

Exploring Knowledge Emergence: From Chaos to Organizational Knowledge

Masao Kakihara & Carsten Sørensen

Department of Information Systems
London School of Economics and Political Science
Houghton Street, London WC2A 2AE, United Kingdom
Tel. +44 (0)20 7955 7655 Fax. +44 (0)20 7955 7385
E-mail: {m.kakihara, c.sorensen}@lse.ac.uk

ABSTRACT

This paper explores the emergent nature of organizational knowledge, which has not been addressed sufficiently in the current Knowledge Management (KM) research. For the task, we reconsider the concept of knowledge by looking at four distinct discourses on knowledge; namely, knowledge as object, knowledge as interpretation, knowledge as process, and knowledge as relationship. Then the fundamental nature of the emergence of knowledge will be discussed where we will argue that human interaction is the source of knowledge emergence. Based on the theoretical discussions, we examine a case study of a fire crisis threatening the supply chain between Aisin Seiki and Toyota in Japan. It demonstrates significant self-organizing, emergent KM practices that effectively coordinated various human and physical resources and contextual information in this chaotic situation. Finally we discuss the implications for future KM practices, by considering in particular the institutional aspects of information and communication technologies in KM practices.

KEYWORDS:

Emergence, organizational knowledge, interaction, the concept of *Ba*, institutional aspect of ICTs.

INTRODUCTION

Contemporary Knowledge Management (KM) research has made significant contributions to understanding the notion of knowledge in various organizational contexts in general, and effective management and coordination of organizational knowledge as pivotal corporate assets in particular. In the late 1990s, many researchers and practitioners have further energized KM research by linking the management of knowledge to various Information and Communication Technology (ICT) applications such as groupware and management information systems (Davenport et al., 1996; Davenport and Prusak, 1997). Knowledge management research has, however, not sufficiently addressed the *emergent* nature of knowledge (Nonaka and Nishiguchi, 2001). The concept of knowledge intrinsically involves emergent properties, systemic characteristics that cannot be analyzed or even perceived *a priori*, because knowledge, unlike data or information, emerges from subjective human interpretation and complex interaction between human beings (Stacey, 2000). Most of the current KM research has been predicated upon reductionistic and functionalist assumptions about the nature of knowledge focusing on conceptualizing knowledge as being static, decomposable and transferable. Knowledge encompasses emergent characteristics resulting from situated and largely unplanned decision-making and activities (Suchman, 1987). Although such

contingent nature of knowledge is often seen as a divergence in the management of organizational knowledge, an increasing number of scholars point out that the emergent and self-organizing aspects of knowledge can be a vital source of creative capability and strategic flexibility of organizations (e.g. Weick, 1993; von Krogh and Roos, 1995; Ciborra, 1999; Stacey, 2000).

This paper aims to explore the emergent nature of organizational knowledge, which has not been addressed sufficiently in the KM research to date, and to discuss its implications for future KM practices. In so doing, reconsidering the concept of knowledge itself is of particular importance here. In the next section, we will first reconsider the concept of knowledge by looking at four distinct discourses on knowledge; namely, knowledge as *object*, knowledge as *interpretation*, knowledge as *process*, and knowledge as *relationship*. Then the fundamental nature of the emergence of knowledge will be discussed where we will argue that *human interaction* is the source of knowledge emergence. The theoretical discussions on the concept of knowledge and interaction will be further examined in a case study of a fire crisis at a manufacturing site of Aisin Seiki, a car parts supplier of the Toyota Group in Japan. In coping with a totally unexpected crisis on the production line, the company demonstrated significant self-organizing, emergent behavior around organizational knowledge that effectively coordinated various resources and tacit know-how in a particularly disastrous situation almost entirely without centralized top-down direction. Based on the case study, the final section concludes the paper with some implications for future KM practices.

RETHINKING THE CONCEPT OF KNOWLEDGE

Here we try to shed light on the emergent nature of organizational knowledge and appreciate how it is associated with the current KM debates. Several perspectives can be applied when considering knowledge and the management of knowledge in organizations. For example, Swan and Newell (2000) offer three perspectives linking knowledge management and innovation within an organizational context: The Cognitive, the Community, and the Networking Model. Swan and Newell, however, focus on the role of different knowledge management strategies for organizational innovation processes. We are here more generally interested in understanding knowledge emergence and not in the more specific issues of the management of knowledge in specific innovation processes. In doing so, it is crucially important to carefully reconsider multiple, competing definitions of knowledge in the literature. Based on a synthesis of several epistemologies outlined below, we suggest the following four knowledge discourses. These are presented below as four analytically distinct but in practice interrelated discourses on knowledge in various social sciences: namely, knowledge as *object*; knowledge as *interpretation*; knowledge as *process*; and knowledge as *relationship*. The first perspective can be characterized as representationistic and the three others are interrelated anti-representationistic perspectives on knowledge.

Knowledge as Object

Although this paper aims to address the emergent nature of knowledge, it is still important to grasp the traditional, dominant, strand of discourse on the concept of knowledge. This debate is closely associated with the problem of *representation*. Representation has been a critical issue of traditional western philosophy, although the term “representation” has come to be used quite recently. From a representationistic perspective, a reality is always an imperfect “mirror image” of *the* perfect, objective world. The modern debate on representation has its roots in Descartes’ philosophical thought in the seventeenth century and has been extremely influential in a wide range of natural and social sciences, clearly including modern management and organization studies in the twentieth century. Representationism is a fairly traditional approach for understanding organizational knowledge in contemporary management and organization studies. According to Aadne et al. (1996), a representationistic view on knowledge is based on several general assumptions about knowledge. *First*, it presupposes that knowledge is seen as a representation of a pre-given world. This indicates that social reality is totally outside the observing actor. *Second*, in this view human intelligence can be seen as information processing and rule-based manipulation of symbols. Behind this assumption is the traditional view of cognitive science; that is, human intelligence is to a large

extent tantamount to the characteristics and functionality of computation. *Third*, knowledge is seen as objectified and transferable. Based on the cognitivist point of view, knowledge is perceived as a billiard-ball-like entity that can be stably transferred within and between human brains. As argued by Stacey (2000): “The social, in human terms, is a highly sophisticated process of cooperative interaction between people in the medium of symbols in order to undertake joint action”. *Fourth*, learning is thought of as creation of the most accurate or “truthful” representations of the objective world. In this view, learning implies improving representation through acquiring information from the outside world and assimilating it to former experiences. Summarizing those traditional debates on knowledge, we may call this strand of discourse as that of “knowledge as object”, or a cognitive perspective on knowledge (Swan and Newell, 2000).

