10 Theoretical constructs for knowledge management

To manage knowledge in organizations, we have to rely on concepts and constructs that are theoretically sound, which cover the most important areas of knowledge processes, and which are easy to communicate and integrate in the practical action within the organization. In the previous sections we have developed theoretical foundations for knowledge management. As we saw, conceptually robust theories of organizations, knowledge, and meaning processing require rather sophisticated discussions on the nature of intelligence, meaning, organized action, and organizational information processing. From this theoretical basis, we should now be able to derive theoretical constructs that are directly relevant for practical organizational life. We should also package these theories into a form that can be integrated into management practice. Based on the previous discussion, we should now be able to describe the different types of knowledge in organizations, the ways knowledge is generated, and the ways knowledge integrates with work activities and strategic development of organizational competencies and processes.

In Parts II and III we used a number of theoretical approaches in an attempt to clarify the nature of intelligence and organizations. Loosely speaking, they all can be described as "phenomenological" approaches, in contrast to much of the extant theory that has been based on objectivistic epistemologies, information processing, and cognitivism.

Based on those theoretical considerations, I argued that the focal units of organizational knowledge creation can be viewed as communities. Organizations themselves can be conceptualized as almost autopoietic systems whose meaning structure defines what can be information for them at the organizational level of analysis. More fundamentally, however, organizations need to be understood within an ecology of social systems. Based on Luhmann's analysis of social systems as meaning processing systems, I argued that organizational communities are systems that self-referentially process meaning. Therefore, they can also be called cognitive systems, and the metaphor of organizational intelligence is interesting and appropriate. The coupling between individual cognition and organizational cognition is, however, loose, as humans-in-society and organizations live in

phenomenally irreducible worlds. An interesting way to approach these loose couplings is to analyze their time relations.

Organizations and organizational actors can manage their knowledge at the various levels where knowledge exists in the organization. At all these levels we may ask what tools and behaviors increase the possibilities for effective action. Moreover, we may ask whether, for example, we can design and implement organizational structures within the focal organization that increase organizational intelligence.

Vygotsky's observation was that language and conceptual thinking become tools for cognition and simultaneously change it. Language, definitely, is one of those tools that we use to manage knowledge. The meaning structures that underlie language embed major stocks of social and historically developed knowledge. Luhmann, however, pointed out that language, as a media and tool, creates tensions, which, in turn, generate further media. As communication is inter-personal, its success is inherently improbable. To overcome the inherent improbability of communicative success, language emerges with media that release tensions created by the three improbabilities of accessibility, acceptance, and understanding. For example, symbolically generalized meanings and conceptual systems discussed by Vygotsky are, in Luhmann's terms, media that manage tensions in communication.

Organizations, themselves, can also be viewed as tools, and, as social systems, they also embed stocks of knowledge. They are, in the Bergsonian sense, examples of "organized matter," constructed from elements available in the social world. As they are social tools, they can simultaneously be used for multiple purposes by the different members of society, both inside and outside the focal organization. To maintain the organization, these purposes, however, have to be mutually compatible. A single focal actor or motive is not sufficient in explaining the nature of organizations. There may be several actors, and the focus of activity may vary. Indeed, metaphorically, we could view an "organizational tool" as analogous to a boat, which several actors can board for various purposes when they want to navigate toward the same direction. An organization can be emerge through collaborative action, or it can be intentionally designed. In the boat metaphor, the first case would happen when people want to sail across an ocean and join their forces in building a boat, the second case when an individual commissions the construction, and after the boat is ready, sells tickets for the journey. Probably the latter better describes

traditional industrial organizations, whereas the previous more closely describes a modern "knowledge-intensive" organization.

The mediated cognition view was based on Bergson's and Vygotsky's analysis of intelligence, language, and mediated thought. Intelligence can be defined as the process that generates meaning structures, which, in turn, underlie effective action. In this terminology, intelligence is a continuous process, and knowledge its accumulated product. Here, as in all biological life, several simultaneous processes operating in different time-scales both produce and reproduce the system. Intelligence recursively defines itself in the process that simulateneously operates within the existing meaning structure and changes it. Metaphorically, we could then say that intelligence is not something that we "have," or something that "is"; instead, it is a process in time that enables "becoming," in true Bergsonian and biological sense. Some parts of the meaning structure provide the "background" for meaning processing, and these relatively "institutionalized" parts of the meaning structure we can call knowledge structures. Other parts of the meaning structure change when the information in the environment changes. This we could call perception. Perception and knowledge, therefore, are not fundamentally different. Instead, they both define what a meaningful reality is for an intelligent being.

There is no fixed privileged position for "institutionalized" meaning structures, except the fact that they are actively reproduced as much of the meaning processing relies on them. Some core concepts and knowledge is central to the reality we operate in, and their reinterpretation requires a paradigm shift that rearranges a large number of meaning relations. As soon as meaning structure changes so that old "institutionalized" meaning structures are not recreated, they disappear and new knowledge emerges. In the pragmatist view, knowledge changes when experience so requires; however, when we compare knowledge with perception, we can say that those meaning relations that underlie knowledge are more "sticky" than those that dynamically become organized in the process of perception.[59]

[59] This dynamic self-organization of meaning in the act of perception can be described for example as a "resonance" between the world and our meaningful construction of it. Indeed, this is one interpretation of Nonaka's concept of *ba*, at its most dynamic and ephemeral form This idea has been developed by Shimizu and Yamaguchi (1987). I have earlier noted the close correspondence between their "holovision" model and the Bergsonian concept of perception (see Heinämaa & Tuomi, 1989:270).

If we reserve the word “intelligence” for the process of meaning processing, and the word “knowledge” for relatively stable accumulated meaning structures, cognition, in its broadest sense, can be defined as capability for effective choice. Cognition, therefore, also means capability to create information about the environment. What “effectiveness” in each case means, depends on the acting unit, and there are no universal criteria for it. Within the autopoietic framework one could, however, say that to be effective, action has to maintain the system organization, although it can at the same time change its structure. Within the activity theoretic framework, we could say that effectiveness of activity is measured by the correspondence between the needs of the actor and their fulfillment by the activity.

In contrast to objectivistic theories of knowledge, we would not—and could not—define knowledge as “true justified belief”—unless we completely redefine the concept of truth, as for example Polanyi did. This is simply because we know the world in the same way as its facts: through socially constructed and historically developed distinctions. The criterion for “truth” and knowledge is therefore pragmatic and defined only within a community of thought. The experts in the community define what is knowledge for the community, but their role as experts, in turn, is defined by the community. Therefore, knowledge evolves in the same way as the meaning of a concept changes every time it is used in meaning processing. Knowledge is therefore not fixed to any objective reality. Neither is knowledge subjective or truth purely relativistic. To put it in other words, our knowledge can not strictly speaking be “false”; instead, it can only make our behavior “stupid” and incompetent. In some cases our incompetence is measured by other social observers, in other cases we just unexpectedly hit our heads into some natural walls.

The third theoretical perspective, the developmental view, focused on the ways that knowledge changes and accumulates. In the Vygotskian framework, the three lines of phylogenetic, ontogenetic, and cultural development interact. Learning occurs through joint effort among people who share a culture or praxis. Practical intelligence uses tools that embed knowledge about practice, and intelligence is augmented by cognitive tools. Identities of people are bound to cultures and communities of practice that interacting and communicating people mutually construct. Simultaneously, knowledge also becomes defined in relation to these social formations. What counts as effective action depends on tools and practices available within a community, as well as on sedimented social structures.

In the developmental view, cognition, knowledge, and intelligence are not stable. The development of knowledge structures changes the way intelligence functions. Simultaneously it changes the criteria for effectiveness. Ontogenic change can lead to new effective habits and concepts; and concepts, in turn, can sediment into structural knowledge. World is continuously constructed using language and socialization, and this emerging world is embedded in new practices, tools, and social structures.

10.1 Cognition and the four basic types of knowledge

Combining the meaning processing and system view with the idea of cognitive tools enables us to make a distinction between self-referential and direct knowledge. Instinctive knowledge, in the sense of Bergson, is direct: it manifests itself in action without mediating tools or mediating meaning. We may include also habits, or conditioned reflexes, into this class of not self-referential behavior, and argue along Polanyi that also tools can be used in instinctive fashion. Therefore there exists knowledge that is sedimented in the meaning structure. Self-referential knowledge, in contrast, underlies active meaning processing. For meaning processors, the environment exists only as a meaningful world. Therefore, reflective intelligence never accesses the world as it is in its totality, in its objective "transcendental" state. The self-referential nature of intelligence, however, makes it possible that intelligence can reflect on the processes of cognition itself, and in this way it can transcend the world it constructs and which is its object. Intelligence can also access world beyond meanings indirectly by reflecting on instinctive knowledge: following Bergson, we can call this capability intuition.

In common language we call intelligent those agents that are not only capable for effective action within a static environment, but who are also able to expand their intelligence and change their knowledge structures. Intelligence, therefore, has often been viewed as a skill in "problem solving"—something that is brought to bear when the environment poses a challenge and novelty is required. For example, in common usage an intelligent person is someone who is able to generate a solution to a problem, not someone who already "knows" the answer. This view, however, should be rejected if we adopt the terminology presented above. As Ceci and others pointed out, it is impossible to distinguish intelligence as a process from the knowledge that structures it. More appropriately, intelligence may be viewed as capability to generate new knowledge, i.e., new structures that enable effective action.

