demands and take place in meetings that addressed these demands. Such situations often resulted in informal "flashes" of insight, as opposed to careful formulation of search strings and incremental knowledge build.

While the idea behind the Experience Factory had been control heavy and top-down oriented, these insights were the result of a more user-focused and distributed perspective on the role of the software engineer vis a vis his/her vocational toolbox; i.e., public database versus personal knowledge. It was found that instances of informal knowledge exchange occurred rather frequently in the organization. It seemed as if knowledge was most effectively exchanged when two parties were actually engaged in an activity where the knowledge was required to solve a problem. Basically the exchange occurred in two primary ways: as *flashes* and as *learning situations*. Flashes were quick, less than 10 min, and involved person-to-person encounters, where one party was exposed to know-how or factual information. Two different forms of flashes were identified: *broker flashes*, where a reference was made to a third party source of knowledge, and *knowledge flashes*, where substantive "know-why," "know-how," and "know-what" were communicated. Broker flashes took place in some of the following situations:

- when people walked around (a person dedicated time to just interact with workers);
- at reviews and inspections (where a person gave concrete and active help to a coworker);
- when workers participated in project risk analyses;
- when workers participated in different kinds of cross-sectional teams and networks.

Broker flashes occurred more often in telephone or face-to-face meetings rather than through written messages (e.g., e-mails). Knowledge flashes happened in much the same way,

only here, the exchanged knowledge was substantial and concerned, for example, specific programming language constructs, product storage handling, and test case specifications.

Learning situations occurred when one of the workers engaged had formal training but lacked experience in the relevant area of problem solving. Learning situations require planned time for on-the-job training, where the person in need of specific knowledge learns by doing in an actual work session with a more knowledgeable coworker or manager. Typical learning situations emerges when a knowledgeable coworker:

- moderates a workshop;
- participates in developing a project plan with one or more workers;
- guides a quality coordinator in using company software quality assurance processes.

A typical example of a learning situation was when a knowledgeable coworker participated in a 3-h walk-through of a preliminary study. The participating software engineer reported this walk-through to have saved him an estimate of several days in work time, and it having led to a significant increase in quality.

3.5. Stage 3: evaluating the "Factory" and a new vision

The work with the corridor study and the interviews stimulated new insights, and as the Experience Factory approach was being implemented a number of critical concerns were leveled against it from the "work floor." These could be summarized as follows:

- The users of the database thought it to be too technology-based, too administratively demanding, and time consuming for them to actually use it and update it.
- Those who were making measurements for the database felt that the parameters were somehow "disconnected" from the core activity of EST, and more connected to the Experience Factory per se. This standardization and formalization of the "Factory" initiative was perceived to be an end in itself and therefore work against innovation and renewal in the organization.
- Context proved to be vital for judging the usability and robustness of information and data, however such context seemed to be hard to specify in words by the contributors to the database. This information therefore fell outside of the framework. Similarly, many workers were "stuck in the measurement trenches" and did not dare to put trust in the data, as they were afraid that obsolete information would lead to fatal errors.
- The "Factory" information, even if fairly correct at any one time, was basically too risky a bet for EST workers due to the time factor. The information used in software engineering has a very short life span, and this makes the database a poor metaphor for that type of work. Software engineering and databases have a "different pace of life."
- Workers found that filling out "competence forms" for the database took a lot of time, that such forms often did not capture the essence of their abilities, and became quickly obsolete. One of the participants noted that after 6 months, the factual content of such information would be outdated.

- Many people felt that to let go of knowledge, there had to be a clear recipient. This did not exist in the "Factory" approach.
- On a company level, the bonus system for the units did not encourage cooperation as it built on comparative production assessments with "zero-sum" qualities. The Experience Factory focused internally and did not stimulate external contacts. A way had to be found for stimulating such contacts as well. A more informal method of knowledge exchange was perceived to be able to do that.

A working KM tool was still believed to be needed. Many new, inexperienced people were thrown into project operation and management, and an additional challenge was to create an open exchange culture given that half of the engineering staff has worked less than 2 years within the company. The idea of a less formalized and more socially oriented approach developed as a solution to these problems. The "Factory" team concluded that the physical and implicative context was required in the exchange of knowledge between individuals, and that spontaneous and informal face to face meetings were the most important channels for those kind of exchanges. The KM Factory team wanted to create a social engine that continuously worked to recycle the collective experience of the company, experience being thought of as knowledge implicated in a physical context and a learning situation. This "Experience Engine" metaphor put the emphasis on the individual as a driver of knowledge integration between workers and his/her ability to connect (to) specific experiences. An alternative to the "Factory" approach had to be time effective, directly beneficial to participants, and conducive to immediate user evaluation and trust. Foremost, it had to be user-driven and adaptable. Given what had emerged in executing the Experience Factory as well as what was given in the corridor study, a semiformalized broker model for knowledge exchange seemed to be called for.