In management and organization studies, the discourse of knowledge as object is closely linked with the information-processing paradigm (Galbraith, 1973; Simon, 1981). As many argue (e.g. Ciborra, 1993; Venzin et al., 1998; Argyris, 1999), the information-processing paradigm has long dominated management and organization studies – the organization can be perceived as a large machine which continuously processes managerial information and data for rational purposes. Based on the information-processing view of the organization, the conventional KM research has seen knowledge as objectified and codified – similar to data – and sought an effective utilization of ICTs for coordinating such object-like knowledge. It is clear that the discourse of knowledge as object has contributed in clarifying the explicit and relatively static aspects of organizational knowledge. However, this view has been subject to strong criticism in the last two decades (e.g. Winograd and Flores, 1986; von Krogh and Roos, 1995; Tsoukas, 1998; Hodgson, 2000; Stacey, 2000).

Knowledge as Interpretation

Many philosophical scholars have argued that knowledge is inherently associated with human intersubjective interpretations and dependent very much on ‘the point of observation’ of the interpreter and that the process of interpretation simultaneously shapes and is shaped by social reality (e.g. Berger and Luckmann, 1966; Schutz and Luckmann, 1974). Here it is important to pay attention to the word ‘reality.’ In the traditional representationistic view of the world, the fundamental assumption is that the world is pre-given, and its aim is to create the most accurate or ‘truthful’ representations of this objective world. This view has been the philosophical foundation of not just the information-processing paradigm of management and organization studies but also a vast range of social sciences including neo-classical economics, modern political science, and experimental psychology. This view can be questioned, however, when the concept of knowledge is reconsidered at its fundamental level. In response to the application of various anti-Cartesian philosophical thoughts, such as ones forwarded by Husserl, Heidegger, Merleau-Ponty, and Gadamer, into social sciences in the second half of the twentieth century, knowledge in managerial and organizational contexts has gradually come to be thought of not just as a representation of the pre-given world but also as *brought forth* through the creative act of human cognition and interpretation. Winograd and Flores (1986) argue that knowledge is always the result of individuals’ mutual interpretive action and linguistic behavior, which depends on the entire previous experience of the interpreter and on situatedness in social convention and tradition. Given the concept of knowledge as the result of human interpretations, the notion of communication, too, should be reconsidered, since the notion of communication in the traditional managerial and organizational context has presupposed the information-processing view of organization. Maturana and Varela (1992), from the perspective of autopoiesis theory, insist that “the phenomenon of communication depends not on what is transmitted but on what happens to the person who received it.” (p. 196)

It could be argued that the concept of knowledge cannot be fully grasped and dealt with without taking human interpretative behavior into account, although the representationistic view of knowledge have no doubt contributed to the development of a functional analysis of organizational behavior concerned with knowledge. The concept of knowledge as intersubjective interpretations

and its theorization in managerial and organizational contexts have emerged with in the last two decades (e.g. Daft and Weick, 1984; Weick, 1995; Tsoukas, 1996; Hodgson, 2000).

Knowledge as Process

The static and objectified view of knowledge which has been pervasive in the management and organization literature has emerged mainly because knowledge more or less has been equated with physical resources in organizations such as money, labor, and land, and fits very well with the mechanistic and functional understanding of organizations. However, this static view of knowledge has been subject to criticism from the *process* view of knowledge. Perhaps the most notable among various classic process views of knowledge is Whitehead's (1929) work, which proposes that reality is no longer viewed as a superficial, accidental changing of its static structure, but as a continuous process and an active alteration in the very fabric of reality itself. Whitehead's work can be seen as another challenge to the Cartesian mechanistic understanding of the world. Whereas the Cartesian philosophy postulates the fundamental dualism between subject and object, namely that between mind and body, Whitehead insists that there exists neither subject nor object that can be isolated from reality itself and both subject and object are intrinsically bound to ongoing processes of transition of reality. From a process-oriented view, knowledge is not a static entity but the manifestation of a dynamic *process* of 'knowing' by which human beings make sense of the world and reality (Varela et al., 1991; Blackler, 1995).

It seems that this process view of knowledge, or knowing, has gradually permeated the research field of management and organization studies as a whole. Weick (1979), for example, uses the term *organizing* rather than *organization* for shedding a light upon the continuous process of organizational behavior. Likewise, Senge (1990), applying systems thinking approaches to the study of learning organization, also stressed that in order to apprehend organization's reality, "seeing processes of change rather than snapshots" is crucial (p. 73). Both Weick and Senge warn that the static and cause-effect based view toward an organization is dangerous for understanding the complex problems organizations face. Nonaka and Takeuchi (1995), the advocates of the 'knowledge-creating company,' argue that knowledge should be viewed as "a dynamic human process of justifying personal belief toward the 'truth'" (p. 58). Spender (1998), adopting a pluralist epistemology, focuses in his knowledge-based theory of the firm not on "the static framework dictated by positivism's monist epistemology" but on "the processes that generate, distribute and apply" the firm's intangible knowledge assets (1998: p. 235) It is thus important to point out here that the concept of knowledge does encompass dynamic and fluid aspects in itself. That knowledge emerges out of dynamic processes between subjectivity (belief) and objectivity (truth) has been a classic discourse since Polanyi (1966). Yet scarce attention has been paid to this perspective within the KM research community.