These constructs are summarized in Table 9. In the terminology of Table 9, intelligence is an effect, whereas knowledge is the result. They are, however, inseparable as intelligence processes meaning based on those meaning structures that we have called knowledge. To rephrase Heraclitus, we might say that intelligence is an ever-changing

flow and knowledge is the contour which both constrains and enables this flow. Therefore, it is as impossible to say what intelligence *is* as it is impossible to step into the same river twice. The stuff that moves in the process is meanings, which simultaneously carve new forms in the sedimented structure, and bring new material for emerging structures. Then, using Leont'ev's concepts, we can say that the gravitation that makes the meaning flow is the human need, and the motive of activity.

cognition (broad)	capability for effective action
cognition (narrow)	capability for self-referential action
knowledge (broad)	structures that constrain and guide effective action
knowledge (narrow)	structures that constrain effective self-referential action
intelligence (broad)	capability to generate knowledge
intelligence (narrow)	capability to generate self-referential knowledge

Table 9. Definitions of cognition, knowledge, and intelligence.

When we define knowledge as those structures that guide meaning processing, we still have to give criteria that distinguishes "more accurate" knowledge from "less accurate." As was discussed before, we can not assume any external or objective criteria here. Instead, we have to adopt the pragmatic epistemological approach: knowledge is more "true" if it leads to effective action.

Using these definitions, we can make a distinction between two developmentally different types of knowledge. First, *ontogenic knowledge* has its source in the development of the knowing entity. It is something that the knowing entity "learns" based on its "experience." *Phylogenetic knowledge*, in contrast, has its source in inherited structures. The generation of phylogenetic knowledge can not be attributed to a specific individual entity; instead, it is trans-generational, or collective. Often such learning is conceptualized as adaptation and selection within an evolutionary framework.

A prototypical form of phylogenetic knowledge is instinct. Instinctive knowledge embeds interactions with the world that result from a history of mutual co-ontogenesis, or structural drift, of the

knowing entity and its object of action. If the knowing entity is a unit in a higher-order system, however, such inherited structure may be embedded in a society. A special case of this is a culture, where the units of culture inherit meaning structures through language and social practice. Individual humans-in-society do not invent culture on their own; instead, their development as humans-in-society make them encultured.

Meanings are typically fluid and they are fixed to the environment only indirectly, through signs. Intelligent signs, using Bergson's terminology, refer to a meaningful world that is constructed by active meaning processing. Instinctive signs, in turn, refer to the environment that is the object of meaning-free interactions. Signs and symbolically generalized meanings provide a relatively stable basis around which meaning processing and inter-personal communication becomes possible. However, the underlying system of meaning processing is in continuous change. Even though some symbolically generalized meanings may be sedimented into the structure of language, they are not fixed in relation to anything, including objects external to the meaning system.

In contrast, habitual and instinctive knowledge is embedded outside the meaning system. Active meaning processing uses such sedimented meaning structures as the background context against which meanings are processed and where intelligence operates. Often such knowledge is sedimented in the phylogenetic structure as instincts. Sedimentation, however, can also happen during the lifetime of the knowing entity, and such ontogenic and sedimented knowledge can be called learned structural knowledge. Figure 22 shows these four basic types of knowledge.

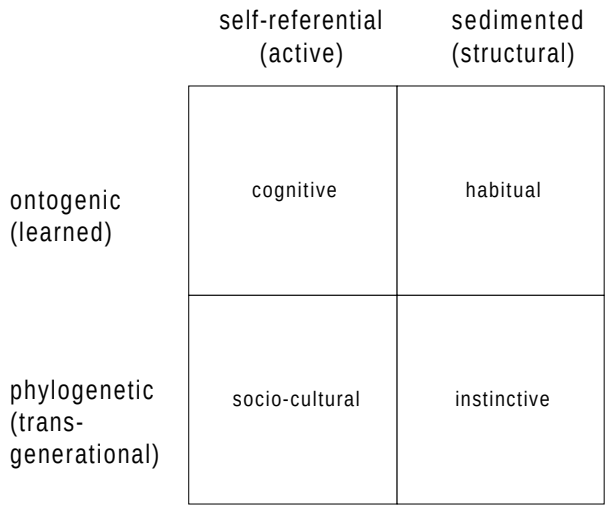

Figure 22. Four basic types of knowledge.

As Vygotsky and Leont'ev noted, cognitive and socio-cultural forms of knowledge are in constant interaction. Their genetic source may be different, but they are indistinguishable as constraints and enablers of meaning processing. Moreover, cognition operates within a socio-cultural context. As Fleck pointed out:

> Every epistemological theory is trivial that does not take this sociological dependence of all cognition into account in a fundamental and detailed manner. But those who consider social dependence a necessary evil and an unfortunate human inadequacy which ought to be overcome fail to realize that without social conditioning no cognition is even possible. Indeed, the very word "cognition" acquires meaning only in connection with a thought collective. (Fleck, 1979:42)

10.2 Knowledge as product, constraint, and competence

Within an organization, we have several perspectives on knowledge. First, knowledge can be viewed as an accumulated *resource* that underlies capabilities. Knowledge makes some types of performance possible. These accumulated possibilities for action we can call competencies. Second, knowledge can be viewed as a *structure* that *constrains* activity, and which makes some actions effective. Third, knowledge can be viewed as a *product*. As a product, knowledge can change existing constraints for actions, and lead to development. These three perspectives and the constructs they generate are shown in Figure 23.

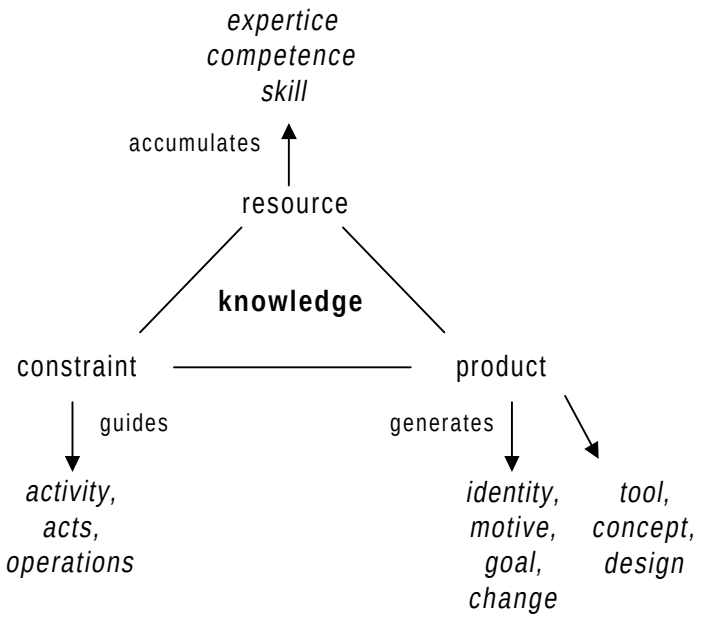

Figure 23. Three perspectives on knowledge.

The focal issue for accumulated resources is their deployment. In organizations knowledge resources manifest themselves, for example,

as customer relationships, core competencies, accumulated best practices, and anecdotes. Some of this knowledge capital is sedimented into organizational structures (Nelson & Winter, 1982; Walsh & Ungson, 1991). For example, logistic networks, customer interfaces, and core processes may be institutionalized within the organization. Other forms of knowledge capital may be embedded in documents, including patents, strategy documents, customer agreements, and product designs. These, however, are knowledge products that become knowledge resources only to the extent that they are used as cognitive tools in competent activity. Indeed, in most cases knowledge is produced because it is expected that someone will use it as a resource.

In the extant literature on knowledge management, the focus has often been on the resource perspective (e.g., Sveiby, 1997; Stewart, 1997; Edvinsson & Malone, 1997; Brooking, 1996). However, at the same time knowledge has also been viewed as a product. As a result, it has been assumed that a design or a document can be valuable as such, without considering the activity in which this value is realized. Often, two different types of knowledge resources have been distinguished: human capital and structural capital. The underlying idea has been, for example, that human competencies "walk out of the door every night," whereas structural capital "stays in the company." In economic terms, this has been thought to mean that human capital can only be rented, whereas structural capital can be owned by the company.

The division of intellectual capital into human capital and structural capital is problematic as it distinguishes knowledge components based on the level of analysis. "Human capital" looks, then, like an aggregate sum of individual competencies, and structural capital is "the rest," i.e., the surplus that remains when this theoretical aggregation of individual intellectual capital is subtracted from the capabilities of the focal organization. Spender (1995) makes a similar distinction between individual and social knowledge. In some cases this approach could be useful; more generally, however, individual competencies exist only in relation to organizational systems of activity, which, in turn, only exist within systems of activity that integrate the focal organization with activity systems in its environment. Therefore, one could as well say that human capital does not "walk out of the door" when the factory bell rings; instead, people go home and their competencies remain within the organized system of activity. To put it in other words: it is as impossible for a company to "own" human capital, as it is for an employee to be a salesman of the year, without a product to sell.

Knowledge processes at the different meta-levels in an organization can not be separated as individuals are essentially individuals-in-society, and their knowledge is collectively generated and used. We could then ask, what "goes out of the door" when people go home? Strictly speaking, it cannot be "competence" or "knowledge capital." What happens is that activity gets discontinued, and motives that relate to organizational activity become latent. Knowing happens in activity, which—to borrow Leont'ev's formulation—is an inherently social category.[60]

Most of the time, knowledge structures that underlie activity and determine operations are not explicitly articulated or reified. We simply use these knowledge structures as a backdrop against which the moving images of meaning relations are projected. Following Polanyi (1998; 1967), these background knowledge structures can be called tacit knowledge. Explicit knowledge then refers to articulated and focal self-referential knowledge, for example, concepts, images, and plans. In some cases, the constraints, however, are not within our meaning processing system, but, for example, based on structural couplings with the environment. In such cases, we may call the constraints *instinctive*, and the related capability a *natural skill*.

