

CHAPTER 13

FLAWS IN THE “ENGINE” OF KNOWLEDGE CREATION

A Critique of Nonaka’s Theory

Stephen Gourlay and Andrew Nurse

Nonaka’s theory of organizational knowledge creation¹ has achieved paradigmatic status since its publication in the mid-1990s,² and has recently been described as “highly respected” (Easterby-Smith & Lyles, 2003b, p. 11). The theory rests on the assumption that knowledge is created through social interaction between tacit and explicit knowledge. Nonaka and his colleagues postulated four modes of knowledge conversion corresponding to different forms of such interaction (see Figure 13.1). According to their framework, knowledge creation begins with socialization (S), continues with externalization (E), combination (C), and internalization (I), before returning to socialization, but at a new level, hence the metaphor of a spiral of knowledge creation (cf. Nonaka, 1991a, 1994, 1995; Nonaka, Byosiere, Borucki, & Konno, 1994; Nonaka, Konno, & Toyama, 2001; Nonaka & Takeuchi, 1995).

These ideas, first published in 1991 (Nonaka, 1991a), drew on studies of information creation in innovating Japanese companies (Imai, Nonaka, & Takeuchi, 1985; Nonaka, 1988a, 1988b, 1990, 1991b; Nonaka &

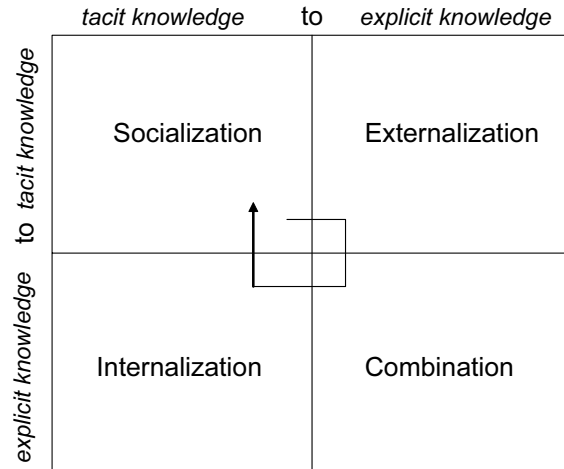


Figure 13.1. The “engine” of knowledge creation.
Adapted from Nonaka and Takeuchi (1995, pp. 57,
62, 71).

Kenney, 1991; Nonaka & Yamanouchi, 1989). Subsequently, Nonaka (1994) published a more extensive theoretical paper and the results of a survey that validated the model (Nonaka et al., 1994). In 1995, the book-length exposition of the theory (Nonaka & Takeuchi, 1995) appeared where the SECI matrix (Figure 13.1) is described as the “engine” of knowledge creation. Other parts of the theory describing how new knowledge becomes organizational knowledge have since undergone considerable modification (see, e.g., Nonaka, Toyama, & Byosière, 2001; Nonaka, Toyama, & Konno, 2000), but the SECI “engine” remained intact.

Although several authors have highlighted important contingent factors, Nonaka’s theory appears to have attracted little systematic criticism.³ Becerra-Fernandez and Sabherwal (2001), for example, show that each of the SECI modes is dependent on the presence of appropriate task characteristics. Poell and van der Krogt (2003), treating the modes as forms of learning, also report that the type of work involved influences how workers learn. More generally, Doyle (1985) and Glisby and Holden (2003) argue that the model rests on Japanese management cultural practices, and is thus not transferable to other contexts.⁴ Other empirical criticisms include Engestrom’s (1999) discovery that problem finding is an important part of innovation missing from the SECI model, and Poell and van der Krogt’s comment that Nonaka apparently assumes workers only learn within parameters set by managers. Their research points to the importance of self-organized learning, particularly in professional organizations.

Questions, however, have been raised about the theory itself. Adler (1995) suggested that Nonaka’s discussion of externalization (e.g., Nonaka & Takeuchi, 1995, pp. 13, 64–67) may not be generalizable, and pointed out that although the other modes had been previously studied, Nonaka and his colleagues neglected that research. Jorna (1998) argued that Nonaka neglected learning theory, especially in his discussion of tacit and explicit knowledge. He also charged Nonaka and his colleagues with misreading important organizational writers, and suggested that better accounts of Western philosophy were available than those used. In addition, Jorna argued that “knowledge conversion” entails semiosis, but the model lacks a semiotic framework.

Nonaka’s conceptualization of the relationship between tacit and explicit knowledge has also been criticized. While Nonaka treats tacit and explicit knowledge as separable, other theorists regard tacit knowledge as always necessary for explicit knowledge to be understood (cf. Adler, 1995; Stacey, 2001; Tsoukas, 2003). More generally, Griffin, Shaw, and Stacey (1999) suggested that Nonaka has subordinated Polanyi’s (1969a, 1969b) concept of tacit knowledge to an objectivist strategic management theory, while Yolles (2000) argued that the SECI model employs a mixed ontology, trying to be both constructivist and positivist.

Recently Bereiter (2002) has identified four important shortcomings in Nonaka’s approach. First, echoing Stacey (2001), he argues that Nonaka’s theory cannot explain how minds produce (or fail to produce) ideas. Second, it overlooks the important question of understanding—in order to learn by doing, one has to know what to observe. Third, while the theory recognizes knowledge abstracted from context, it says little about how it can be managed. Finally, the view that knowledge originates in individual minds prevents Nonaka from conceptualizing knowledge that arises from collective actions, for example, as a product of teamwork. Overall, Bereiter argues that the theory is rooted in a folk epistemology that regards individual minds as full of unformed knowledge that must be projected into an external world, an approach that hinders any attempt to provide a theory of knowledge creation. As such, he suggests that Nonaka’s theory fails both as a theory and as a practical tool for business.

These are serious issues that raise questions about the utility of the model as a guide to research and practice.⁵ Yet, while Bereiter’s (2002) remarks suggest the SECI model is ill-founded, he was only tangentially interested in Nonaka’s theory and did not develop his critique. Similarly, other criticism remains largely piecemeal, and within organization and management studies circles the theory remains largely unchallenged. Having drawn the attention of this research community to these criticisms, we now turn to our main task. It is our view, however, that the “engine” of Nonaka’s theory of organizational knowledge creation is fun-

damentally flawed on both empirical and theoretical grounds. As such, its utility—especially as a guide for organizational intervention and knowledge development—is questionable. As a basis for our critique, the chapter initially reviews the empirical evidence for the model, and then turns to key conceptual dimensions of the theory.