Knowledge as Relationship

As well as being interpretive and process-oriented, knowledge is in nature *relational* to its surrounding world. As argued above, knowledge is a result of human mental acts, be it individual, group, or social, and those acts are dependent on various socio-cultural contexts. At the same time, mental acts, along with linguistic acts, continuously shape social reality and can induce new contextual drifts of the world (Maturana and Varela, 1992). From this point of view, knowledge does not exist in an isolated state in the objective world, but rather resides within a variety of contextual factors that are inseparably connected with the body of knowledge. Knowledge thus can be seen as an interconnected web of *relationships* in which human interpretative acts ceaselessly shape and maintain, both intentionally and unintentionally, the relational setting of the web and contextual disposition of the social reality. Any knowledge always depends on a set of relationships to other knowledge in the framework of the whole social reality (Stacey, 2000).

That knowledge is seen as relationship is not a novel idea. Many philosophers have explored this idea and seen it as crucial for surmounting the Cartesian objective understanding of the world.

Dilthey (1976), a German philosopher, criticizes the traditional Cartesian subject-object split and its view of the world as pre-given, and argues that the very essence of reality and human knowledge exists in the relationship between subject and object. Heidegger (1962) asserts that humans are 'thrown' into the reality and *Dasein*, or being-there, is the fundamental existential mode of humans. Human being's *Dasein* is assured and are characterized by relationships to the world, which are inseparable to each other and to the human. Kimura (1988), a Japanese psychiatrist and philosopher, offers the notion of 'inbetweenism.' Highly influenced by Heidegger's work, he argues that the world should be seen as an ongoing flow of events, not objects, emerging through human subjective observation, and that human being resides in 'Aida,' a Japanese word meaning a symbolic space between those events the relationship between the events and human is the nature of living.

In recent studies, the idea of knowledge as relationship has acquired significance, since there is a strong resonance between this idea and an emerging social reality — the advent of a network metaphor of organization. Largely helped by the development and diffusion of ICT, particularly the Internet, organizations now become relatively freed from geographical constraints and institutional incompatibilities across various boundaries. Consequently, organizations are able to directly reach and connect with a variety of players in the market such as foreign business partners, suppliers of raw materials and parts, excellent designers in the world and even their own customers (Rochart and Short, 1991; Jarvenpaa and Ives, 1994). Castells (1996), from a much broader perspective, argues that “*networks constitute the new social morphology of our societies, and the diffusion of networking logic substantially modifies the operation and outcomes in processes of production, experience, power, and culture*” (p. 469). In such a new reality, organizational knowledge thus should be viewed in terms not only of possession and storing but also, or more importantly, relationship and connectedness with other social actors and structures.

EMERGENCE, INTERACTION, AND BA

The discussions on the four distinctive discourses on knowledge in the previous section shed light upon aspects of organizational knowledge that have rarely been dealt with in depth in the current KM research. The KM research is still largely dominated by the representationistic view of knowledge, viewing knowledge as something like *object* in rationalistic and functional ways. However, we think that we should pay more attention to other aspects of knowledge which are beyond the representationistic perspective. That is to say, knowledge is inherently dependent on human intersubjective and contextual *interpretation*, on the dynamic *processes* in which the significance of knowledge is brought about, and on the *relational* characteristics that cannot be appreciated when dissected into constituent parts. These three alternative perspectives on knowledge clearly indicate that knowledge encompasses distinctive characteristics that cannot be perceived *a priori*, that is, the *emergent nature* of knowledge. In this section we try to further clarify those emergent aspects of knowledge and discuss how they are related to organizational issues particularly by looking at the notion of *interaction* and the concept of *Ba*.

Emergence: The Nature of Knowledge

In the second half of the twentieth century, many scholars in various disciplines, including theoretical biologists, mathematicians, and computer scientists, have grappled with emergent phenomena in the real world and proposed various intriguing, and at the same time controversial, ideas and frameworks for explaining them. See for example Hodgson's (2000) excellent overview of how the concept of emergence has emerged, disappeared and re-emerged in the social sciences over the past 100 years. In its broadest sense, emergence is a self-organizing behavior or state that comes out of the interaction of many actors' behaviors that cannot be predicted or even envisaged from knowledge of what each component of a system does in isolation (Holland, 1998). Maturana and Varela (1992) radically apply their theory of self-organizing systems — Autopoiesis — to various philosophical issues on human cognition and knowing, and argue that human cognition is not a representation of the world, but rather a continual bringing forth of a world through the process of living. They insist that human knowledge is not the aggregation of discrete, objective

information but a result of *emergent processes of knowing* through human subjective interpretations, or sense-making, dependent on complex historical contexts.

Although the current KM research has successfully clarified objective and codifiable aspects of knowledge in organizational contexts, it has not sufficiently dealt with emergent properties and resulting behaviors of organizational knowledge. Given that emergence is a fundamental aspect of knowledge, most of the current KM approaches, largely resting on the representationistic understanding of knowledge, would be problematic because of its powerlessness to deal with emergent properties of organizational knowledge. Furthermore, some argue that the concept of knowledge and the traditional notion of ‘management’ are mutually contradictory (e.g. McAdam and McCreedy, 2000; Alvesson and Kärreman, 2001). They critically say that the term ‘knowledge management’ is a naïve combination of the notion of *knowledge*, which is inherently so ambiguous, diverse, inconsistent, and vague that it cannot be controlled or even perceived in rationalistic ways, and the notion of *management*, which seeks control-based, rationalistic intervention to a given social reality or phenomenon. This conceptual conflict within KM is, in our view, a result of the conventional management theories lack of appreciation of the emergent properties of social and organizational systems in general and of knowledge intensive behaviors of actors in particular. In order to overcome this contradiction between emergent knowledge and the issue of management, contemporary and future KM research should actively address “knowledge emergence” issues (Stacey, 2000; Nonaka and Nishiguchi, 2001).

Interaction: The Source of Knowledge Emergence

Faced with the increasing importance of considering ‘emergence’ issues within Knowledge Management, the question remains how to approach emergent aspects of organizational knowledge in actual business operations and strategic practices of firms? In the following we suggest the initial consideration of characterizing knowledge emergence in terms of a particularly important aspect of organizational behavior: *interaction*.