Using these constructs we can relate the various types of constraints to the corresponding levels of analysis of activity as in Table 10.

[60] This has implications also for the development of intellectual capital measurement systems at organizational and national levels. For example, educational certificates should be seen as social signs of appreciation, nbot as indicators of underlying capability. "Individual" capability depends on those systems of activity where they are realized; education certificates often relate to decontextualized "capabilities" or "skills" that are assumed to be independent of the underlying system of social and collective activity. Therefore, it is questionable that a generic measurement system for skills could be developed. The appropriate level of aggregation of "skills" is also a major theoretical problem. For example, Thurow's model of job queues probably better explains the nature of educational certificates than any link with productivity or capability (Tuomi, 1992b). According to Thurow (1975), certificates are used mainly to by-pass competitors in job competition, and much of the educational effort should be understood as a defensive cost.

	behavioral driver	**self-referential constraint**	**non-referential constraint**
Activity	motive	tacit knowledge	—
Action	goal	explicit knowledge	—
Operation	action	tacit knowledge	instinctive, habitual, and embedded knowledge

Table 10. Levels of activity and types of knowledge constraints.

The main distinction between constraints at the level of operations and at the level of actions is that operations show "skillful behavior" and capability to "go on" in an actual situation in all its complexity, whereas actions are reflective articulations and plans within an abstracted meaningful situation. Using Giddens' (1984) term, actions within a system of activity require "knowledgeable social agents." However, this is so only at the level of actions. Activity, although it requires the existence of such knowledgeable social agents, is based entirely on tacit knowing. In contrast to operations that occur in the context of articulated goals, the motives driving activity are not articulated or "conscious." Instead, activity emerges *itself* as an articulation of a situation where potential fulfillment of a need creates a motive. Although a conscious subject may reflect on his or her needs and activities and, for example, change them, activity in itself is not based on conscious reflection and articulation of meaning structures.

10.2.1 Reproduction and expansion of social activity

When knowledge structures constrain action, the goal for the action is fixed and the focal issue is the effectiveness of knowledge. Within a given stock of knowledge, action can be unintelligent, for example, a mistake or an error. In many cases an external observer can argue that some action could be viewed within a broader or different stock of knowledge, and within that context the action is dysfunctional. Therefore, knowledge can be contested. This can happen when there is another "external" stock of knowledge that is used as a reference.

Knowledge can, however, also be contested as a result of knowledge creation. A mistake may be detected by reflecting on past action and by reinterpreting it. Knowledge, therefore, plays a dual role: it guides activity by coordinating actions and by reproducing social structure, but—through generation of new knowledge—it also changes activity and existing routines. By producing knowledge, organizations change their world, simultaneously changing the criteria for intelligent action within the organization. Knowledge can be produced to produce change.

If there is lack of relevant knowledge, or if existing knowledge is "wrong" and creates anomalies, a need for new knowledge emerges. The third perspective on knowledge in Figure 23 is the one that sees knowledge as a product that can be used to change existing meaning structures. Therefore, we may also consider the effectiveness of the production of knowledge in itself. This meta-level consideration views knowledge production as an end in itself—as a process that accumulates stocks of knowledge, and reconfigures constraints for activity in ways that, for example, overcome anticipated threats or realize anticipated opportunities.

Knowledge is also viewed as product in those organizations that actually market knowledge that they have generated. As the discussion above shows, such knowledge "products" are only a tip of an iceberg in even the most "knowledge-based" organizations. In some cases such knowledge products can be "packaged" and sold, for example, as consulting services, reports, databases, or tools. This metaphorical way of viewing knowledge as a product that can be transferred from one organization to another, however, easily misses the point that knowledge is something that is integrated into social processes. It is a conceptual category error to assert that knowledge, for example, exists on pieces of paper. Instead, pieces of paper, at best, trigger processes that change organizational knowledge structures. Therefore, an organization does not become more "knowledgeable" just by adding knowledge products on top of it, or by providing its employees "the best information available." A more accurate metaphor for knowledge products would be to see them as catalysts for organizational learning processes. Without connecting external knowledge products into organizational knowledge processes, these products are, in most cases, just piles of paper. This is so for even the most structured knowledge products. For example, a database of mailing addresses typically has value only if the focal organization has a system of activity that needs addresses to mail letters.

Knowledge products, do not, however, exist only in externalized form, for example, as documents. Knowledge stocks also define what it is to be the organization in question, and a change in these stocks redefine organizational identity. Such knowledge is not necessarily articulated but it can be directly acted in organizational practice. It can be, for example, inherently bound with organizational activity. Knowledge products can be embedded in tools that are used in organizational practice, and knowledge production can produce new forms of activity by creation of new organizational motive systems and practices. Simultaneously, however, knowledge production also maintains and reproduces existing motive systems and identity in the organization.

Knowledge can then be viewed as a generator of two fundamentally different but integrated system phenomena. On the other hand, knowledge processes underlie organizational change. This change can be expansion of activities, extension of activities into new domains, or renewal by changing organizational identity, culture, and practices. But as was pointed out before, knowledge also underlies organizational stability. Organizational stocks of knowledge define its routines, its language, practices, culture, and identity. In addition, organizational knowledge underlies reproduction of these structures by coordination, either explicitly by communication, or implicitly via social institutions. Knowledge processes, therefore, can be seen as fundamental drivers for organizational life. Without knowledge, organizations would have no stability, and could not maintain themselves. But knowledge also drives these self-maintaining systems as dynamic and changing entities. Schematically, organizations can therefore be viewed as two mutually constitutive modes of existence—stability and change—which are driven by organizational knowledge processes. These relations are symbolically depicted in Figure 24. A simple way to rephrase the idea of Figure 24 is to say that knowledge is the media between stability and change.

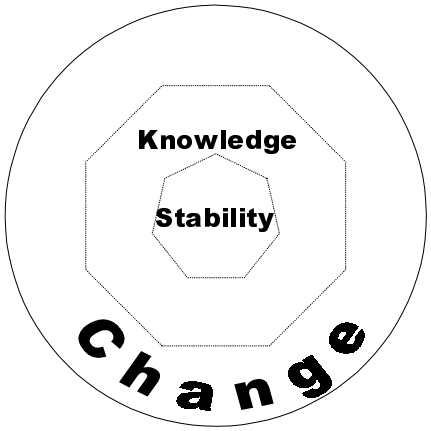

Figure 24. Knowledge between stability and change.

Knowledge management, therefore, needs to address organizational knowledge from several different directions. We need to manage knowledge resources, for example, skills, competence, and expertise. However, we also need to manage knowledge as it constrains and enables social activity and praxis. In addition, we need to manage the actual articulated knowledge products, such as product designs, documents; but also more fundamental organizational assets: its identity, language, and system of motives. Most important, we need to manage the balance between organizational stability and change.

One could say that the most limited and valuable resource at the times of change is stability. To manage stability, we have to understand and manage change. Therefore, a critical task for knowledge management is to understand those processes that underlie the generation of knowledge. The next section, therefore, briefly describes some current views on how people and organizations learn and create knowledge. I shall discuss several different types of learning, and analyze then in more detail an influential model of knowledge creation developed by Nonaka and Takeuchi. After that, I shall introduce a new model for organizational knowledge creation that addresses some of the limitations of the extant models.

10.3 Learning and knowledge creation

Learning has often been understood as the process of knowledge acquisition or as transfer of knowledge from one individual to another. We talk about learning as synonymous to internalization of new knowledge, as creation of knowledge, or as development of new skills. As was discussed before, more generally, learning can be understood as a process that develops knowledge structures, thereby changing capabilities that underlie intelligent action. Learning may be viewed as a change in activity, in the structure of behavior, and in a person's mode of engagement in social practices (Packer, 1993:264). It is change in mind—metanoia, as Senge (1990) calls it—but also change that is reflected in action.

Bergson noted that both instinct and intelligence involve knowledge. We could say that instinct and habit embody knowledge, and that intelligence both produces and processes knowledge. "Embodiment" of knowledge is, however, relative to a specific biological organism. In the case of a living species, the primary time-scale that distinguishes instinct, habit, and intelligence is that of the life-time of an individual member of the species. Ontogenic development happens, by definition, during the life-time of an individual unit. In biological organisms structural phylogenetic knowledge may develop through maturation, but even in those cases, the process of maturation is inherited.

Those forms of knowledge that depend on ontogenic development, i.e., history of a specific individual, or unit of learning, we called ontogenic knowledge. Learning, most often, is used to refer to the development of ontogenic knowledge. Cognitive theories of learning focused on self-referential ontogenic development, i.e., change in the meaning structure; whereas behaviorists focused on change that was independent of self-referential meaning processing. Pavlov, with his "second signaling system" was more or less conceptualizing learning as "meaning processing habits." As was noted above, in discussing Figure 22, the different types of learning, however, can not easily be classified based on the distinction between ontogenic and phylogenetic development. A cognitive being does not know whether its meaning structures originated from inter-generational processes or not. Instead, what matters to it is the fact that some meaning structures are difficult to change.

When we distinguish four different types of knowledge—cognitive, habitual, instinctive, and social—we can see that, as the name indicated, the sedimented forms of knowledge are difficult to change. These sedimented knowledge structures appear to the knower and learner as given meaning structures against which cognitive learning happens. Although these sedimented structures may change, they change slowly.