THE EMPIRICAL BASIS FOR THE SECI MODEL

In 1993, a convenience sample of 105 Japanese male middle managers was issued a self-completion questionnaire designed to test Nonaka's emerging theory of knowledge creation (Nonaka et al., 1994). The questionnaire comprised 185 items, 38 of which concerned "the content of organizational knowledge creation," as measured by the amount of time spent on specific activities (see Nonaka et al., 1994, pp. 342–343, 350). Hierarchical confirmatory factor analysis of the data confirmed the suggestion that knowledge creation comprised four modes of knowledge conversion, thus validating the SECI hypothesis (Nonaka et al., 1994; see also Nonaka & Takeuchi, 1995).⁶

Nonaka and his colleagues (1994) raised a number of cautions about this work: (1) this was the first time the questionnaire had been used, except for piloting; (2) the heterogeneity of the sample raised questions of internal validity; (3) the generalizability of the findings to other cultures was questionable; and (4) qualitative data would have enriched the study. There are, however, more fundamental issues involved than those noted by the researchers. First, the questionnaire focused on the *content* of organizational knowledge creation; *process* issues remained to be investigated. Yet, since the SECI model is a process model, the claim that the survey validated Nonaka's hypothesis cannot be accepted. Second, it is not clear how scales for measuring the knowledge conversion modes could have been constructed given the lack of previous research. Although we are told that externalization had only been studied in the context of research into semantic information creation (see Nonaka, 1991b; Nonaka et al., 1994), it appears that the only data available at that time was from such studies (see, e.g., Imai et al., 1985; Nonaka, 1988a, 1988b, 1990, 1991b; Nonaka & Kenney, 1991; Nonaka & Yamanouchi, 1989). Thus, we are forced to conclude that the measures of *knowledge conversion mode content* actually came from studies of *semantic information creation*. Insofar as Nonaka has made much of the difference between information and knowledge (e.g., Nonaka, 1991b, 1994; Nonaka & Takeuchi, 1995), this suggests that the 1993 survey actually focused on *semantic information creation*.⁷

Even if it were possible to set these difficulties aside, by arguing for example that semantic information and knowledge are equivalent,⁸ another important difficulty remains. In confirmatory factor analysis, it is normal to accept a factor when at least 60–70% of the variance has been accounted for (e.g., Hair, Anderson, Tatham, & Black, 1998). While the percentage of variation explained for socialization (73%) and combination (64%) do fall within these limits, the figures for externalization (51%) and internalization (56%) fall below them. Thus, we cannot accept the claim that the survey “validated the existence” (Nonaka & Takeuchi, 1995, p. 91) of the four *knowledge* creation *processes*. At best, it provided support for two of four hypothesized modes of *semantic information* creation.

Turning to the case study evidence, as noted earlier, most if not all this data was originally collected for studies of innovation and information creation. It does not appear that studies of *knowledge* creation were carried out as part of the theory development process. While it might be quite acceptable to reinterpret data in light of a new theory, as we have just suggested, Nonaka has not justified treating semantic information as equivalent to knowledge. Moreover, much of this illustrative material is itself far from convincing.

Socialization

Nonaka proposed that knowledge conversion begins with socialization, the tacit acquisition of tacit knowledge by people who do not have it from people who do. Three examples are given: a brainstorming camp, the development of an automated bread-making machine, and interaction with customers (cf. Nonaka, 1991b, 1994; Nonaka, Konno, & Toyama, 2001; Nonaka & Takeuchi, 1995). Descriptions of both the brainstorming camp and customer interaction suggest these were arenas of intense discussion and exchange of ideas, but give no details of how or even whether tacit-to-tacit knowledge exchange occurred (Imai et al., 1985; Nonaka, 1988a, 1988b; Nonaka & Kenney, 1991; Nonaka & Takeuchi, 1995). Had these studies shown, for example, that participants’ cognitive maps changed as a result of the discussions in ways that could not be attributed to anything that was explicitly said, Nonaka’s case would be more convincing. Moreover, since dialogue is also central to externalization and combination (as we will explore below), it is difficult to understand why brainstorming and customer interaction exemplify “socialization” as distinct from the other modes.

The automatic bread-making machine case, which “shows how a tacit technical skill was socialized,” is more extensively documented (Nonaka,

1991b, pp. 98–99; Nonaka & Takeuchi, 1995, pp. 63–64, 100–109), and, on the face of it, appears to provide better evidence of “socialization.” A prototype machine produced a loaf with an overcooked crust that was raw inside. This machine did not produce “tasty bread,” the problem the second phase of development sought to rectify (Nonaka & Takeuchi, 1995). While the issue of taste is emphasized in part of the account, we are also told that the second phase focused on how to knead bread dough properly. It is not clear whether there were two distinct objectives, or whether the team decided that attention to kneading would resolve the taste problem.

As a master chef could not “tell” them what they needed to know, a team member apprenticed herself to learn the appropriate skills. We are told that one day she “noticed the baker was not only stretching but also ‘twisting’ the dough, which turned out to be the secret for making tasty bread” (Nonaka & Takeuchi 1995, p. 64). We are not told why or how the team reached this conclusion, but only that they decided to replicate this “twist” by modifying the design. Eventually, the team “succeeded in developing a machine that could make tasty bread” and thus the baker’s tacit knowledge (the “secret for making tasty bread”) had been transferred (socialization) (Nonaka & Takeuchi 1995, pp. 64, 104–105).

One difficulty with this account is that kneading does not affect the taste of bread. Taste is influenced by the raw ingredients, the dough maturation process (which produces the complex chemicals that are further changed during baking), and by the baking process itself (see Barfield, 1947). Thus, we must conclude that the team solved the taste problem *accidentally* during the lengthy development process. Since they did not *understand* how to make tasty bread, it hardly makes sense to suggest that tacit knowledge about making tasty bread was transferred. Events like this are perhaps not unusual, as illustrated by scientists’ accounts of their failure to fully understand how they had been able to complete an experiment (Collins, 1974, 2001a). Yet, unless we extend “knowing” to include such lack of understanding (which might better be called “ignorance”), we must conclude that no “knowledge” about making tasty bread whatsoever was transferred. Thus we have no evidence for tacit-to-tacit knowledge transfer.

If, on the other hand, the problem concerned the kneading process, then the following account seems reasonable. Each team member successfully learned how to knead bread dough, under the watchful eye of the master chef. The team members’ primary concern was to identify aspects of the manual process that would help them improve the prototype, and discussion of this problem could be grounded in their common experience. One team member noticed what they called a “twist,” and when

they replicated this move the resulting machine produced tasty bread. Consequently, they concluded they had found the key to their problem.