We here use the notion of *interaction* with a particular emphasis on the formalization of knowledge emergence, because interaction, we believe, is the primal source of knowledge emergence. Various actors in an organization continuously interact with each other, intentionally or unintentionally, and purposefully or non-purposefully. As discussed above, knowledge, which sometimes can be usefully regarded as object, is dependent on human intersubjective interpretation, process in which the knowledge is brought forth, and relationship to other knowledge and various social contexts. This clearly implies that knowledge does not exist in isolation from the social environment; rather it is embedded in the *social fabric of human interaction* and emerges out of ongoing complex human interactions with other actors. Holland, (1998) an eminent computer scientist and complexity theorist, points out the critical relationship between emergent properties of a system in general and the notion of interaction as follows:

“Emergence is above all a product of coupled, context-dependent interactions. Technically these interactions, and the resulting system, are *nonlinear*: The behavior of the overall system *cannot* be obtained by *summing* the behaviors of its constituent parts... the whole is indeed more than the sum of its parts. However, we *can* reduce the behavior of the whole to the lawful behavior of its parts, *if* we take the nonlinear interactions into account.” (pp. 121-2: original emphasis)

It is here particularly important to note that in order to characterize emergent properties of knowledge and resulting phenomena, we must understand the notion of interaction, which is a primal source of knowledge emergence, not as a discrete unit of human activities but as an *ongoing, nonlinear, fluid process* of interaction of participating actors oriented towards other actors and/or systems (Stacey, 2000; Kähkönen et al., 2002).

Cook and Brown (1999) also point out the importance of interaction by proposing the distinction of the *epistemology of possession* and *epistemology of practice*. They argue that the traditional understanding of the nature of knowledge is predicated on the epistemology of possession whereby

the forms of “what is known” are typically treated as something people possess. Because this epistemology cannot account for the dynamic interplay between human action and a body of knowledge, they propose the *epistemology of practice* whereby knowing, rather than knowledge, plays an active role of interaction with other actors and the world as part of human practice. They argue:

Within the relational and interactive character of knowing, the world shapes our actions by requiring that we honor it, just as we shape the world by interacting with it in a disciplined way. *Knowing is to interact with and honor the world using knowledge as a tool.* (p. 389, original emphasis)

It is hence important to understand that the notion of interaction not only refers to mutual activity between a human actor and another but also indicates the reciprocal interplay between the actor’s action and the world where s/he reside. Thus it is through interaction that knowledge, be it explicit or tacit and individual or collective, can hold its relation to actual social reality, not separated from it. Furthermore, it is by interaction that knowledge is enacted and mobilized in an organization’s KM practices.

The Concept of ‘Ba’: The Place for Knowledge Emergence

We have in the previous discussed the significance of interaction for knowledge emergence, but how can we relate these theoretical findings to contemporary KM frameworks? How are interactions initiated and organized in actual social and organizational settings? We suggest applying the concept of *Ba* (Nonaka and Konno, 1998; Nonaka et al., 2001) as a viable approach to understanding how interactions are initiated and organized in actual social and organizational settings.

Nonaka and his colleagues propose the concept of *Ba*, a Japanese word for place or field, for further clarifying their SECI (Socialization, Externalization, Combination and Internalization) model. They define the concept of *Ba* in the following way:

Ba can be thought of as a shared mental space for emerging relationships. This space can be physical [...] virtual [...] or mental. *Ba* provides “a platform for *interaction* between individual and/or collective knowledge [...] We consider *ba* to be an *emergent foundation for knowledge creation*. (Nonaka et al., 2000: p. 93, emphasis added except for *Ba*)

Their adoption of the concept of *Ba* into their SECI model can be seen as their attempt of taking emergent behavior of knowledge within organizations into account. They envisage the four types of *Ba* in relation to each stage of the SECI model. First, *Originating Ba* is the place where individuals share feelings, emotions, experiences and mental models. This type of *Ba* is to be the platform for *Socialization* processes in the SECI model. Physical and face-to-face interactions facilitate the sharing of individual tacit knowledge with other individuals. Second, *Dialoguing Ba* is where individuals reflect not only their own but also others’ mental models and share them in an explicit form at a group level. This *Ba* facilitates *Externalization* process of knowledge creation. Third, *Systemizing Ba* is a place where new explicit knowledge is combined with existing explicit knowledge, being a platform for *Combination* processes of knowledge creation. In this phase, group knowledge comes to be shared at an organization level, and effectively organized and stored, in most cases, helped by various IT applications. Finally, *Exercising Ba* is a platform for *Internalization* of knowledge, that is, new sets of explicit knowledge converge into individuals’ tacit knowledge by, for example, on-the-job-training and participative learning.

The concept of *Ba* allows us to relate the notion of interaction and the emergent behavior of organizational knowledge in a context of KM practice. Knowledge emergence does not occur in vacuum, but in a *topological* space the network of interactions recursively create. By topological we mean that interactions exist not in a pre-given, three-dimensional, physical space but in a space that

interactions themselves create in recursive, production processes of the network of interaction as a whole. A topological space for knowledge emergence, in a sense, exists only in terms of process and relationship. The concept of *Ba* can be seen as a manifestation of a topological space for knowledge emergence. If we adopt a representationistic perspective for understanding organizational knowledge, it is unnecessary to think of such a topological space, since from this perspective knowledge can be processed and transmitted just as computer data. However, given that the essence of knowledge is the emergence out of ongoing, fluid interactions (Kakihara et al., 2002), it seems useful to consider a topological space like *Ba* in order to explain the emergence of knowledge because emergence of any kind cannot be perceived of in physical terms.