3.6. Stage 4: the development of a broker model

For the purpose of further establishing what was needed in the new approach, an empirical pilot study, which evaluated over 100 occasions of knowledge exchange in the EST organization, was carried out by the team. After a while it was understood that the informal, experiential processes for knowledge exchange would need some kind of reinforcement to occur with the strength necessary to live up to the (albeit unrealistic) expectations earlier placed on the database system. By drawing on the previous observations, an organizational role was defined, namely that of a "knowledge broker," a catalyst whose responsibility would be to connect those with knowledge and experience with those who needed it for particular purposes. The role of the knowledge broker had to be clear, visible, and acknowledged throughout the organization, both within and between units. The broker was to be appointed by management, yet have enough social skill and trust among coworkers to carry his/her own mandate for brokering. The role of the knowledge broker was set to be:

- to facilitate knowledge flashes and learning situations, such as those described above;
- to identify several knowledgeable persons (with particular expertise), their respective competence areas, and list them;

- to facilitate contacts between knowledge need and such expertise;
- to strive to connect people across organizational boundaries;
- to be perceived to be available by potential "users;"
- to follow up flashes and learning situations.

The broker is someone who invest their time in moving around the organization, talking to as many people as possible, listening, and establishing knowledge needs and corresponding expertise so that these can be connected. One may say that they are well familiar with the supply and demand structures of knowledge in the company. The broker should not be assigned to any one branch or specialty, but rather have an independent position.

Hence, the broker is all around, sitting at different tables every lunch and talking to people with different positions in the company. He/she has a large contact network, and is respected as a generalist in the company. One of the specific "know-what's" of the broker is on what arenas people interact and exchange knowledge in the organization. He/she also has as an outspoken task to establish such arenas continuously. The broker may use a variety of "instruments" to further these goals. One is to communicate "success stories" pertaining to specific projects or cooperative relationships in the organization. Brokers may be part-time as well as full-time employed in this capacity.

The corresponding role vis a vis the broker is of course the expert, who is a knowledgeable coworker with experience in some field, and who is willing and able to share his/her experience with others. The expert role is informal and hard to define; in one respect, the broker simply "connects people" for knowledge exchange. From this point of view, everybody is a potential expert for somebody else. However, the broker pinpoints specific people who are "extra knowledgeable" in some area, and he/she can make lists or inventories of these experts so as to keep them accessible and make the structure more transparent. These experts should not do other's work for them, but rather help coworkers to solve their own problems. The expert should then not be a bonafide project resource. A feedback relationship must exist between the broker and the expert. In this respect, the expert also takes the role as a broker, by referencing to other experts or back to a more suitable broker. These roles must be seen as essentially fluid and defined interactively and continuously. The goal is for the broker role to become a ubiquitous phenomenon in the company, one that does not have to be mandated by management.

3.7. Impact of the broker model on EST

The approach described here was successfully developed in a pilot project with the four members of the original "Factory" team, who acted as part-time knowledge brokers. The project impacted in a number of ways. For one, the number of broker-initiated mediations between expert and coworker increased fivefold during a 3-month period (as compared to the original level found in the pilot study). The broker team has started to engage managers in meetings on how the leadership cadre can connect to coworker in terms of providing "cultural guidance" and insight into the network structure and market position of the company. Managers have picked up on this and one heavyweight project manager is

actively engaged in the broker system. Lead-times where significantly cut in projects where the members had been in active contact with the brokers. On one occasion, the broker overheard a conversation in the copying room, which lead him to suggest a reconfiguration and a number of special resources for a project team. The project team maintained that this had saved the project (eight people) about 3 weeks of work time! There are plans at EST to establish an Intranet site that tracks and presents broker and expert activity, so that transparency may be increased and search costs be minimized. Internally the broker model has received a lot of attention; it is brought forward in the global corporate change program called "World Class Provisioning" that is aimed at reducing errors, lead times, costs and increase quality.

4. Discussion: managing knowledge through brokerage

Taking the EST knowledge brokerage model at "face value" or as a case instance of a phenomenon that bears the sign of the future, we will use the discussion section of this paper to explore the conceptual, practical, and wider cultural angels of the emergence of these types of models.

4.1. Management between market and hierarchy

The successful evolution of a broker model in an organization in some sense represents the prevalence of market over hierarchy. By this, we mean that the two modes of guiding the organizational system, while always in some respect existing side by side, may unexpectedly change in their relative importance, and in a sense end up competing with each other. This possible contradiction between the management system of brokerage (market) and the management system of command control (hierarchy) must be addressed for the broker model to function in the long run. A successful broker quickly gathers knowledge about the organization, about its weaknesses and strengths both on the individual and the departmental level. This knowledge should be of great value to managers, however if management tries and succeeds to make use of the knowledge of the broker for decisions on cutbacks and dismissals, or even resource redistribution, trust may erode vis a vis the broker function and the process will be halted. On the other hand if management does not use this information they risk distancing themselves from the organizational processes at large, and become marginalized by rendering themselves abstract and obsolete.