While this account may be more coherent, it is still not clear that it exemplifies the tacit transfer of tacit knowledge. The team members learned a new skill by doing it, guided by an expert who could give instruction, demonstration, and feedback. That people regularly learn new skills without direct personal contact with an expert testifies to the centrality of learning-by-doing for acquiring skills. An expert can assist in this process, but there is no need to suggest that when they are present some indescribable kind of knowledge is “transferred” by an unknown process. Since the Nonaka account permits an alternative explanation, there is no unambiguous evidence for “socialization.”

Externalization

Externalization, the next step in the knowledge conversion process, involves converting tacit into explicit knowledge, and holds the key to knowledge creation (Nonaka, 1994; Nonaka & Takeuchi, 1995). It is exemplified by stories of new product development, especially their best-documented Honda City case that describes how young designers produced a novel car design (Imai et al., 1985; Nonaka, 1988b, 1990, 1991a; Nonaka & Takeuchi, 1995; for the other cases, see Nonaka, 1988a; Nonaka & Kennedy, 1991; Nonaka & Yamanouchi, 1989). After several false starts, new ideas began flowing under the stimulus of the phrase “Automobile Evolution”—which resulted in a formal proposal or “concept.”⁹ The claim that this and similar cases provide evidence of externalization rests on the hypothesis that tacit knowledge is externalized through the use of metaphors and analogies (Nonaka, 1991b), a hypothesis that is *not* supported by evidence or theory. No evidence is given to substantiate the implicit claim that the design ideas somehow “tacitly” existed and were externalized by these techniques. All we have are anecdotes illustrating the use of creativity techniques and other Japanese management procedures that facilitated the development of novel products.

The bread-making case, however, does appear to provide better evidence. Attempts to describe the effects of exercising a physical skill, expressed within a group whose members could exercise that skill, facilitated production of descriptions of that skill in terms of engineering formulae and designs, and ultimately in machinery. Although this account is far from satisfactory, lacking details comparable to Collins’s (1995, 2001a) studies of “tacit knowledge” in scientific work, it does suggest that a process akin to externalization took place. Collins’s studies suggest a lot more talk, testing, and other activity went on than was reported by Nonaka and

his colleagues. “Externalization” is probably the result of hard cooperative work.

Combination

Externalization is followed by combination—the process of “systematizing concepts into a knowledge system” (Nonaka & Takeuchi, 1995, p. 67). Combination occurs when someone writes a report synthesizing explicit knowledge (Nonaka, 1991b) and through meetings, conversations, and exchange of documents (Nonaka, 1994; Nonaka & Takeuchi, 1995). We are also told that an MBA education is “one of the best examples” of combination (Nonaka & Takeuchi, 1995, p. 67) and that “modern computer systems” (Nonaka, 1994, p. 19) and the “embodiment” of knowledge into products also exemplify combination (Nonaka, 1991b, p. 99; Nonaka et al., 1996, pp. 207–208). However, no details of any of these activities are given and it is impossible to understand how various forms of communication (using language, talking, listening, reading, or writing) can sensibly be treated as being characterized by explicit knowledge exchange.

Adler (1995, p. 111) suggested Nonaka’s claim that an MBA involves “exchange” of explicit knowledge might be a “playful” remark, pointing out that the case study method was designed to help transmit managers’ tacit knowledge. Some communication theories treat documents as channels along which messages pass to the reader, but this application of the mathematical theory of communication has long been criticized as inappropriate for human behavior (Cherry, 1966). Computer functioning and so-called knowledge “embodiment” processes might well be viable candidates for a distinct “combination” process, but as they have not been described, it is impossible to know what is intended. There is no empirical support for, nor even a clear description of, the notion of knowledge “combination.”

Internalization

Internalization, the final step in the cycle, is also exemplified by a variety of activities: (1) it involves “embodying” explicit knowledge to become tacit knowledge; (2) it is “closely related” to the “traditional notion of learning” and “learning by doing” (Nonaka et al., 1994, pp. 340-41; Nonaka, 1994, p. 19; Nonaka & Takeuchi, 1995, p. 69); and (3) it is also “triggered” by learning-by-doing (Nonaka et al., 1996, p. 208). Furthermore, *documentation* (which can mean reading or writing) “helps individuals

internalize what they experienced [and to] experience the experiences of others indirectly" (Nonaka & Takeuchi, 1995, pp. 69–70). Finally, internalization also involves, or is achieved through, the dissemination of explicit knowledge throughout an organization (Nonaka, 1991b; Nonaka et al., 2001b).

Learning by doing is exemplified by team members who enriched their tacit knowledge through the experience of creating a new product (Nonaka, 1991b), and employees who experienced working reduced annual hours by working at the new annual rate for a month (Nonaka & Takeuchi, 1995), which is suggested to show that workers gained a subjective understanding of working shorter hours. Insofar as tacit knowledge is personal and subjective, this seems to indicate that a process suggestive of the acquisition of tacit knowledge took place. It is difficult, however, to see how the knowledge of how many hours were to be worked, as distinct from the experience of working shorter hours, actually contributed to development of this subjective feeling. As for "the traditional notion of learning," it is far from clear what this means. "Embodying" is clearly a metaphor, and its meaning is also obscure. We are again forced to conclude that no clear evidence is offered for internalization in the sense of an explicit to tacit "conversion."

In summary, we have to conclude that there is no unambiguous evidence at all for any of the four modes, or for the hypothesis that knowledge is created by the "interaction" of tacit and explicit knowledge. The case study evidence only provides tentative support for externalization. Even if we overlook the likelihood that the survey actually concerns semantic information creation, it only provides support for socialization and combination. However, the latter mode appears extremely ambiguous as, like internalization, it comprises multiple forms of activity between which there is no obvious similarity.

Perhaps we should not be too surprised. Nonaka's data was drawn almost wholly from studies of semantic information creation and he and his colleagues categorically said that more research was needed, particularly to examine the relations between the four modes, the "spiral" sequence of knowledge creation, and the application of the model to other cultures (Nonaka et al., 1994). The empirical shortcomings highlighted here, however, concern the very validity of each of the modes and the key claim about knowledge creation, not just questions about the nature of relations between them. It is not unusual, of course, that a good theory may initially lack clear empirical support. Thus, to assess whether the SECI model is worth effort to substantiate it, we now turn to examine Nonaka's conceptual framework.