Inter-generational phylogenetic knowledge is sedimented into the structure of the organism. As a first approximation, such innate knowledge can be taken to be static within the life-time of an individual. Habitual knowledge, in contrast, emerges as a result of ontogenic development. Within the time-scales of active cognitive processing, habits, however, are static. Although they are not fixed in relation to the life-time of the living unit, they are sedimented in relation to the time-scales of active meaning processing. Habits, therefore, bridge the two time-scales of phylogenetic structural drift and meaning processing. In this sense, we could also say that habits bridge mind and body, by embedding meaning into body.

The distinction between inter-generational and intra-generational learning leads to the concepts of instinct and intelligence, in the Bergsonian sense. These concepts assume that learning and development can be understood simply by focusing on an individual organism. However, as was discussed above, developmental processes may also extend the boundaries of a single individual learner in another direction: learning can occur in the time-scale of ontogenic development, but it may be collective. On the inter-unit level of analysis we could, for example, talk about collective conceptual learning and collective habit formation. The former could be understood as cognitive learning at the social level, whereas the latter could be viewed as structural collective learning. An example of collective structural learning could be development of new social practice or routine. However, it should be noted that, although social practice and routines may be difficult to change, the reason is not because they would be embedded somewhere outside the world of cognition; instead, their rigidity results from the fact that they are reproduced and reified by many different social actors, and no single actor can easily change them.

When we talk about phylogenetic learning, it becomes clear that there is a problem: what exactly is the focal unit that learns? Although we can say that a species of hymenoptera has learned to sting its victims in their nervous centres, destroying the power of movement of

their victims without killing them, it is difficult to see who actually has been the focal unit of learning. In our everyday parlance, an insect species does not learn, instead it adapts. In the terminology of Maturana and Varela, the system becomes structurally coupled with its environment.

We could then make a further distinction based on two types of structural learning: some structural couplings develop during the ontogenic time-scale, others develop across generations. In the inter-generational time-scale the individual and social dimensions become blurred, and learning does not happen purely socially or individually. Instead, we might say that in this domain learning is fundamentally collective. The process of learning can not, therefore, be understood from the point of view of any specific individual. Instead, as Bergson pointed out, it is a process where the relations between a unit and its environment evolve gradually in a population of individuals. This is what Maturana and Varela called structural drift.

The definitions given above enable us to talk both of individual learning and social learning, organizational learning comprising aspects of both. These different types of learning are represented in Figure 25. The arrow at the bottom of the figure indicates that some social knowledge created within one generation eventually becomes sedimented in the socio-cultural stocks of knowledge that will be available for the subsequent generations. In the social domain we could say that some “acquired characteristics are inherited.”

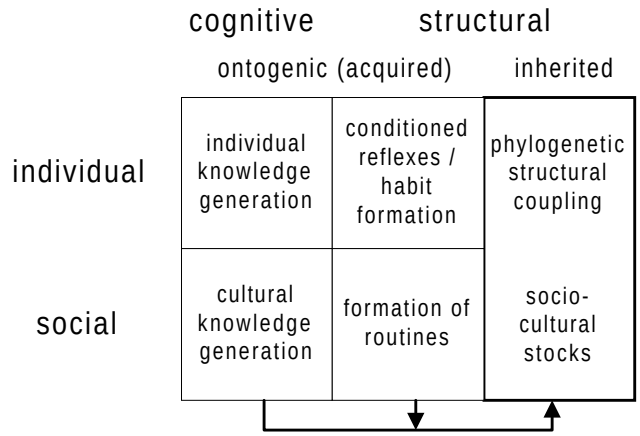

Figure 25. The five types of learning.

As was noted before, learning can change both self-referential meaning processing and non-referential behavior. The formation of habits requires meaning processing, for example perception, but in the performance of a habit, meaning processing is not necessarily needed. In this sense, habits and conditioned reflexes can be independent of cognitive meaning processing. Developmentally, habit formation originates from cognitive meaning processing, but after a habit is formed, it loses some of its cognitive characteristics. We can, however, also call some forms of mental change as formation of "mental habits." For example, during ontogenic development animal retina may change its synaptic connections so that it detects specific forms, such as lines, edges, or moving objects. Or we may associate a sound with the immediate availability of food, or a voice with a person. Such changed meaning processing structures can be seen as constraints and enablers in our meaning processing even when they are not actively part of the self-referential and recursive meaning processing itself. Instead, such mental habits provide a relatively stable context against which the meaning processing happens.

Most human learning happens through change in meaning relations. As the meaning processing system is self-referential, whenever a meaning reference changes the whole system of meanings changes. This is the holistic character of meaning that was pointed out

by Luhmann. New meanings are created, or the structure of already available meanings change.

Some meaning relations, however, are more central than others. If we understand concepts as such central clusters of meaning, we can see that re-organization of our conceptual structure equals to major change in our meaning structure. Moreover, as we use our concepts as cognitive tools that enable new forms of thinking, re-interpretation of our concepts also means—in addition of changing our reality—that we have a different set of cognitive tools available. For example, we may acquire qualitatively new forms of thinking.

Here one could argue that the system of meaning undergoes development within the Vygotskian model that was described before: spontaneous concepts emerge as perceptually coherent ways to interpret a meaningful world, evolving to diffuse complexes that eventually become fixed within a conceptual system. As a result, a new reality, interpretation, and related praxis emerge. When the relations that bind central concepts of such realities are changed, the world is fundamentally changed. Meaning that was subsidiary becomes now focal. This is what Fleck (1979) called a "thought style," tightly connected to the underlying community and its practices, and what Kuhn (1970) meant by paradigms. As Polanyi said such change is irreversible. Where a moment ago we saw a duck, now we see a rabbit (Kuhn, 1970:114). A new rich panorama of significant details is revealed, and the learner has entered a new world (Polanyi, 1998:101).

If the change occurs as a result of symbolic thinking, new concepts can be created. If the change occurs as a result of communication, new concepts can be adopted. Communication may be articulated as language; more generally, however, communication, i.e., coordination of social interaction, results in learning through socialization. In some cases, learning can be an intended consequence of social interaction and we can call it *training*. In other social situations, learning can happen unintentionally through imitation, adaptation and sensemaking. Training typically involves all available modes of learning, and it may be viewed as a highly developed form of social behavior which tries to make effective learning possible. This intention, however, is at least partly based on our extant theories of knowledge development and learning, and, as such, there is no guarantee that the institutionalized forms of training are effective in practice. For example, when learning is assumed to result from transfer of knowledge, the role of socialization and practice is easily underestimated.

In summary, then, we have several different types of learning, and different types of processes that underlie behavioral change. We can not simply discuss individual cognitive learning without considering the other forms that constrain and enable individual cognitive change. Most important, we can expect that these various forms of learning differ both in their dynamics, i.e., the time scales that characterize them, and in the level of analysis that characterizes them. In addition, the advanced forms of learning rely on the cognitive subsystem and, in the case of humans, on language. Therefore, individual learning is inherently social. I return to this topic later in more detail.

10.3.1 Process models for learning

Learning is often irreversible change. Although simple adaptation does not necessarily assume irreversibility, in most cases we expect that learning creates new ways of acting and thinking. Unlearning can occur as a result of loss of memory, but often it happens as a result of learning something new that makes old learning obsolete. It is therefore natural to model learning as a cycle. Indeed, most models of learning are based on cycles. The phases of learning follow each other, and the process of learning itself becomes as a repeating and irreversible process.

A simple and in organization theory very influential model has been proposed by Argyris and Schön (1978). This model adapts a Batesonian model of learning.

Bateson's (1973) analysis of the levels of learning was based on classification of the different types of error that needs to be corrected through the learning process. First, according to Bateson, zero learning happens when a specific response occurs that is not subjected to correction. Learning I, in turn, is characterized by change in response, by selecting a new response from a set of available ones. Learning II occurs when the set of such alternatives is changed. Learning III occurs when the process underlying Learning II is changed. Finally, Learning IV would be change in the process of Learning III. According to Bateson, such learning probably does not occur in any adult living organism, but the combination of phylogenesis with ontogenesis achieves Level IV.

Bateson notes that the outcomes of Learning II—unconscious habits—frequently and necessarily lead the individual to double bind situations. The habit once acquired becomes self-defeating in a similar

but structurally altered social context, or two mutually exclusive responses are needed at the same time. One may compare this model with the Piagetian model. According to Piaget, learning consists of accommodation and assimilation. Assimilation is the process of adjusting to the current situation, whereas accommodation happens when the current situation is reinterpreted and when the cognitive model that is used in the interpretation is changed. In the model of Argyris and Schön, direct adaptation is called "single-loop learning" and accommodation is called "double-loop learning." This model is depicted in Figure 26.

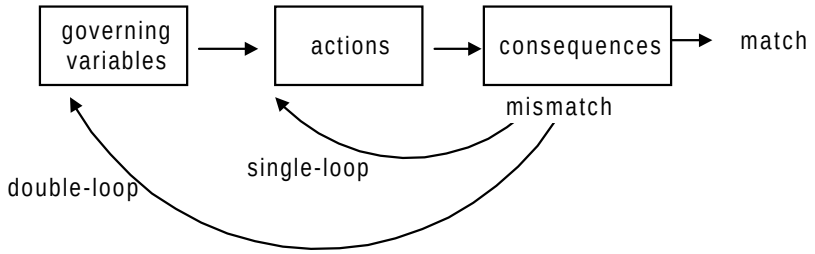

Figure 26. Organizational learning as correction of system error.