A CASE OF KNOWLEDGE EMERGENCE: THE AISIN SEIKI CRISIS

In the previous section, we have discussed some important notions in contemporary KM theories and practices and outlined several theoretical findings around knowledge emergence. These largely hypothetical ideas need to be empirically validated. Although such empirical work is beyond the scope of this paper, we want in this section to explore a brief but particularly interesting case study that might enable us to further appreciate the significance of knowledge emergence in actual organizational settings. The case discussed here is the fire crisis of Aisin Seiki, one of the biggest parts suppliers of Toyota, a Japanese car manufacturer. It shows how self-organizing, emergent behavior of organizational knowledge can emerge out of the chaotic situation of the fire crisis and play a crucial role in coping with the unexpected and very serious problems caused by the incident. Nishiguchi and Beaudet (1998; 1999; 2000) have thoroughly investigated the incident from the perspective of organizational and interorganizational knowledge. The purpose here is to reexamine their detailed study and, based on the previous discussion of knowledge emergence, to draw implications for KM practices. We have validated our analysis of the Aisin Seiki crisis through conversations with Professor Nishiguchi, who also commented an earlier version of the paper.

Background

The incident occurred on February 1st, 1997 at one of the plants of Aisin Seiki, which supplies Toyota proportioning valves (P-valves), a brake-related part used in almost all Toyota vehicles. The production line of P-valves was almost entirely destroyed by the fire and Aisin was immediately unable to supply the parts to Toyota. Due to Just-In-Time (JIT) operations in the production and supply of P-valves, only a few-day worth of stock was left in Toyota's factories, and Toyota could do nothing but immediately close down 20 of its 30 assembly lines, including those at Toyota's contractors' assemblies.

A P-valve is a small but high-precision part. The fact that Aisin was the sole supplier of P-valves, in spite of the recent huge demand for risk management in manufacturing industries, was quite surprising to many. In fact, parallel sourcing is more common than single sourcing in car manufacturers since JIT operations can be particularly fragile to sudden supply problems just as the Aisin incident clearly demonstrated (Richardson, 1993). However, Toyota's choice of sourcing P-valves solely to Aisin is reasonable in many ways, not just because Aisin is one of its closest suppliers in terms of sales, personnel and financial linkages (particularly share holding) but also because Aisin has long maintained an outstanding performance in terms of cost, quality and delivery. The fact that even after the incident Toyota kept sourcing P-valves to Aisin rather than seeking alternative suppliers clearly indicates the difficulty in replacing Aisin's performance in P-valve production.

Far more important in the light of knowledge emergence is the fact that in order to produce P-valves at alternative production sites after the sudden incident, intense collaboration immediately developed inside and outside Toyota and Aisin. Various collaborative efforts were accomplished almost without the top-down, direct control of Toyota and with no conflict over technical proprietary rights or financial compensation. As a result, one of the worst crises of Toyota's long history was averted and Toyota assembly plants were reopened within only a few days of the

shutdown. This striking fact has tended to be overlooked and instead the fragility of JIT was emphasized by the media (e.g. *NikkeiBusinessMagazine*, 1997). However, we think that this clearly shows Toyota group's high degree of flexibility and adaptability to rapid environmental changes, and Nishiguchi and Beaudet's analysis does shed light upon the dynamism of knowledge emergence and its effective functioning in the chaotic situation.

Knowledge Emergence Out of Chaos

The sudden destruction of the Aisin plant demanded a quick and well-coordinated response, since the closing down of the Toyota assembly lines of Toyota and its continuation meant huge and irretrievable losses of revenue and profit not only for Aisin and Toyota themselves but also for hundreds of firms in the Toyota Group. The first urgent step Aisin took was to find potential collaborators that could make various sub-parts of P-valves both inside and outside Toyota group as soon as possible. Many firms responded to Aisin's request within the same day of the incident, and, more interestingly, many other firms voluntarily offered Aisin their help after hearing about the fire on the radio and TV. However, although a few firms such as Nabco, Sumitomo Electric Industries, and Akebono Brake Industry, had previously produced different types of P-valves, many others had no previous experience even with dealing with P-valves. Facing this problem, Aisin immediately faxed design drawing and the production instructions of the P-valves that were particularly needed. Aisin also installed 250 additional fixed phones and 300 mobile phones to support firms' inquiries regarding the production of P-valves as well as keeping lines available for the rest of the external environment in the chaotic situation (Nishiguchi and Beaudet, 2000: p. 213).

Although many firms eventually declined to help Aisin for numerous reasons including lack of experience, knowledge, or enough special machines to manufacture P-valves, quite a few others agreed and decided to manufacture P-valves under Aisin's instruction. Significantly, most of them, including Denso Corp., Taiho Kogyo, Kayaba, started preparing and manufacturing the parts with little direct assistance and coordination of Aisin or even Toyota but with "shared understandings and capabilities" (Ibid. p. 214). This is what Nishiguchi and Beaudet particularly focus on, and they explain that those characteristics have been acquired through *institutionalized mechanisms* of knowledge sharing in the Toyota supply network, which enabled Aisin and Toyota to cope with the disruptive events and to coordinate various efforts and actions within the network in a largely self-organized manner.

In terms of institutionalized mechanisms, they draw particularly two distinctive features of within the whole Toyota Production System (TPS): *JIT* and *inter-supplier discussion forums*. First, JIT is a key mechanism, allowing Toyota to make its supply chain management efficient and highly adaptable to rapid change within its operational environment. Toyota's JIT system requires close and careful coordination and cooperation of micro-operations supported by the *Kanban* system, a plate-based demand-supply coordination system originally invented by Toyota and now further assisted by a highly sophisticated computer network. Nishiguchi and Beaudet argue that the dense and agile network of the supply chain not only enabled Toyota to synchronize a huge number of its suppliers at quite a low level of stocks, but also helped foster "network-wide problem solving capabilities" which worked in a highly decentralized way (Ibid. p. 201). JIT operations in the Toyota supply network hold the ability to develop the functional capabilities, which are required to perform specific tasks and achieve specific targets in day-to-day operations, and the relational capabilities, which make it easier to collaborate with customers and suppliers. They put: "JIT institutionalizes cooperation among units to achieve both day-to-day results (such as meeting consumer demand) and long-term improvements in group performance through interpersonal and interorganizational interaction" (Ibid. pp. 201-2).