THE CONCEPTUAL FRAMEWORK

Bereiter's (2002) claim that Nonaka and his colleagues' epistemology hinders their enterprise deserves further consideration. While this discussion will doubtless inform forthcoming debates, it is not our intention to consider it further here. Should Bereiter's arguments be rejected, defenders of the theory might wish to fall back on details of Nonaka's ideas and it is on these that we focus here. In this section, we consider Nonaka's approach to tacit knowledge, the SECI process, and the implications of their particular definition of knowledge.

Tacit Knowledge

Nonaka took the notion of tacit knowledge from Polanyi (1969a, 1969b) and modified it in a "practical direction" by distinguishing technical tacit knowledge (concrete know-how and skills) from cognitive tacit knowledge (mental models of the world) (Nonaka, 1994, p. 16; Nonaka & Takeuchi, 1995, pp. 8, 60).¹⁰ Tacit knowledge, we are informed, is a "rich, untapped source of new knowledge" and is the basis of organizational knowledge creation (Nonaka et al., 1994, p. 342; Nonaka & Takeuchi, 1995, pp. 72, 85). Such tacit knowledge is difficult to communicate or share because it has "a personal quality ... [and is] deeply rooted in action, commitment, and involvement in a specific context" (Nonaka, 1994, p. 16; Nonaka & Takeuchi, 1995, pp. 8, 59–60; Nonaka et al., 2001b, p. 15). Tacit knowledge is contrasted with explicit knowledge, and while they use the metaphor of an iceberg to refer to the relationship between these two forms of knowledge (Nonaka & Takeuchi, 1995, pp. 60–61), they more frequently treat them as separate entities. This tendency is reinforced by the "assumption" that their "social interaction" produces knowledge (Nonaka & Takeuchi, 1995, p. 62), a relationship that can be represented by a matrix.

It is difficult to see how the metaphor of an iceberg (a base-superstructure model) and of interaction can both be logically applied to the same relationship. More important perhaps is that treating tacit and explicit knowledge as opposites is a more radical modification of Polanyi than the one they acknowledge. On several occasions, Polanyi (1969a, p. 144; 1969b, p. 164) stressed that while "tacit knowledge can be possessed by itself, explicit knowledge must rely on being tacitly understood" (see also Adler, 1995; Tsoukas, 2003). Tacit knowledge is thus claimed to "underlie" all explicit knowledge—the iceberg metaphor is an apt one. Thus, it may not make sense to portray the relationship between tacit and explicit knowledge through a matrix, or even to describe it as an "interaction."

—▶
 Au: Add Janik
 1990 to
 references.

A further difficulty concerns their monolithic treatment of “tacit knowledge.” There is a consensus that some tacit knowledge can be made explicit, while some is inherently tacit (Barbiero, 2002; Collins, 1974, 2001b; Janik, 1988, 1990). Janik (1988) suggested that tacit knowledge in the forms of trade secrets, craft knowledge and skill, and everyday pre-suppositions can be made explicit. On the other hand, there are “aspects of human experience which are *wholly* knowable self-reflectively” and thus “by their very nature ... [are] incapable of *precise* articulation” (Janik, 1988, pp. 54, 56). Such inherently tacit knowledge included sensuous experience or practice and rule-following. We “know” what coffee smells like or how a particular musical instrument sounds, knowledge that can only be acquired through experiencing the sensations. As regards rule-following, we cannot fully specify the rules for carrying out an action since any rules require additional rules concerning their application—and so on *ad infinitum*. Rule-following always rests on doing, practice, or activity, and therefore entails tacitly knowing what to do (Janik, 1988).

The omission of inherently tacit knowledge severely compromises Nonaka’s theory. Even if it were useful to portray the tacit–explicit knowledge relationship in a matrix, several cells of a matrix including inherently tacit knowledge would be invalid. If we cannot use a matrix to categorize tacit–explicit knowledge relationships, perhaps the very notion of their “interaction” should be questioned—or at least treated as the metaphor that it evidently is, rather than as a statement of fact. This reinforces the claim that the tacit–explicit knowledge relationship might be more usefully conceptualized as a base–superstructure relationship than as an interaction between opposite poles.

Difficulties with the SECI Process

One problem with the SECI spiral concerns understanding what comes out of it. Of course the key “assumption” is that “knowledge” is created through the interaction of tacit and explicit knowledge involving the four modes of “knowledge conversion” (Nonaka & Takeuchi, 1995, p. 62). But we are also told that tacit knowledge is created through socialization¹¹ and internalization, and explicit knowledge by externalization. Elsewhere, however, we are told that externalization results in “conceptual knowledge,” and that each of the other modes also produces a distinct type of knowledge (Nonaka & Takeuchi, 1995, p. 72). We thus end up with six types of “knowledge”—four created through the interaction of tacit and explicit—together with the grand product of this interaction: knowledge.

A further problem concerns understanding how one phase of activity relates to the next. The “spiral” metaphor draws attention to the idea of



Figure 13.2. The SECI process of knowledge conversion: A linear view.

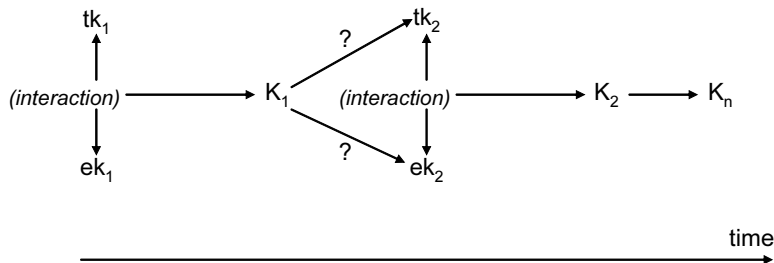


Figure 13.3. Knowledge conversion over time.

knowledge conversion as a continual and progressive process. As illustrated in Figure 13.2, however, this metaphor obscures the fact that we are dealing with a linear process (see Griffin et al., 1999, for a similar argument).

The process is linear because it involves time. Figure 13.2 represents one phase of the SECI process operations—one or perhaps a number of spirals of interaction result in new knowledge. If we extend the time frame to include more than one phase of SECI processes, the question of the relationship between knowledge produced in former times and ongoing knowledge conversion becomes evident (see Figure 13.3).