Another influential model has been proposed by Kolb (1984). Kolb calls his model "experiential learning model." In this model, shown in Figure 27, learning occurs through sequence of phases where concrete experiences generate an opportunity for observation and reflection, which in turn lead the to creation of new concepts and models that are then tested in novel situations.

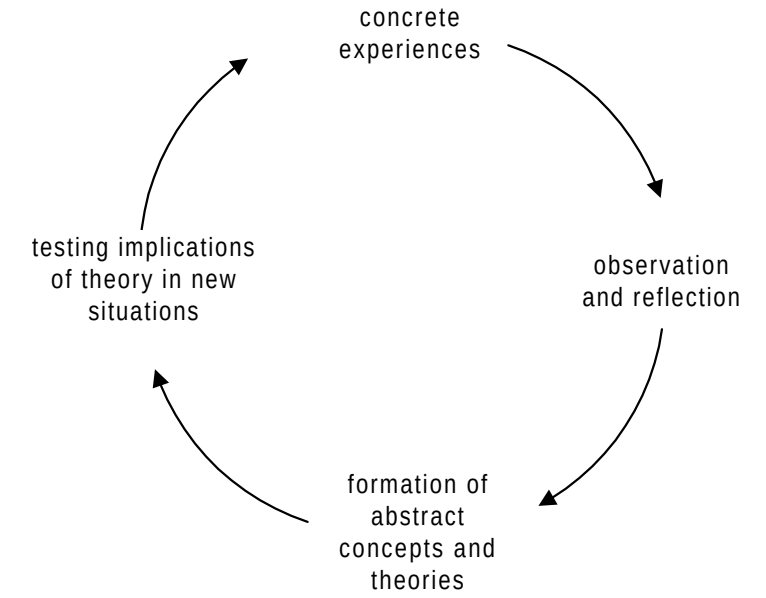

Figure 27. Kolb's learning model.

According to Kolb, learners need four different types of skills to make the learning cycle effective. They have to be able to engage openly and without prejudgement in new experiences, reflect and observe their experiences from many perspectives, create concepts that integrate observations into logically sound theories, and, finally, use these theories in decision making and problem solving (Kolb, 1984:30).

Kolb has argued that his model is based on the learning theories of Dewey and Lewin, which according to Kolb take experience as their starting point. However, the connection between Kolb's model and Dewey's conception of the learning process is rather loose. Miettinen (1998b) has compared these models in detail, and argues that Kolb's model is incompatible with Dewey's model, and that Kolb's model is actually a collection of theoretically unrelated concepts. In Dewey's model, learning starts when unconscious routine breaks down, and when a problem emerges that needs to be solved. This leads to problem definition and conceptualization, a working hypothesis, a thought experiment where the hypothesis is tested, and experimental action, where the hypothesis is confirmed. In Dewey's model, therefore, experience and action can not be separated as two independent modes

of being. There is no "open and unprejudiced engagement in experience"; on the contrary, all experience is completely colored by our assumptions concerning the normal routine way things are supposed to be. We become conscious of our experience only when our "taken-for-granted" approach to the world breaks down. Strictly speaking, an open unprejudiced experience is impossible, as concrete experience, in Kolb's sense, exists only as a difference from our expectations. Also, whereas Kolb assumes that experience is more or less a mental phenomenon, in Dewey's thinking experience is closely related to practical action. Moreover, despite the close similarity between the words "experiential" and "experimental," they imply a very different view on the learning process. As Miettinen points out, in Dewey's model experimental activity is activity where a new form of behavior is tested. Dewey's model, as defined by Miettinen (1998b), is shown in Figure 28.

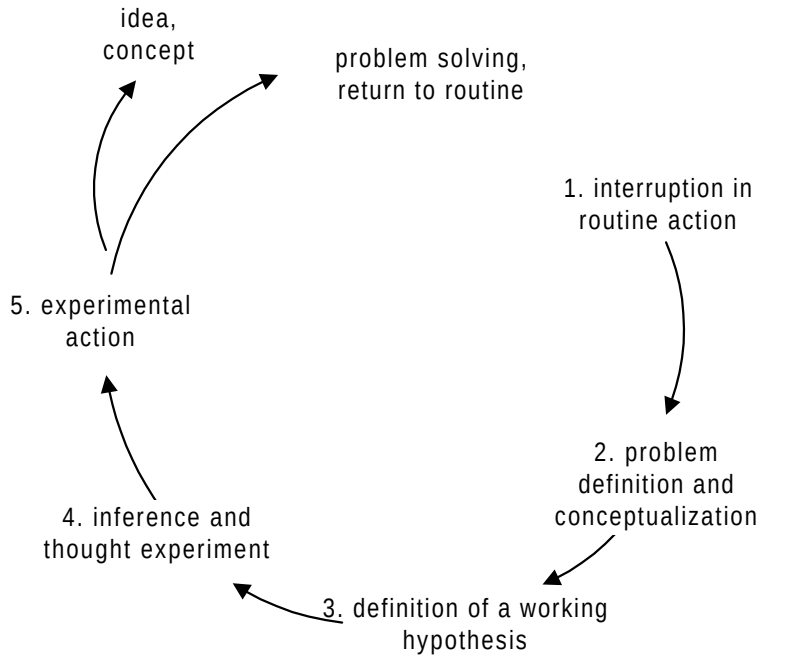

Figure 28. Learning cycle according to Dewey.

Engeström (1999:383-4) has described a learning cycle that can be related to Dewey's ideas. In Engeström's model, the first step is similar to that in Dewey's model. A problem emerges that requires a solution. In the next step, the problem is analyzed. Based on the created understanding of the problem, a solution model is produced, its characteristics are studied, and a promising solution is implemented. These steps map closely with Dewey's model. However, Engeström adds an intermediate step between experimental action and consolidation of the new practice. This is reflection on the process. Engeström's model also inherently incorporates the idea that learning is a social process that develops new forms of activity and practice. In Engeström's words: "The expansive cycle begins with individual subjects questioning the accepted practice, and it gradually expands into a collective movement or institution" (1999:383). Engeström's learning cycle is depicted in Figure 29.

Although these models share a number of characteristics, there are also major differences. The most important of these is the unit of analysis. In the model of Argyris and Schön, the unit that learns is an organization. In Dewey's model it is an individual. In Engeström's model, the learning occurs in a community of people. In Kolb's model, the unit of analysis is ambiguous, and the model has been used to explain individual, team, and organizational learning.

Although, for example, Kolb's model may be theoretically incoherent as Miettinen argues, it has been widely used by organizational practitioners. It is easy to see why it has often been accepted without hesitation: to "organize" learning it helps a lot if we can separate different activities required for organizational learning. For example, it is easy to set up a meeting that specifically reflects on organizational "experiences," and another one that tries to formulate and articulate models that can improve organizational action. If Kolb's model would be interpreted in the Vygotskian framework, we could say that it might be possible to apply it in a collective context where people may "borrow" each other's cognition. However, one should note that the orginal motivation for applying Kolb's model in organizational contexts was that it was supposed to be a model of how people learn. The idea was that "this is how learning happens, and so this is how it should be organized to happen." However, the critics of Kolb would say that this is not how learning happens, and therefore the use of the model in organizational contexts requires some justification. In addition, it is, of course, not obvious that the same learning

processes that undelie individual learning also describe collective learning.

In Engeström's model this problem is to a large extent avoided, as it assumes that learning is from the start related to a change in social practice. This also means that a "distributed cognition" view is built in to the model. For example, Engeström (1999:401) describes an analysis of a meeting where the various actors drive the different stages in the process. A team coordinator starts the meeting by proposing a model of the problem, which leads another team member to questioning, followed by a third member propose an analysis of the situation, etc. In contrast to Dewey's model, Engeström's model is not intended to be a model of an individual's learning process; instead, it describes learning in work groups or whole organizations.

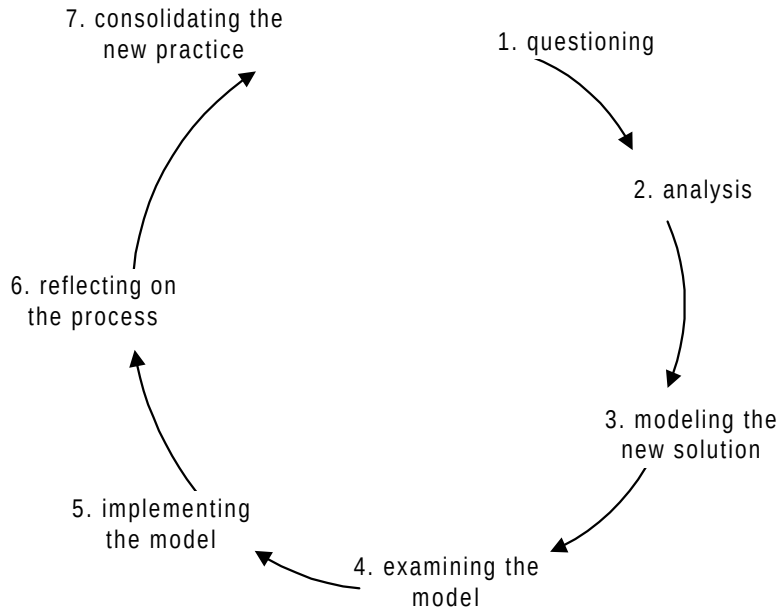

Figure 29. Engeström's learning cycle.