In addition to JIT, various discussion forums among suppliers are held regularly and irregularly, serving as a catalytic role for sharing information and know-how concerned with various parts productions. Among them, particularly noteworthy are *Kyohokai*, regular meetings of supplier

association, and *Jishuken*, voluntary study groups that are organized beyond formal organizational boundaries of suppliers. Although both Kyohokai and Jishuken were initiated by Toyota's direction, the meetings and workshops are in effect organized and held on suppliers' voluntary basis with little intervention of Toyota management. Those face-to-face forums among suppliers can be seen as a distinct *Ba*, facilitating the diffusion of contextual knowledge that offers suppliers solution to a given problem and helps them identify which practice are effective and/or whom to contact for more details.

Implications

These TPS mechanisms, in particular JIT and inter-supplier discussion forums, facilitate the rapid diffusion and sharing of best practice and interorganizational learning by institutionalizing the accumulation and crystallization of highly tacit and contextual knowledge of detailed production management processes. Moreover, they help fostering a strong sense of common fate and mutual familiarity within the whole group and among the suppliers. Nishiguchi and Beaudet argue that such institutionalized learning of TPS is much deeper than the typical North American benchmarking methods and that it offers "the foundation for long-term *co-evolution* of network members through on-going interorganizational interaction" (Ibid. p. 203, original emphasis). Obviously, Nishiguchi and Beaudet notice through their investigation that various interactions within and between organizations can be a key factor for practical utilization of highly contextual and relation-based organizational knowledge. It could be argued that whereas American benchmarking methods focus mainly on static and largely explicit knowledge in a given organization, Toyota's institutionalized learning mechanisms including JIT and inter-supplier discussion forums include the significance of *interpretive*, *process-oriented*, and *relational* aspects of organizational knowledge in its scope

The case of the Aisin fire crisis shows that Aisin and Toyota's surprisingly rapid response to the destructive crisis is no coincidence but rather the manifestation of the potential capability of organizing dynamic knowledge emergence, which have been fostered through various institutionalized practices within the Toyota group, such as continuous adjustment of organizational settings in the JIT operations, and knowledge sharing in inter-supplier discussion forum. In the extreme situation Aisin faced, the creative emergence of organizational knowledge can be seen as a key factor in coping with the problem at hand. As many argue (e.g. Weick, 1993; Orr, 1996; Ciborra, 1999), improvised, situated, and self-organizing human interactions and practices can play a crucial role in nurturing and facilitating the knowledge emergence processes in organizations, and that they are sometimes much more effectively and rapidly than planned, top-down, and formalized solutions.

DISCUSSION

In this section, based on the Aisin case we examined above, we try to draw some implications for the study of knowledge emergence in relation to technological aspects of KM practices. In so doing, we particularly look at *institutional* roles of ICTs and information systems.

ICTs in general and information systems in particular play an important role in KM practices, but perspectives towards technology in the KM practices vary significantly. A significant proportion of KM research has been dominated by a relatively simplistic understanding of ICTs as tools for increasing the efficiency and effectiveness of organizational operations and information systems are a particular unit of such ICTs for certain specific purposes (Sørensen and Kakihara, 2002). This view towards ICTs is not completely irrelevant; it has to a large extent contributed to the development and cultivation of KM research so far. However, it is insufficient to grasp emergent properties of knowledge and dynamic behavior of interactions within and between organizations, since the traditional view of ICTs is intrinsically mechanistic and functionalistic in its analytical trait.

We suggest here a new perspective on information systems: not as tools for efficient and effective operation but instead as an *institution*. By institution we particularly imply the concept used in North's (1986; 1990) institutional economics. He explains:

Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social, or economic. (1990, p. 3)

He argues that institutions consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights). He also insists:

Institutions consist of a set of constraints on behavior in the form of rules and regulations; a set of procedures to detect deviations from the rules and regulations; and, finally, a set of moral, ethical behavioral norms which define the contours and that constrain the way in which the rules and regulations are specified and enforcement is carried out. (1984, p. 8)

From North's perspective on the notion of institution, it would be fair to say that information systems encompass institutional characteristics; that is, information systems in organizations are not merely technological artifacts that make operations efficient and smooth but rather *social institutions that shape managers' strategic decision making processes and hence the organizational form of firms*. As shown in the case of the Aisin fire crisis, a variety of information systems in Toyota's supply network contributed to the effective functioning of JIT operations and the communication between actors within the network. It is easy to imagine that, without information systems and other ICT applications, Aisin and Toyota could not coordinate collaborative efforts across various organizational boundaries. The interplay between the utilization of information systems and ICT applications in everyday operations and the process of an organization's structural and strategic change plays a critical role in the creation and coordination of organizational knowledge (Orlikowski and Hofman, 1997; Robertson et al., 2000). In the Aisin case, information systems and institutionalized mechanisms such as JIT and inter-supplier forums were inseparably interwoven and consisted of distinctive and competitive social institutions, which competitors could not imitate easily. In the light of knowledge emergence, information systems should be seen not only as technological artifacts but as institutional settings, or formative contexts (Ciborra and Lanzara, 1994), that shapes the trajectory of the creation and utilization of organizational and interorganizational knowledge.

Based on this broader understanding of the role of ICTs and information systems in KM practices, it can be said that although the incident Aisin and Toyota faced is perhaps an extreme case, the case is nevertheless quite informative in other organizational and national contexts. The Aisin case clearly tells us that a KM practice for fostering, maintaining, and mobilizing knowledge emergence is not such a superficial activity as applying a certain technological solution to a given problem setting but to carefully set a effective institutional arrangement for organizational knowledge and its creation in an everyday level across organizational boundaries. Along with a variety of in-depth study on the TPS and Japanese automobile industry's production management (e.g. Womack et al., 1990; Nishiguchi, 1994; Fujimoto, 1999; Spear and Bowen, 1999), what we learnt from the Aisin case would be largely applicable to KM practices in different organizational settings and even different countries. But it is important to note that in order to deal with emergent nature of organizational knowledge, KM practices, no matter in which national contexts they are conducted, must be incorporated both technological and institutional arrangements of everyday work activities within and between organizations.