It is not clear whether knowledge created in one phase of knowledge creation affects tacit knowledge, explicit knowledge, or both (or even neither) at the next phase of the process. Does knowledge subsequently *become* explicit knowledge? Perhaps some prior knowledge enters the next phase directly as tacit knowledge (internalization) while some enters as explicit knowledge, having been codified during phase one. These ambiguities suggest that much remains to be worked out if the “engine” of

their theory of knowledge creation is to function as an adequate representation of real processes. Consideration of what Nonaka meant by “knowledge” answers some of these questions—but at the expense of the theory itself.

The argument that knowledge from one phase subsequently becomes explicit knowledge for a later phase runs as follows. Explicit knowledge is another name for *declarative knowledge* (Nonaka & Takeuchi, 1995, p. 61) and “knowledge of facts” (Alexander, Schallert, & Hare, 1991, p. 332), which, called propositional knowledge, is one of three types of knowledge recognized by epistemologists (see Klein, 1998). “Explicit,” “declarative,” and “propositional” are thus adjectives used by different groups of scholars to refer to the same type of knowledge. Furthermore, this is what Western epistemologists refer to as “justified true belief” (Klein, 1998; Nonaka & Takeuchi, 1995, p. 58).¹² Hence, knowledge produced by one phase of SECI processes could be regarded as the same as the explicit knowledge that enters subsequent phases. Nonaka and his colleagues would, however, reject this argument because they wish to differentiate the “knowledge” resulting from the SECI processes from knowledge as justified true belief.

Nonaka and his colleagues emphasize “the nature of knowledge as ‘justified belief’” rather than justified true belief. This “critical” distinction is necessary, they claim, because “traditional epistemology emphasizes the absolute, static, and nonhuman nature of knowledge” against which they pose the idea of “knowledge as a *dynamic human process of justifying personal belief toward the ‘truth’ ...*” (Nonaka & Takeuchi, 1995, p. 58, original emphasis; see also Nonaka, 1994, p. 15; Nonaka et al., 2001b, pp. 14–15). There are actually two distinct notions here: knowledge (“justified belief”) as the product of a process (justification) and knowledge itself as a “process.” The latter idea does not appear to inform subsequent discussion,¹³ but the claim that knowledge is “justified belief” remains central.

The full implications of their redefinition of knowledge as “justified belief” become clear in light of their discussion of “justification.”¹⁴ This is described as “the process of determining if the newly created concepts are truly worthwhile for the organization and society” (Nonaka & Takeuchi, 1995, p. 86). Thus the prototype bread-making machine failed to be “justified against the original product concept” because it did not make tasty bread. When the taste problem had been resolved, the “concept” still remained unjustified because it failed to meet cost criteria (Nonaka & Takeuchi, 1995, pp. 103–108). We have already seen that “concept” means ideas and plans for new products or processes. “Justification” clearly means the evaluation of “concepts” by managers in light of pre-defined performance or other criteria (Nonaka & Takeuchi, 1995, pp. 86, 103, 108–109; see also Nonaka, 1994, p. 26). In other words, “knowl-

edge” as “justified belief” simply means ideas and plans that have been sanctioned by those in authority.

The SECI model is evidently a hypothesis about the generation of ideas for new products or processes that, when sanctioned by managers, acquire a special status, called “justified belief” by Nonaka and his colleagues. They are *justified* because they meet predefined criteria and presumably they are *beliefs* because managers believe them. The underlying problem with the SECI process that was described earlier can thus be resolved: the “interaction” of tacit and explicit knowledge results in managers’ “justified beliefs,” not “justified true belief” or even “explicit knowledge.” Since these are not equivalent to knowledge in any more generally accepted sense of that ambiguous word, the SECI framework cannot be regarded as the “engine” of a theory of organizational *knowledge* creation.

Finally, Nonaka's claim that “justified belief” is preferable to “justified true belief” implies that “truth” is not particularly important to businesses and organizations. We have seen, however, that the bread-making team’s “justified belief” that flavor is influenced by kneading was false. Should the team want to improve the process further, and acts on the basis of this belief, they would be likely to fail (or, at best, succeed once more by accident). The “truth” value of any claim to knowledge is surely important to businesses, depending as they do on “truths” rather than simply on “beliefs” about the material and other transformations on which their activities and their success depend.

CONCLUSIONS

Nonaka and his colleagues’ “engine” of knowledge creation has been found wanting on both empirical and theoretical grounds. First, it appears that the data for the SECI modes of knowledge conversion came largely, if not entirely, from studies of semantic information creation. The necessary explanatory links between semantic information and knowledge are missing. Second, claim that a survey validated the SECI hypothesis cannot be accepted because it too draws wholly on the semantic information studies. The survey focused on content not process, and on the most generous interpretation only provides support for two of the four modes of conversion, one of which (combination) is also conceptually ambiguous. Third, examination of the case study evidence reveals ambiguity about the four modes, lack of detail or clarity about the processes, and an absence of convincing examples (with the possible exception of one instance of externalization). Furthermore, there is no persuasive evi-

dence that “knowledge” is created by the interaction of tacit and explicit knowledge, the key assumption on which the whole model was based.

Turning to their concepts, they have used an unjustified monolithic notion of tacit knowledge, whereas other authorities argue for and provide illustrations of two types, one that can and one that cannot be made explicit. Nonaka and his colleagues only recognize the former, and their matrix cannot be modified to accommodate the latter. There are also important ambiguities about the SECI processes, in particular the relation between the different types of knowledge alleged to be involved. These problems can be resolved when it is appreciated that “knowledge” as “justified belief” actually means *managers’ beliefs* that product or process ideas appear to meet preestablished criteria. Thus the SECI process should be described as a hypothesis concerning the production of managers’ “justified beliefs.” Making “knowledge” a matter of authority harks back to premodern practices in Europe. While this may reflect the way employees’ ideas are treated by managers, had authority been the judge of knowledge we would probably still think the earth was the center of the universe. Such a radical redefinition of the word “knowledge” hinders communication and thus development of understanding about whether and how knowledge might be managed.

Finally, since the SECI matrix is the “engine” of Nonaka and his colleagues’ theory of organizational knowledge creation, and that engine has now been shown to be empirically unsupported and conceptually flawed, we have to question whether the rest of the theory can be sustained. The SECI model and related ideas have undoubtedly been of heuristic value and, like the erroneous conclusion about making tasty bread, may have generated insights that will turn out to be more than someone’s justified beliefs. Its value, however, has now been exhausted, and we need to begin afresh, if at a higher level than before.