In comparing the models presented above, we can easily see that the model proposed by Argyris and Schön applies the Piagetian model in a rather straightforward way to organizations. Organizations learn just

like individual people. However, the social aspect enters the model of Argyris and Schön through the governing variables. People have theories of the social world, and these theories are constructed through mutual action and socialization. Organizational behavior, however, is based on unarticulated theories of behavior that contradict the espoused theories in a systematical way. Therefore, in most organizations learning is inefficient. It can only be based on detecting errors between produced results and expected results, and if the expectations are not known, learning can not happen. Therefore, if an organization wants to improve its learning capability, it has to articulate those assumptions that underlie its behavior. These assumptions Argyris and Schön call "theory-in-use." Although such a reflection phase is not explicitly shown in their model, it is actually a key aspect of organizational learning in the model.

Kolb's model may be inadequate as a theoretically justified model of learning, but it can be used in a context where the process of "learning" is distributed both in time and among people. However, as there is no solid theoretical foundation for the model, it is an open question whether it is useful to structure organizational learning processes along the lines proposed by Kolb.

Dewey's model, as described by Miettinen, is theoretically a more robust description of the process of learning. It shares, however, with the other cycle models the assumption that there are sequential steps in the learning process. For example, as represented above, Dewey assumes that the definition of a working hypothesis is a separate stage from the inference and thought experiment where this hypothesis is tested. It is, however, possible to assume that there is a constant interplay with the articulation of the working hypothesis and testing it. Moreover, there may be several working hypotheses simultaneously under development, and the selection of one as the basis for experimental action may happen in parallel, depending on the attractiveness of the alternatives. It would also be consistent to expect that, as soon as an experimental action starts to indicate that there is a problem in the working hypothesis, the hypothesis becomes redefined. Indeed, we could say that within the Dewey cycle there is recursion: whenever, any of the phases in the model do not proceed fluently, they become problems on their own, and launch a new cycle of learning. These are the types of action-related thinking which Schön described as "reflection-in-action."

10.3.2 Social learning

Now, we can once again ask who it is that learns? Can there be other subjects in addition to an individual-in-society that learn? Is it possible that organizations learn?

Nonaka and Takeuchi maintain that this is not possible. New knowledge cannot be created by society or an organization, and an individual is the learner:

> In a strict sense, knowledge is created only by individuals… Organizational knowledge creation, therefore, should be understood as a process that 'organizationally' amplifies the knowledge created by individuals and crystallizes it as a part of the knowledge network of the organization. (Nonaka & Takeuchi, 1995:59)

Similarly, Bood (1998:216) asserts that "it is generally accepted that organizations do not learn, only their members do."

Argyris, in contrast, argues that there are both individual and social elements in organizational learning. In his view, individuals are "walking social structures" (Argyris, 1993:36). For Argyris, the main problem in organizational learning is resistance to change and dysfunctionalities that inhibit learning. Argyris and Schön assume that human actors design their actions in a social context, and that they use learned theories of effective action which they bring to bear of any given situation (Argyris & Schön, 1978). According to them, there are two types of theories of action: espoused theories and theories-in-use. Theories-in-use are learned through socialization, and espoused theories are collectively shared (Argyris, 1993).

As was noted above, human learning is inherently social and bound to social practices. Vygotsky's main thesis was that higher mental functions are first acquired on the social plane, and only subsequently they become available for internal operations. Moreover, when they are internalized, their structure and function change.

The individual learner is not a solitary identity, who absorbs and internalizes existing "knowledge" in the learning process. Instead, the individual, as a learner and an identity, is fundamentally constructed through the same social process that makes the individual a member of a community. We are who we are through memberships in such communities. One could say that although we are individual bodies, in some biological sense, our identity is not inside our bodies but exists in the social world. Our intelligence constructs the world around this

identity, and therefore our perception and thinking rest on collective basis. As Leont'ev argued:

> The real foundation of human personality is not in the stored genetic programs, nor in natural inclinations or instincts; nor even in acquired habits, knowledge and skills, including professional ones; instead, it is in that system of activity which these knowledges and skills realize. (Leont'ev, 1978:153)[61]

Human activity is inherently social. When we conceptualize learning, we should therefore be careful in defining the subject that learns. In the conventional view, the subject is the common-sense unit: an individual person who has the capability to acquire knowledge. However, one could claim that "person" is a category error that puts identity—an essentially social construct—at the level of extended material objects, and sees it erroneously as something bound to a biological body. If this is so, we need to reconceptualize the idea of learning as a process of knowledge acquisition, and replace it with a relational view that has a more sophisticated understanding of the social nature of knowledge.

Indeed, we could say that the subject that learns is a human-in-society. As almost all human knowledge, including practical knowledge, is in this domain, almost all learning happens in this phenomenal domain. The main mechanisms for such learning are social participation, and individual and collective concept formation. In the former case, knowledge exists within the culture but is not yet appropriated by the focal human-in-society. For example, there may exist a social practice that is new to a novice who just starts to learn it. In the case of concept formation, knowledge is created in a symbolic domain. Individual concept formation is based on cognitive processes within the human-in-society, and it may be reflective or intuitive. Collective concept formation is based on communicating humans-in-society that together create socially new concepts, which may be reflected in new forms of activity, speech, and artifacts.

As Vygotsky pointed out, thinking is an advanced mental function, which is profoundly transformed as a result of emergence of verbal thinking. Verbal thinking, in turn, is social in it origin. Therefore, we, as languaging and reflecting beings, are individuals whose individuality is largely sociocultural. Indeed, we might ask whether human individuals should be understood as some kind of

[61] The page number refers to the Finnish 1977 translation. The English translation (p.113) uses the term wisdom in place of skill.

concentrations or carriers of social systems, and to what extent their "individuality"—it at all—can be associated with the body that mediates these social-historical influences.

Vygotsky explained the dynamics of social interaction in the development of child using the concept of *zone of proximal development* (Vygotsky, 1978:84-91). This has several interpretations, which Lave and Wenger classify in three categories (Lave & Wenger, 1991). First, the zone of proximal development may be characterized as the distance between problem-solving abilities exhibited by a learner working alone, and that learner's problem-solving abilities when collaborating with more experienced people. This is the so-called "*scaffolding*" interpretation, where a parent or teacher provides support that is necessary for the learner during the initial learning phase, but which becomes unnecessary and can be removed as soon as this phase is over. The second interpretation is a "*cultural*" interpretation. It construes the zone of proximal development as the distance between the cultural knowledge provided by the sociohistorical context and the everyday experience of individuals. In this interpretation the distance between understood knowledge and active knowledge defines the zone of proximal development. The third interpretation views the zone of proximal development in a "*collectivistic*" perspective. In this context, the zone of proximal development is the distance between everyday actions and new forms of social action that can be collectively generated. The first two interpretations, therefore, focus on an individual learner in a social context, whereas the third focuses on collective learning.

Lave and Wenger argue that learning involves the whole person, not only in relation to specific activities, but also in relation to social communities. In their view, learning only partly implies becoming able to be involved in new activities, to perform new tasks, or to master new understandings:

> Activities, tasks, functions, and understandings do not exist in isolation; they are part of broader systems of relations in which they have meaning. These systems of relations arise out of and are reproduced and developed within social communities, which are in part systems of relations among persons. The person is defined by as well as defines these relations…To ignore this aspect of learning is to overlook the fact that learning involves the construction of identities. (Lave & Wenger, 1991:53)

To Lave and Wenger, development of human knowing happens through participation in an ongoing social world. Learning is not

acquisition of knowledge, but increasing participation in a community of practice. Knowledge is not something that can be found in "knowledge domains" of facts and know-how. Instead it is mastership of practice within a community that defines what this mastership means. Learning involves changing membership status in these communities of practice, from entrance as a novice newcomer, to being an expert old-timer, and eventually being replaced by new newcomers. The idea of learning as "internalization" of knowledge therefore is misleading. Knowledge in a community of practice is constantly negotiated in the community, and the identity of a member in the community, the membership status, and "expert" community practices are mutually constitutive.

One way to think learning is as the historical production, transformation, and change of persons (Lave & Wenger, 1991:51). This metanoia, in Senge's (1990) terminology, however, is understood this time in a context of social practice. Identities of persons may be conceived as long-term, living relations between persons, and as reproduced locations and participation in communities of practice. As was noted before, Lave and Wenger introduced the concept of legitimate peripheral participation to explain this process of learning. Legitimate peripheral participators enter the community of practice as newcomers, and through their engagement in community practices learn the skills of masters of this practice. Legitimate peripheral participation refers to both the development of knowledgeable skilled identities and to the reproduction and transformation of communities of practice.

Lave and Wenger introduced the concept of community of practice to describe how apprentices become experts. This process has also been called cognitive apprenticeship (e.g., Collins, Brown, & Newman, 1989; Orr, 1990; Teles, 1993). Cognitive apprenticeship sees learning as enculturation and attempts to promote learning within the nexus of activity, tool, and culture that they together define. Brown, Collins, Duguid (1989) have a Vygotskian emphasis on the role of cognitive tools:

> To explore the idea that concepts are both situated and progressively developed through activity, use should abandon any notion that they are abstract, self-contained entities. Instead, it may be more useful to consider conceptual knowledge as, in some ways, similar to a set of tools…The community and its viewpoint, quite as much as the tool itself, determine how a tool is used. Thus carpenters and cabinet makers use chisels differently. Because tools and the way they are used reflect the particular accumulated insights of communities, it is

not possible to use a tool appropriately without understanding the community or culture in which it is used.

The process of becoming a competent expert within a community may be represented as in Figure 30.