CONCLUSION

In this paper we have tried to reconsider the current KM theorizations and frameworks by shedding

light upon aspects of organizational behavior that have not been taken seriously in the KM research to date; namely, the emergent nature of organizational knowledge and its dynamic functioning in actual organizational practices. Summarizing, knowledge is by nature emergent in term of its interpretative, process-oriented and relational properties, and knowledge in organizational contexts is generated through complex, dynamic and fluid interactions between actors, organizations and social environments. As we have discussed in the case of Aisin Seiki fire crisis, the emergent nature of organizational knowledge can be best seen in such situations where creative, flexible and coordinated organizational practices are immensely needed, for example coping with a totally unpredictable fire crisis in the Aisin case. The ideas on knowledge emergence discussed in this paper are largely hypothetical at this stage, so it is clear that these ideas have to be empirically validated in future research. We hope, nevertheless, that although the study of knowledge emergence has not yet attracted enough attention in the KM research community, this work will further facilitate debate on this topic.

Acknowledgements

Thanks to Maxine Robertson for proofreading. Also thanks to Professor Nishiguchi for helping us with further details and analysis of the Aisin Seiki case. This research was partly funded by the Daiwa Anglo-Japanese Foundation through the Japan Foundation Endowment Committee.

REFERENCES

- Aadne, J. H., G. von Krogh, & J. Roos (1996): Representationism: The Traditional Approach to Cooperative Strategies. In *Managing Knowledge: Perspectives on Cooperation and Competition*, ed. G. von Krogh and J. Roos. London: Sage Publications, pp. 9-31.
- Alvesson, M. & D. Kärreman (2001): Odd Couple: Making Sense of the Curious Concept of Knowledge Management. *Journal of Management Studies*, vol. 38, no. 7, pp. 995-1018.
- Argyris, C. (1999): *On Organizational Learning*. 2nd edition. Malden, MA: Blackwell Business.
- Berger, P. L. & T. Luckmann (1966): *The Social Construction of Reality*. Garden City, NY: Anchor Books.
- Blackler, F. (1995): Knowledge, Knowledge Work and Organizations: An Overview and Interpretation. *Organization Science*, vol. 16, no. 6, pp. 1021-46.
- Castells, M. (1996): *The Rise of the Network Society*. The Information Age: Economy, Society and Culture. ed. M. Castells. Malden, MA: Blackwell. 1-55786-617-1.
- Ciborra, C. U. (1993): *Teams, Markets and Systems: Business Innovation and Information Technology*. Cambridge: Cambridge University Press. 0-521-57465-X.
- Ciborra, C. U. (1999): Notes on Improvisation and Time in Organizations. *Accounting, Management and Information Technologies*, vol. 9, pp. 77-94.
- Ciborra, C. U. & G. F. Lanzara (1994): Formative Contexts and Information Technology: Understanding the Dynamics of Innovation in Organizations. *Accounting, Management and Information Technology*, vol. 4, no. 2, pp. 61-86.
- Cook, S. D. N. & J. S. Brown (1999): Bridging Epistemologies: The Generative Dance Between Organizational Knowledge and Organizational Knowing. *Organization Science*, vol. 10, no. 4, pp. 381-400.
- Daft, R. L. & K. E. Weick (1984): Toward a Model of Organizations as Interpretation Systems. *Academy of Management Review*, vol. 9, no. 2, pp. 284-95.
- Davenport, T. H., S. L. Jarvenpaa, & M. C. Beers (1996): Improving Knowledge Work Processes. *Sloan Management Review*, vol. Summer, pp. 53-65.
- Davenport, T. H. & L. Prusak (1997): *Information Ecology: Mastering the Information and Knowledge Environment*. New York: Oxford University Press.
- Dilthey, W. (1976): *W. Dilthey, Selected Writings*. Translated by H. P. Rickman. Cambridge: Cambridge University Press.
- Fujimoto, T. (1999): *The Evolution of a Manufacturing Systems at Toyota*. Oxford: Oxford University Press.
- Galbraith, J. (1973): *Designing Complex Organizations*. Reading, MA: Addison-Wesley.
- Heidegger, M. (1962): *Being and Time*. Translated by J. M. a. E. Robinson. Oxford: Basil Blackwell.
- Hodgson, G. M. (2000): The Concept of Emergence in Social Science: Its History and Importance. *Emergence*, vol. 2, no. 4, pp. 65-77.
- Holland, J. H. (1998): *Emergence: From Chaos to Order*. Oxford: Oxford University Press.
- Jarvenpaa, S. L. & B. Ives (1994): The Global Network Organization of the Future: Information Management Opportunities and Challenges. *Journal of Management Information Systems*, vol. 10, no. 4, pp. 25-57.
- Kakihara, M., C. Sørensen, & M. Wiberg (2002): Fluid mobile work. In *Tokyo Mobile Roundtable, Tokyo, Japan*, ed. Takeishi. Institute of Innovation Research (IIR), Hitotsubashi University.
- Kimura, B. (1988): *Aida*. Written in Japanese. Tokyo: Kobundo.
- Maturana, H. R. & F. J. Varela (1992): *The Tree of Knowledge: The Biological Roots of Human Understanding*. Revised