Implications for Knowledge Management Theory and Practice

Two avenues may prove fruitful—and indeed much work has already been done or is under way. First, we need to work to develop useful theory. If knowledge management is to progress and provide useful advice (even to provide clear evidence on whether or not “knowledge” is manageable, and if so in what sense) we need common working definitions of the concept. Establishing these will not be an easy task. Dewey and Bentley (1949, p. 48) concluded that “the word ‘knowledge’ ... is a loose name ... for which it is impossible to give a precise definitive account.” Bentley noted that at least all the meanings they considered concerned living

things (see Ratner & Altman, 1964, p. 459), but knowledge management authors have extended “knowledge” to cover something “embedded” (or “embodied”) in “technology” (e.g., Teece 2001, pp. 126–130; see also Nonaka & Takeuchi, 1995, pp. 223). A review of knowledge-related concepts in the field of learning and literacy (Alexander et al., 1991) reveals a further lack of agreement and Bereiter (2002) has recently offered a new way of thinking about knowledge specifically directed at educational issues. While researchers in artificial intelligence did have a clear definition, that too has been criticized and new approaches are emerging (e.g., Clancey, 1997).

This is not to suggest that we can do no useful work unless or until we agree on a definition of knowledge. Students of knowledge management might benefit by drawing on previous work in cognitive science, education, biology, psychology, and other empirical disciplines rather than, on the whole, ignoring such work, and trying to literally invent a “new wheel.” In the absence of consensus on a working operationalizable definition of knowledge, knowledge management researchers could at least be more explicit about which definition they are using so that the effects of using different perspectives can be discussed, and consensus can emerge on which approach seems more useful than others. Unless we recognize this confusion and develop and share as clear and unambiguous a meaning (or meanings) of what we mean by “knowledge,” we are unlikely to make any progress, or even to discover whether what we now call “knowledge” was previously called something else (e.g., “information”).

A second potentially useful avenue of research would be to conduct systematic reviews of existing research in knowledge management with a view to determining the extent to which something new is being studied, and if so, what the dimensions and characteristics of that new object are. This implicitly bottom-up approach to establishing what the field of knowledge management is concerned with is a necessary task complementary to that of theory-building and synthesis. All these kinds of work are already taking place—witness two recent knowledge management handbooks (Dierkes, Antal, Child, & Nonaka, 2001; Easterby-Smith & Lyles, 2003a)—and our remarks are intended to underscore the importance of such work.

As regards practice, first it should be noted that we have focused on reviewing the evidence, arguments, and theoretical concepts of the “engine” of knowledge creation. We have not reviewed knowledge management projects that have been inspired by the SECI matrix, or other components of Nonaka and his colleagues’ models. Just as the bread-making team was able to develop a functioning bread-making machine despite apparently false assumptions about the process of making bread (and Collins’s studies showed that scientists’ work proceeded to success on

similar false assumptions), so it is possible that useful innovations in the management of knowledge have been inspired by the SECI matrix. We would argue, however, that any such successes could not be *explained* by Nonaka and Takeuchi’s theory for the reasons given above. If there are any such cases, they would need to be studied in some depth to determine exactly *why* they came about.

A second practical point concerns the management of tacit knowledge. It is widely agreed that tacit knowledge is important and if it cannot be converted wholly into explicit knowledge, we need to be alert to other ways of managing it. Here, the fact that so many of Nonaka’s examples are based on teamwork seems to the point since the use of multidisciplinary teams does appear to be a useful way of “unlocking” and sharing tacit knowledge through learning-by-doing together. This observation, in turn, suggests that perhaps some tacit knowledge can only be managed by particularly sensitive ways of managing people. The notion of communities of practice, natural or contrived, comes to mind in this context. Communities of practice can be seen as an attempt to leave knowledge where it is generated and used, and to control it indirectly by managing, motivating, and rewarding people. The idea that it might not be possible, or perhaps not fruitful, to attempt to separate “knowledge” from the context of its use also directs attention toward managing production processes and the design of work more generally, as well as to the management of people. Of course, this is not the only avenue open to managers—they can and do attempt to diminish reliance on tacit knowledge by redesigning products, production processes, or both, through what used to be called “deskilling.”

Third, when generalizing about knowledge management it is all too easy to forget that the needs of organizations differ greatly one from the other. It is no accident that Nonaka and his colleagues developed their ideas through studying innovative organizations, and such organizations may have special knowledge management needs. An innovating organization, one that implicitly introduces changes to products, processes, or to both, must have management structures (in the widest sense) that facilitate the generation of new ideas and their evaluation and dissemination throughout an organization. Some of the kinds of management and work processes that might help are those discussed by Nonaka and his colleagues. If Nonaka is right to suggest that individual employees are or can be an important source of new ideas originating in working practices, and new ideas are important to an organization, then clearly means need to be established to capture those ideas and to bring them into the public domain. They probably will take the form, among others, of discussions, working together to learn from each other. We are simply suggesting that

it does not appear useful to conceptualize such processes in terms of tacit–explicit knowledge transfer, or to confuse ideas with knowledge.

However, companies or enterprises that compete in ways that do not depend so highly on innovative practices implicitly might not need the same kinds of knowledge management practices. They will be less interested in generating new ideas than in the management of routine, by, for example, reusing knowledge and documenting best practice rather than reinventing the wheel to cope with repetitive problems. In this context, Nonaka and his colleagues' model and discussion probably holds little of interest. Snowden (2002) has described three generations of knowledge management, placing Nonaka's ideas in the second generation. Perhaps what Snowden has actually identified is that different models suit different kinds of firms, and firms that depend on innovation could do worse than to follow what seem to be the practical implications of the SECI model and related ideas. Firms that do not need to innovate in the same way, in contrast, can well stick with first-generation knowledge management, otherwise known as information management.

Finally, we believe there is another practical lesson for academic and managerial practitioners that arises from our investigation—claims to knowledge (including this chapter) should be treated with informed and critical skepticism. Consumers of academic research, and particularly of popularized versions, such as Nonaka and Takeuchi (1995), must become sophisticated critical consumers. This means that they must learn to ask questions about the nature of evidence being offered to support a claim; they must ask how that evidence was collected; they must question whether the methods of data collection used were valid and tested. If they are satisfied with the answers to these questions, they must then ask if the data has been analyzed adequately, or if it is open to alternative interpretations, and they must learn how to evaluate the linkages between evidence and claims. Nonaka and his colleagues did draw attention to some of the methodological limits of the original SECI model (Nonaka et al., 1994), but perhaps not forcefully enough, and their cautions went unheeded in a market for ideas that was crying out for a model like theirs in the mid-1990s.