The market/hierarchy tension poses a real challenge for decentralized models of managing knowledge work that cannot be ignored. The specific challenge may consist in finding a dynamic equilibrium between the two organizational rationalities. Both logics are in some way dependent on the idea of an organizational community growing out of individual "self-interested" action (Miller, 1992), albeit the communities which the two respective logics tend to create are very different indeed. Is it possible then to see the market system of the broker as a "disciplining" of the hierarchy of the traditional organizational management system, where incentives for cognitive achievement on the

behalf of effectiveness are typically low (e.g., Liebenstein, 1982, 1987; Stiglitz, 1987)? Is there a basic contradiction between knowledge creation due to broker activity (and the concomitant survival of an internal knowledge market) on the one hand, and the traditional external market effectiveness necessary for the survival of the company viz. hierarchy on the other?

We may note that the tension between market and hierarchy, between natural tendency and designed intervention, exist in all organizations (Scott, 1998). This begs the question whether some variant of the broker phenomenon, possibly semi-ordered, actually exist in all organizations as well. Intuitively, of course, it does. What happens then if you try to organize it? Will it integrate into the hierarchical, ''rational'' structure and loose force if it becomes an ''official'' part of the system?

The broker role is a delicate one, especially if one considers its relation to hierarchical management solutions. But it is also delicate in its relation to the task at hand, which may be closely connected to broker identity as ''a free spirit'', an entrepreneur who breaks the boundaries of organized life and creates unknown resources for others and for him/herself (cf. Hellström & Malmquist, 2000). In this sense, it is probably important for the broker to be ''slightly unofficial,'' e.g., to be assigned other missions as well and to be approached by middle management and ''entrusted with a task,'' which he/she then has to carry out following personal discretion. At the same time, the impact of a visible broker is much greater than that of an invisible one in the sense that visibility reduces search costs, and legitimizes certain odd broker behavior (like eavesdropping in copying rooms). Yet, the natural broker, i.e., the one that has not been formally appointed, is self-selected and, in a way, informally elected by coworkers and management. Such silent and yet very powerful processes need to be understood and at least partly recreated in the selection and enabling of brokers.

The question of the broker role and scope as well as its relation to the organization at large forces the point of what type of knowledge it is that being brokered, what processes and capabilities the broker may enable, and what the key resources are to achieve this. An answer to these questions may give us a hint of whether there must be a difference between broker imperative and management imperative, or if these can coexist or even support each other in terms of the knowledge that is being exchanged. We turn to these issues in the conclusion.

5. Conclusion

The broker model seems to be a fruitful one as it harbors the promise of remedy to some of the problems inherent in KM approaches built on centralized epistemologies. The mere existence of the model seems to beg the question of whether a decentralized KM approach is at all possible. At the same time, the broker model is, as we have seen, not without its restriction and conundrums. The trade-off between the efficiency of the internal knowledge market and the constitutive force of organizational hierarchy (read bureaucracy) is difficult to make (especially if you happen to be in an organizational position to make that decision). A possible remedy is to recognize that the broker is drawing on many

resources and many types of knowledge, some of which may act preserving on organizational totality. Also, since the broker is moving around a multitude of environments, with their respective demands and restrictions, it becomes important to understand what arsenal of resources he/she may draw upon, what type of knowledge may be brokered via these resources, and to what end. Building on the case material as well as the discussion above, we have concluded that broker *knowledges*, *foci* and *resources* are diverse, but that they may combine to answer the question of how an activity which strength lies in spontaneity can be organized into a goal-driven organizational hierarchy. These combinations are summarized in Table 2.

First, core to the broker model presented was the connection of people who needed some specific piece of knowledge (knowledge what) with those who possessed it (knowledge that). The aim, or foci, of the exchange would be to lend *understanding* on some technical detail to the person lacking such understanding. The principle is one of transferring technical knowledge, pretty much like what would be the case in the engagement with an expert system, a database, or even a human expert. The key broker resource in this regard is an *expert*, in whatever form. Brokerage is what makes the expert effective, as opposed to the expert just existing on its own, which would have been the case without the broker system. In this model, the broker may therefore direct the inquiring worker to a machine or a portal as well as to a human expert, all depending on where the "what" knowledge is located.

Second, the most pervasive aspect of the brokerage model, as presented in the EST case, is of course the connecting of coworkers to help on practical and technical matters where knowledge "how" is the commodity in demand. In facilitating these "experience"-based knowledge exchanges, the broker focus is on creating *ability* to perform certain tasks, and the key resource for exchanging this ability is the *competent coworker*.

Third, in exchanging "why" knowledge, the focus is on broad issues of organizational politics and the raison d'etre of task, direction, or place of a group or person. The broker focus will most pervasively be one of culture and market, that is, to exchange knowledge that makes a routine or event reasonable from an institutional, rather than a technical angle. Key resources in broking "why" knowledge are the managers, especially the middle manager, who has the mandate, political knowledge, and network to interpret goals and strategies in operational terms both down and upwards in the organization. It is likely that it is this type of knowledge that is most likely to balance off the market forces vis a vis the need for organizational borders and internal coherence.

In conclusion, we believe it is by mixing these three types of knowledge broking foci, and by making space for all three to be executed, that a decentralized KM model builds on knowledge brokerage may be successful.

Table 2
Broker knowledge, focus, and key resources

Knowledge	What	How	Why
Broker foci	Understanding	Ability	Culture
Key broker resource	Expert	Competent coworker	Management

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