- edition. Boston, MA: Shambhala. 0-87773 642-1.
- McAdam, R. & S. McCreedy (2000): A Critique of Knowledge Management: Using a Social Constructionist Model. *New Technology, Work and Employment*, vol. 15, no. 2, pp. 155-68.
- NikkeiBusinessMagazine (1997): Morosa Koso Tsuyosa Da (Fragility is Power). (Written in Japanese). no. February 17, pp. 10-11.
- Nishiguchi, T. (1994): *Strategic Industrial Sourcing: The Japanese Advantage*. New York: Oxford University Press.
- Nishiguchi, T. & A. Beaudet (1998): Case Study: The Toyota Group and the Aisin Fire. *Sloan Management Review*, vol. 40, no. 1, pp. 49-59.
- Nishiguchi, T. & A. Beaudet (1999): Kaosu Ni Okeru Jikososhikika (Self-Organization in Chaos). (Written in Japanese). *Soshiki Kagaku*, vol. 32, no. 4, pp. 58-72.
- Nishiguchi, T. & A. Beaudet (2000): Fractal Design: Self-organizing Links in Supply Chain Management. In *Knowledge Creation: A Source of Value*, ed. G. von Krogh, I. Nonaka, and T. Nishiguchi. London: Macmillan Press, pp. 199-230.
- Nonaka, I. & N. Konno (1998): The Concept of 'Ba': Building a Foundation for Knowledge Creation. *California Management Review*, vol. 40, no. 3, pp. 40-54.
- Nonaka, I., N. Konno, & R. Toyama (2001): Emergence of "Ba": A Conceptual Framework for the Continuous and Self-transcending Process of Knowledge Creation. In *Knowledge Emergence: Social, Technical, and Evolutionary Dimensions of Knowledge Creation*, ed. I. Nonaka and T. Nishiguchi. Oxford: Oxford University Press, pp. 13-29.
- Nonaka, I. & T. Nishiguchi, ed. (2001): *Knowledge Emergence: Social, Technical, and Evolutionary Dimensions of Knowledge Creation*. Oxford: Oxford University Press.
- Nonaka, I. & H. Takeuchi (1995): *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press.
- North, D. C. (1986): The New Institutional Economics. *Journal of Institutional and Theoretical Economics*, vol. 142, pp. 230-37.
- North, D. C. (1990): *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Orlikowski, W. J. & J. D. Hofman (1997): An Improvisational Model for Change Management: The Case of Groupware Technologies. *Sloan Management Review*, vol. 38, no. 2, pp. 11-21.
- Orr, J. E. (1996): *Talking About Machines: An Ethnography of a Modern Job*. Ithaca, NY: Cornell University Press.
- Polanyi, M. (1966): *The Tacit Dimension*. London: Routledge & Kegan Paul.
- Richardson, J. (1993): Parallel Sourcing and Supplier Performance in the Japanese Automobile Industry. *Strategic Management Journal*, vol. 14, pp. 339-50.
- Robertson, M., C. Sørensen, & J. Swan (2000): Managing Knowledge With Groupware: A Case Study of a Knowledge-Intensive Firm. In *33rd Hawaii International Conference on System Sciences (HICSS-33), Maui, Hawaii*, ed. R. Sprague Jr. IEEE.
- Rochart, J. & J. Short (1991): The Networked Organization and the Management of Interdependence. In *The Corporations of the 1990s: IT and Organizational Transformation*, ed. M. S. Scott-Morton. Oxford: Oxford University Press, pp. 189-216.
- Schutz, A. & T. Luckmann (1974): *The Structure of the Life-World*, vol. 1. London: Heinemann.
- Senge, P. M. (1990): *The Fifth Discipline: The Art and Practice of The Learning Organization*. London: Random House.
- Simon, H. A. (1981): *The Sciences of the Artificial*. 2nd edition. Cambridge, MA: MIT Press.
- Sørensen, C. & M. Katakura (2002): Knowledge Discourses and Interaction Technology. In *35th Hawaii International Conference on System Sciences (HICSS-35), Big Island, Hawaii*. IEEE.
- Spear, S. & K. Bowen (1999): Decoding the DNA of the Toyota Production System. *Harvard Business Review*, no. Sept.-Oct., pp. 96-106.
- Spender, J.-C. (1998): Pluralist Epistemology and the Knowledge-based Theory of the Firm. *Organization*, vol. 5, no. 2, pp. 233-56.
- Stacey, R. D. (2000): The Emergence of Knowledge in Organizations. *Emergence*, vol. 2, no. 4, pp. 23-39.
- Suchman, L. A. (1987): *Plans and Situated Actions: The Problem of Human-Machine Communication*. Cambridge: Cambridge University Press.
- Swan, J. & S. Newell (2000): Linking Knowledge Management and Innovation. In *8th European Conference on Information Systems, Vienna, Austria*, ed. H. R. Hansen, M. Bichler, and H. Mahrer, pp. vol. 1, 591-8.
- Tsoukas, H. (1996): The Firm as a Distributed Knowledge System: A Constructionist Approach. *Strategic Management Journal*, vol. 17, no. Winter Special Issue, pp. 11-25.
- Tsoukas, H. (1998): Forms of Knowledge and Forms of Life in Organized Contexts. In *the Realm of Organization: Essays for Robert Cooper*, ed. R. C. H. Chia. London: Routledge, pp. 43-66.
- Varela, F., E. Thompson, & E. Rosch (1991): *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: MIT Press.
- Venzin, M., G. von Krogh, & J. Roos (1998): Future Research into Knowledge Management. In *Knowing in Firms: Understanding, Managing and Measuring Knowledge*, ed. G. von Krogh, J. Roos, and D. Kleine. London:

- Sage Publications, pp. 26-66.
- von Krogh, G. & J. Roos (1995): *Organizational Epistemology*. New York: St. Martin's Press. 0-312-12498-8.
- Weick, K. E. (1979): *The Social Psychology of Organizing*. Reading, MA: Addison-Wesley.
- Weick, K. E. (1993): Organization Redesign as Improvisation. In *Organizational Change and Redesign*, ed. G. P. Huber and W. H. Glick. New York: Oxford University Press.
- Weick, K. E. (1995): *Sensemaking in Organizations*. London: Sage Publications.
- Whitehead, A. N. (1929): *Process and Reality*. New York: Macmillan.
- Winograd, T. & F. Flores (1986): *Understanding Computers and Cognition: A New Foundation for Design*. Norwood, NJ: Ablex Publishing. 0-89391-050-3.
- Womack, J. P., D. T. Jones, & D. Roos (1990): *The Machine that Changed the World: The Story of Lean Production*. New York: Rawson Associates.