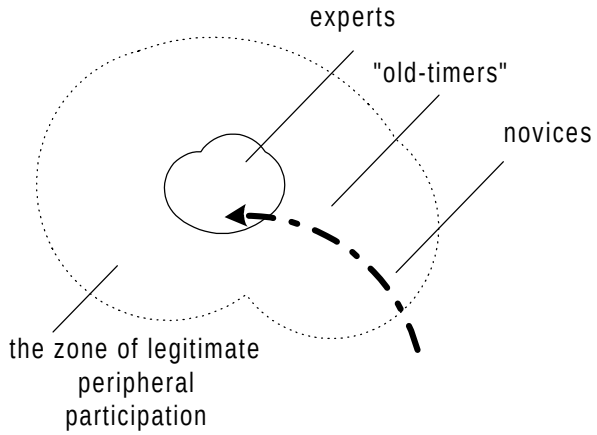

Figure 30. Trajectory of learning in a community of practice.

Engeström (1996) has compared three approaches to learning that share the focus on practice, culture, activity and tools. These include the Davydovian model of learning by formation of theoretical concepts. A child learns, with the teacher's help, to analyze the content of the curricular material and identify a primary general relationship in it. When the child continues the analysis, he or she finds out that this primary relationship is manifested in many different particular relationships in the curricular material, and develops a generalization of the subject under study. As this process goes on, the child eventually is able to develop a "kernel" concept that subsequently serves the child as a general principle that can be used in orienting within the multiplicity of factual curricular material.

Underlying the Davydovian model is the Vygotskian idea that scientific concepts are fundamental in the development of advanced mental functions. Although the Davydovian model may at first look like making children little scientists through acquisition of abstract theories about laws of nature and society, the model actually views teaching—not as a method to put scientific knowledge into the head of

a child—but as a method to help a child to develop advanced mental functions. In this sense, the Davydovian approach tries to make children more intelligent. In contrast to everyday spontaneous concepts, scientific or theoretical concepts are systems that profoundly change thinking:

> Scientific concepts, with their hierarchical system of interrelation, seem to be the medium within which awareness and mastery first develop, to be transferred later to other concepts and other areas of thought. Reflective consciousness comes to the child through the portals of scientific concepts. (Vygotsky, 1986:171)

Although Vygotsky used the term "scientific concepts," more widely they could be seen as theoretical concepts that embody systems of cultural development. This contrasts with the view implicitly adopted in much of school learning where, instead of enculturation, the focus typically is on empirical facts, description, and classification of phenomena (Engeström, 1996:160). In the Davydovian model, the goal of learning is development of thinking, not internalization of facts and theories—which, in any case, would be irrelevant without the capability to process them.

In the Davydovian model, the goal is not the acquisition of knowledge embedded in a textbook. Instead, it aims at reconstruction of an open *context of discovery* through practical actions by the students. In contrast, Lave and Wenger focus on the *context of practical social application*. Engeström comments on the Davydovian and the community of practice models of learning:

> The Davydov solution to the encapsulation of school learning is to create such powerful intellectual tools in instruction that students can take them into the outside world and grasp its complexities with the help of those tools…The legitimate peripheral participation approach would break the encapsulation the other way around, by creating genuine communities of practice within schools or perhaps by partially replacing school learning with participation in such communities of practice outside school. (Engeström, 1996:168)

According to Engeström, these modes of learning can be integrated in a learning model that is based on *learning by expanding*. This requires that the learners have an opportunity to analyze systematically and critically the learning activity itself. This provides *the context of criticism*, and generates a meta-level understanding of the subject under study, including its relations to other communities of practice. Within this view, the object of learning is the relationships between the context of criticism, the context of discovery, and the context of

practical social application (Engeström, 1996:165). In this view, school learning would be integrated in networks of learning that transcend the institutional boundaries of the school in a process of self-organized social transformation.

As was pointed out above, those researchers who have taken the approach of social practice have conceptualized also individual learning as inherently and fundamentally social, even questioning the nature of identity of individuals. For example, Engeström uses the concept of zone of proximal development in analyzing changing work practice. His interventionistic and developmental approach could be characterized as a theory of "generating and negotiating best practices," but in a context where these practices are tightly bound to a system of activity and the underlying communities of people. Engeström emphasizes also the role of collective generation of new behavior:

> Our concept of zone of proximal development may be provisionally defined as the distance between the present everyday actions for the individuals and the historically new form of the societal activity that can be collectively generated as a solution to the inner contradictions embedded in the everyday actions. (Engeström & Engeström, 1985:214)

10.3.3 Sources of learning

In the current literature on learning theory, it has been common to emphasize the role of experience as a source of learning (Miettinen, 1998b). If we combine the views of Bergson, Maturana and Varela and Vygotsky, we can see that there are three possible sources of learning for a living being. First, as a biological unit interacting with its environment, the intelligent being can learn from its interactions with environment. Second, as an intelligent self-referential system, it can learn from itself. Third, as a member in a social community, it can learn from other members of this community. The first alternative was emphasized by behaviorists, the second by cognitive theorists, and the last alternative has been prominent in social learning theories.

A special case of self-referentiality is that of language. Language makes it possible to articulate and intentionally communicate knowledge. This can happen, for example, by training, or by sharing stories about experiences and worldviews. There are, however, also non-linguistic modes of reflective social learning. These include

situations where the learner observes social behaviors and builds models of them, for example, based on his or her beliefs about human behavior. Such self-referential nonverbal changes are changes in the meaning system. The third form of learning in the social domain is simple social coordination, which happens directly, without reflection about the meaning of the activity. Using the terminology of Leont'ev, one could say that in the course of development intentional and reflective acts may transform into automatic operations. For example, a novice jazz musician may reflect on playing a specific harmony, but after some learning, focus on playing well. Yet, this playing well may be a fundamentally social activity.

Similarly, if we focus on individual cognition as a source of learning, *self-referential verbal learning* could be equated with verbal and conceptual thinking, in the Vygotskian sense. In this mode, change is produced by internal operations that change the meaning structure. Internal speech is used as a cognitive tool to control these meaning processes, at the same time guaranteeing that thought can be articulated in a social context. A second mode of internal learning is *imagination*. By this I denote meaning processing which is non-conceptual and which is not based on language. This mode is still self-referential and therefore can be conscious. In contrast to these meaning-processing activities that are intelligent in the sense of Bergson, one can also learn through *intuition*. This is learning that happens—at least partly—outside the self-referential meaning processing system. Indeed, according to Bergson, only intuition can create true novelty, as the function of intelligence is to find regularity and repeatability. It should, however, be noted that within the social domain also intelligence may be creative, for example, in creating new language and concepts. However, intuition remains the function by which human cognition is able to transcend the world of intelligence, and which plays an important part in feeding intelligence with insights that eventually may become central components in the meaning system.

As a living cognitive body, a human being can also learn by its interactions with the environment. When experience is articulated at the level of languaging, new spontaneous concepts are formed. Such spontaneous concepts that are triggered by environmental interactions may be called *spontaneous empirical concepts*. In the generation of spontaneous empirical concepts, the changes in the meaning system are

triggered by the environment. Empirical spontaneous concepts, therefore, relate to perception.[62]

Environment can also be a source of learning in providing feedback on our behavior. When we put the world into a "test" and observe its results, this can happen on nonverbal level. However, if such a test is intentional comparison of our mental models of the world with the world itself, it is experiental meaning processing, where we, as cognitive individuals, reflect against the world using reflection-in-action. This can happen on two levels. In Piaget's terms, we can assimilate or accommodate our models. When the change occurs without cognitive reflection, this mode of learning may be called *skill acquisition*. This refers to activities such as motor skills, for example, driving a bicycle. In contrast to tacit socialization, where behavior happens in the social domain, in skill acquisition behavior happens in interaction with the non-social world. It should be noted, however, that in both cases fully developed humans infuse the world with the social dimension. So, for example, driving a bicycle could also be seen inherently social—as driving a socially constructed "bicycle" that is intended to be a tool and product in a world full of roads. It may, indeed, be difficult to dig through all the layers of human development to find pure non-referential learning.

If we combine the Bergsonian and Vygotskian views, we could say that there is no intelligent behavior left in fully developed humans that would be purely non-referential, and that only direct intuition could qualify for non-referential cognition. Therefore, the division of self and environment is not a very useful in the case of intuitive learning. Intuition was after all, according to Bergson, dependent on some kind of fusion and sympathy between the environment and the living cognitive being. Outside the system of self-referential meaning processing the difference between self and environment more or less disappears.

These different modes of learning are summarized in Table 11. It should be noted, however, that the unit of analysis assumed in the table is a cognitive individual-in-society. The modes of learning also refer only to ontogenic change.

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[62] As in all living phenomena, such characterizations should be understood to be only simplified sketches. There is no logically complete list of attributes that would put the sources of change into the "environment" or to the "self." However, in practical cases there are internal processes, such as thinking and dreaming, which are, of course, eventually connected to external triggers, but where the actual processing is predominantly internal.

Source of behavioral change	**Environment**	**Society**	**Self**
Language (mode: verbal)	generation of spontaneous empirical concepts	training, generation of scientific concepts, participation in thought communities	conceptual thinking
Meaning processing (mode: non-linguistic self-referential)	experience, empirical experiment	reflective socialization	imagination
Body (mode: non-referential)	habit formation, skill acquisition	tacit socialization	intuition

Table 11. Modes, sources and processes of ontogenic learning.