NOTES

1. The theory appears to have originally been developed by Nonaka (1991a, 1991b, 1994) and subsequently presented in several collaborative publications (e.g., Nonaka et al., 1994; Nonaka & Takeuchi, 1995). The chapter will refer to “Nonaka” and “Nonaka and his colleagues” interchangeably except where it is necessary to be more precise.

2. The Nonaka and Takeuchi (1995) volume, for example, has been cited over 1,000 times between its publication in 1995 and October 2004. The number of citations has increased year by year, as has the range of categories of journals in which this publication has been cited (see the ISI Citation Indexes, searched April 2003).
3. The volume of citations of their work (see Note 2) makes it difficult to be certain that all significant criticisms of their model have been identified. For this chapter, abstracts of all the citations of Nonaka and Takeuchi (1995) (to December 2002) were searched for terms indicative of criticism or significant amendment: only six were found. Further criticism may have been published in edited volumes, which are typically not indexed. However, we assume that had any sustained criticism been published, it would have been cited. In the absence of any such evidence, we are left with the impression that no systematic critique of their model has been published.
4. It should be noted that the significance of Japanese management and social practices for the model of information/knowledge creation that Nonaka developed is evident in his papers (see, e.g., Hedlund & Nonaka, 1993; Imai et al., 1985; Nonaka et al., 1994).
5. It does not appear that Nonaka and his colleagues have responded, either directly or indirectly, to any of these criticisms.
6. The data were also analyzed using structural equation modeling, but the paucity of data precluded full development of this model (see Nonaka et al., 1994). We have therefore limited our discussion to the confirmatory factor analysis.
7. Nonaka’s earlier studies focused on *semantic* information, as distinct from *syntactic* information, which, he argues, is usually meant when “information” is studied (see especially Nonaka 1991b).
8. It should be stressed that neither Nonaka nor, to the best of our knowledge, anyone else has made this explicit suggestion. The shift from semantic information to knowledge in Nonaka’s work (e.g., Hedlund & Nonaka, 1993; Nonaka, 1991b, 1994) suggests he implicitly made this connection.
9. It should be noted that Nonaka uses the word “concept” to mean new product or process ideas. This is clearly different from the usual meaning of that word in the context of epistemology.
10. The distinction between technical and cognitive tacit knowledge is curious because it reinstates the body versus mind dualism dichotomy that Nonaka and his colleagues are otherwise at pains to disavow. See Bereiter (2002, p. 176) for another example of “Western” dualism in their ideas.
11. Strictly speaking, Nonaka and his colleagues intend “socialization” to refer to the transfer of tacit knowledge from one person to another, but this must involve creation of tacit knowledge in or by the person who did not initially possess it.
12. Klein (1998, p. 268) in fact argues that “justification” is inadequate, and epistemologists now prefer to define knowledge as “true, warranted belief.”
13. This idea continues to interest them (see Nonaka et al., 2001b, p. 15), but it plays no part in the SECI model development. The suggestion that knowledge is a process “toward” truth seems to imply the notion of truth as being outside human endeavor that they criticized.

14. Nonaka and his colleagues do not discuss “belief” implicitly, taking its meaning for granted—an unsound position since “belief” is an ambiguous word (see Dewey, 1986, p. 15). Luper (1998) also indicates that the relationship between knowledge and belief is unclear.

REFERENCES

- Adler, P. S. (1995). Comment on I. Nonaka: Managing innovation as an organizational knowledge creation process. In J. Allouche & G. Pogorel (Eds.), *Technology management and corporate strategies: A tricontinental perspective* (pp. 110–124). Amsterdam: Elsevier.
- Alexander, P. A., Schallert, D. L., & Hare, V. C. (1991). Coming to terms: How researchers in learning and literacy talk about knowledge. *Review of Educational Research*, 61(3), 315–343.
- Barbiero, D. (2002). Tacit knowledge. In C. Eliasmith (Ed.), *Dictionary of philosophy of mind*. Retrieved February 15, 2005, from <http://artsci.wustl.edu/~philos/MindDict/tacitknowledge.html>
- Barfield, W. T. (1947). "Manna": *A comprehensive treatise on bread manufacture*. London: Maclaren & Sons.
- Becerra-Fernandez, I., & Sabherwal, R. (2001). Organizational knowledge management: A contingency perspective. *Journal of Management Information Systems*, 18(1), 23–55.
- Bereiter, C. (2002). *Education and mind in the knowledge age*. London: Erlbaum.
- Cherry, C. (1966). *On human communication: A review, a survey and a criticism*. Cambridge, MA: MIT Press.
- Clancey, W. J. (1997). *Situated cognition: On human knowledge and computer representations*. Cambridge, UK: Cambridge University Press.
- Collins, H. M. (1974). The TEA set: Tacit knowledge and scientific networks. *Science Studies*, 4, 165–186.
- Collins, H. M. (2001a). Tacit knowledge, trust, and the Q of sapphire. *Social studies of science*, 31(1), 71–85.
- Collins, H. M. (2001b). What is tacit knowledge? In T. R. Schatzki, K. Knorr Cetina, & E. von Savigny (Eds.), *The practice turn in contemporary theory* (pp. 107–119). London: Routledge.
- Dewey, J. (1986). *Logic: The theory of inquiry*. In J. A. Boydston (Ed.), *The later works, 1925–1953. Volume 12: 1938*. Carbondale: Southern Illinois University Press.
- Dewey, J., & Bentley, A.F. (1949). *Knowing and the known*. Boston: Beacon Press.
- Dierkes, M., Antal, A. B., Child, J., & Nonaka, I. (2001). *Handbook of organizational learning and knowledge*. Oxford: Oxford University Press.
- Doyle, J. L. (1985). Commentary: Managing the new product development process: How Japanese companies learn and unlearn. In K. B. Clark, R. H. Hayes, & C. Lorenz (Eds.), *The uneasy alliance: Managing the productivity-technology dilemma* (pp. 377–381). Boston: Harvard Business School Press.
- Easterby-Smith, M., & Lyles, M. A. (Eds.). (2003a). *The Blackwell handbook of organizational learning and knowledge management*. Oxford: Blackwell.

- Easterby-Smith, M., & Lyles, M. A. (2003b). Introduction: Watersheds of organizational learning and knowledge management. In M. Easterby-Smith & M. A. Lyles (Eds.), *The Blackwell handbook of organizational learning and knowledge management* (pp. 1–15). Oxford: Blackwell.
- Engeström, Y. (1999). Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen, & R.-L. Punamäki (Eds.), *Perspectives on activity theory* (pp. 377–406). Cambridge, UK: Cambridge University Press.
- Glisby, M., & Holden, N. (2003). Contextual constraints in knowledge management theory: The cultural embeddedness of Nonaka's knowledge-creating company. *Knowledge and Process Management*, 10(1), 29–36.
- Griffin, D., Shaw, P., & Stacey, R. (1999). Knowing and acting in conditions of uncertainty: A complexity perspective. *Systematic practice and action research*, 12(3), 295–309.
- Hair J. F., Anderson R. E., Tatham R. L., & Black W. C. (1998). *Multivariate data analysis*. Englewood Cliffs, NJ: Prentice Hall.
- Hedlund, G., & Nonaka, I. (1993). Models of knowledge management in the West and Japan. In P. Lorange, B. Chakravarthy, J. Roos, & A. Van de Ven (Eds.), *Implementing strategic processes: Change, learning and cooperation* (pp. 117–144). Oxford: Blackwell.
- Imai, K., Nonaka, I., & Takeuchi, H. (1985). Managing the new product development process: How Japanese companies learn and unlearn. In K.B. Clark, R.H. Hayes, & C. Lorenz (Eds.), *The uneasy alliance: Managing the productivity-technology dilemma* (pp. 337–375). Boston: Harvard Business School Press.
- Janik, A. (1988). Tacit knowledge, working life and scientific method. In B. Göranson & I. Josefson (Eds.), *Knowledge, skill and artificial intelligence* (pp. 53–63). London: Springer-Verlag. .
- Jorna, R. (1998). Managing knowledge. *Semiotic Review of Books* 9(2). Retrieved September 17, 2000, from www.chass.utoronto.ca/epc/srb/srb/managing-know.html
- Klein, P. D. (1998). Knowledge, concept of. In E. Craig (Ed.), *Routledge encyclopedia of philosophy* (pp. 266–276). London: Routledge.
- Luper, S. (1998). Belief and knowledge. In E. Craig (Ed.), *Routledge encyclopedia of philosophy* (pp. 706–709). London: Routledge.
- Nonaka, I. (1988a). Creating order out of chaos: self-renewal in Japanese firms. *California Management Review*, 15(3), 57–73.
- Nonaka, I. (1988b). Toward middle-up-down management: Accelerating information creation. *Sloan Management Review*, 29(3), 9–18.
- Nonaka, I. (1990). Redundant, overlapping organization: A Japanese approach to managing the innovation process. *California Management Review*, 32(3), 27–38.
- Nonaka, I. (1991a). The knowledge-creating company. *Harvard Business Review*, 69(6), 96–104.
- Nonaka, I. (1991b). Managing the firm as an information creation process. In J.R. Meindl, R. L. Cardy, & S.M. Puffer (Eds.), *Advances in information processing in organizations* (pp. 239–275). Greenwich, CT: JAI Press.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 14–37.

- Nonaka, I. (1995). Managing innovation as an organizational knowledge creation process. In J. Allouche & G. Pogorel (Eds.), *Technology management and corporate strategies: A tricontinental perspective* (pp. 73–109). Amsterdam: Elsevier.
- Nonaka, I., Byosière, P., Borucki, C. C., & Konno, N. (1994). Organizational knowledge creation theory: A first comprehensive test. *International Business Review*, 3(4), 337–351.
- Nonaka, I., & Kenney, M. (1991). Towards a new theory of innovation management: A case study comparing Canon, Inc. and Apple Computer, Inc. *Journal of Engineering and Technology Management*, 8(1), 67–83.
- Nonaka, I., Konno, N., & Toyama, R. (2001). Emergence of “Ba”: A conceptual framework for the continuous and self-transcending process of knowledge creation. In I. Nonaka & T. Nishigushi (Eds.), *Knowledge emergence: Social, technical and evolutionary dimensions of knowledge creation* (pp. 3–29). Oxford: Oxford University Press.
- Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. New York: Oxford University Press.
- Nonaka, I., Toyama, R., & Byosière, P. (2001). A theory of organizational knowledge creation: Understanding the dynamic process of creating knowledge. In M. Dierkes, A.B. Antel, J. Child, & I. Nonaka (Eds.), *Handbook of organizational learning and knowledge* (pp. 491–517). Oxford: Oxford University Press.
- Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba, and leadership: A unified model of dynamic knowledge creation. *Long Range Planning*, 33, 5–34.
- Nonaka, I., & Yamanouchi, T. (1989). Managing innovation as a self-renewing process. *Journal of Business Venturing*, 4, 299–315.
- Nonaka, I., Umemoto, K., & Senoo, D. (1996). From information processing to knowledge creation: A paradigm shift in business management. *Technology in Society*, 18(2), 203–218.
- Poell, R. F., & van der Krogt, F. J. (2003). Learning strategies of workers in the knowledge-creating company. *Human Resource Development International* 6(3), 387–403.
- Polanyi, M. (1969a). The logic of tacit inference. In M. Grene (Ed.), *Knowing and being: Essays* (pp. 138–158). London: Routledge & Kegan Paul.
- Polanyi, M. (1969b). Tacit knowing: Its bearing on some problems of philosophy. In M. Grene (Ed.), *Knowing and being: Essays* (pp. 159–180). London: Routledge & Kegan Paul.
- Ratner, S., & Altman, J. (1964). *John Dewey and Arthur F. Bentley: A philosophical correspondence 1932–1951*. New Brunswick, NJ: Rutgers University Press.
- Snowden, D. (2002). Complex acts of knowing: paradox and descriptive self-awareness. *Journal of Knowledge Management*, 6(2), 100–111.
- Stacey, R. D. (2001). *Complex responsive processes in organizations*. London: Routledge.
- Teece, D. J. (2001). Strategies for managing knowledge assets: The role of firm structure and industrial context. In I. Nonaka & D. J. Teece (Eds.), *Managing industrial knowledge: Creation, transfer and utilization* (pp. 125–144). London: Sage.

- Tsoukas, H. (2003). Do we really understand tacit knowledge? In M. Easterby-Smith & M. A. Lyles (Eds.), *The Blackwell handbook of organizational learning and knowledge management* (pp. 410–427). Oxford: Blackwell.
- Yolles, M. (2000). Organizations, complexity, and viable knowledge management. *Kybernetes*, 29 (9-10), 1202–1222.