Within the Vygotskian framework, we could say that those authors who claim that learning or knowledge creation happens only on individual level pay too little attention to the social nature of the isolated individuals. In other words, they replace an individual-in-society with an individual, and try to understand learning based on this unit of analysis. Most authors share this individualistic view on organizational learning. On the other hand, within the Luhmannian framework we could say that those authors who explicitly discuss learning on the organizational level typically miss the cognitive microstructure and meaning processing underlying knowledge creation and concept formation. Therefore, we need to develop a multi-level theory that is able to discuss all the relevant units of analysis in learning processes, without losing the connections between these. I will do this below. First, however, I shall discuss an influential knowledge creation model that has been proposed by Ikujiro Nonaka and Hirotaka Takeuchi. This model currently represent the state-of-the-art within the knowledge management literature. Therefore, it is instructive to see how the theoretical concepts developed above can be used to analyze this model.

10.4 The Nonaka-Takeuchi knowledge creation model

A major contribution to the theory and practice of knowledge management has been provided by Ikujiro Nonaka. Indeed, much of the recent interest in knowledge management can be traced back to Nonaka's earlier work (1988; 1991; 1994), and to the landmark exposition of the subject by Nonaka and Takeuchi (1995). It is therefore interesting and illustrative to use the constructs developed above to discuss the knowledge creation model described by Nonaka and Takeuchi. In contrast to many earlier discussions on organizational knowledge or innovation, their model is dynamic, addressing the question on how knowledge emerges in organizations in the first place, and how it is transformed into concepts, models, artifacts, and structures that change organizational behavior. Their model is also interesting because it tries to explicate the various units of analysis that interact in organizational knowledge creation. In this section, I shall show that the constructs proposed above cover the phenomena discussed by Nonaka and Takeuchi, and that—using the theory developed above—we can point some areas where the Nonaka-Takeuchi model may be extended. I shall argue, however, that there are some important aspects of knowledge generation that do not become visible within the Nonaka-Takeuchi model. Most important, the constructs developed above lead to different practical recommendations for organizing and managing knowledge creation within actual organizations.

Following Polanyi, Nonaka and Takeuchi base their model on dynamic interaction between two types of knowledge. *Tacit* knowledge, according to Nonaka and Takeuchi, is personal, context-specific, and therefore hard to formalize and communicate. *Explicit* knowledge, in contrast, refers to knowledge that is transmittable in formal, systematic language (Nonaka & Takeuchi, 1995:59). According to Nonaka and Takeuchi, tacit knowledge includes cognitive and technical elements. The cognitive elements include mental models, such as schemata, paradigms, perspectives, beliefs, and viewpoints, and they help individuals to perceive and define their world. The technical elements, on the other hand, include concrete know-how, crafts, and skills.

The central idea in Nonaka-Takeuchi model is that new knowledge is created in articulation of tacit mental models, in a kind of

"mobilization process" (1995:60). In this process, tacit knowledge is converted into explicit form. Although new knowledge is, strictly speaking, created only by individuals according to Nonaka and Takeuchi, knowledge creation does not happen within a single individual:

> Our dynamic model of knowledge creation is anchored to a critical assumption that human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge…It should be noted that this conversion is a "social" process *between* individuals and not confined *within* an individual. (1995:61)

The transformation of knowledge between different forms is a bi-directional process. Tacit knowledge becomes explicit, but explicit knowledge also becomes tacit. Corresponding to the four possible types of knowledge conversion, there are four conversion modes. Tacit knowledge transforms to tacit knowledge through *socialization*; tacit knowledge transforms to explicit knowledge through *externalization*; explicit knowledge is converted to explicit knowledge through *combination*; and explicit knowledge transforms to tacit knowledge through *internalization*. Nonaka refers to this knowledge creation model as the SECI model (Nonaka & Konno, 1998). Innovative learning and knowledge creation is in this model understood as conversion of tacit knowledge into explicit forms where it can be combined, followed by an internalization process where this new combined knowledge becomes a part of the learner's knowledge structure. This model is shown in Figure 31.

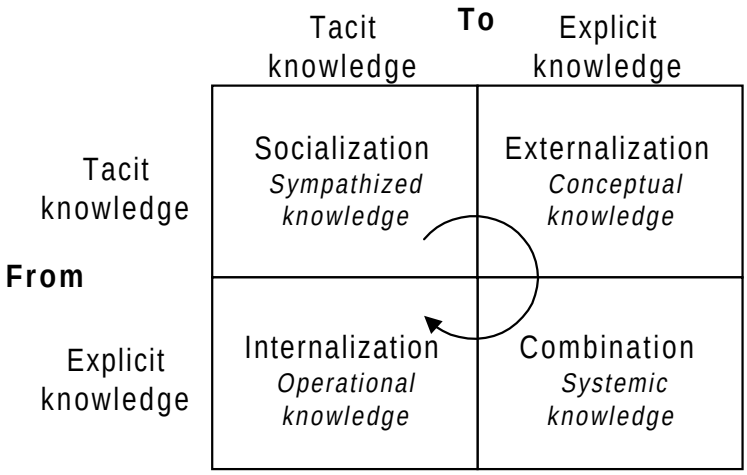

Figure 31. Nonaka-Takeuchi learning cycle.

According to Nonaka and Takeuchi, an individual can acquire tacit knowledge directly from others without using language (1995:62). This socialization process happens through observation, imitation, practice, and shared experience. Externalization, on the other hand, is a process of articulating tacit knowledge into explicit concepts. In that process, tacit knowledge takes the shape of metaphors, analogies, concepts, hypotheses, and models. These we—more or less successfully—try to express using language. Among the various forms of knowledge conversion, "externalization holds the key to knowledge creation, because it creates new, explicit concepts from tacit knowledge" (1995:66). The third mode of knowledge conversion, combination, is the process of systemizing concepts into a knowledge system, and it integrates different bodies of explicit knowledge. This includes such activities as sorting, adding, and categorizing explicit knowledge. According to Nonaka and Takeuchi, knowledge creation carried out in formal education and training at schools usually takes this form (1995:67). In business contexts, one of the main roles of middle management is to create new concepts through combining various sources of organizational knowledge (Nonaka, 1988). Internalization, the fourth conversion mode, is a process of embodying explicit knowledge into tacit knowledge. Experiences through socialization, externalization, and combination are "internalized into

individual's tacit knowledge bases in the form of shared mental models or technical know-how," and therefore become valuable assets (1995:69).

Organizational knowledge creation is a continuous process where the different modes of knowledge conversion interact. Nonaka and Takeuchi describe this dynamic process as a knowledge spiral. In this spiral of knowledge creation, the socialization mode starts with building a "field" or "space" of social interaction (Nonaka & Takeuchi, 1995:70; Nonaka & Konno, 1998). After such a social interaction field exists, externalization is triggered by meaningful dialogue that sustains collective reflection. As a result, the combination mode is triggered by networking and integrating the newly created knowledge with existing stocks of explicit knowledge. Finally, "learning by doing" triggers internalization. The different phases of knowledge conversion lead to different knowledge contents:

> Socialization yields what can be called "sympathized knowledge," such as shared mental models and technical skills…Externalization outputs "conceptual knowledge"…Combination gives rise to "systemic knowledge"…Internalization produces "operational knowledge"…" (1995:71)

Based on these considerations, Nonaka and Takeuchi propose a five-phase model of the organizational knowledge creation process. The first phase consists of *sharing tacit knowledge* within the organizations. The "rich and untapped knowledge that resides in individuals must first be amplified within the organization" (1995:84). In the second phase, tacit knowledge that is shared, for example, by a team within an organization, must be made *explicit*. In the third phase, this explicit knowledge must be *justified*, so that the rest of the organization can determine if the new concept is worthy of pursuit. If the organization gives a "go-ahead" for the new concept, it then has to be converted into an *archetype*, for example, a prototype or an operating mechanism. The last phase extends the knowledge created across the organization. Such *cross-leveling of knowledge* may involve also outside constituent such as customers, distributors, sub-contractors, and other stakeholders.

10.4.1 Analysis of the Nonaka-Takeuchi model

When we consider the Nonaka-Takeuchi model within the theoretical framework developed in the previous chapters, it seems to be

congruent with major points made above. For example, Nonaka and Takeuchi strongly emphasize the social nature of knowledge processes, and point out that much of knowledge is tacit. In contrast to large bodies of epistemological, organizational, and information systems literature, their model is dynamic and non-representational to the extent that has been uncommon in the "traditional Western epistemology."[63] However, the conceptual framework we have been developing allows us to constructively criticize the Nonaka-Takeuchi model, and point out areas where it can be clarified and improved.

As Nonaka and Takeuchi start with the primary distinction between tacit and explicit knowledge, it is interesting to note the different ways Polanyi and Nonaka and Takeuchi use this distinction (c.f. Tuomi, 1999a). For Polanyi, tacit knowledge is a precondition for meaningful focal knowledge, and there can be no explicit knowledge without subsidiary, marginal, and tacit meaning structure that underlies focal knowledge. It is therefore impossible to separate two different "stocks" of knowledge, one tacit, another focal. Instead, the tacit stock of knowledge is the background from which the knower attends to the focal knowledge.

Using Polanyi's concept of tacitness, therefore, knowledge at the individual level is not converted into a separate set of explicit individual level knowledge. Instead, the structure of meaning changes so that some parts of it become focal in relation to "the rest" which provides the periphery and the background to the focal knowledge.

At the social level, essentially the same process happens when individual tacit knowledge becomes collectively shared tacit knowledge. In this "socialization" process the tacit background is provided by socially shared meaning structure, built through a social and cultural process that is internalized by the members of the society during their cognitive and social development.

In contrast to Polanyi, Nonaka and Takeuchi use the tacit-explicit distinction to differentiate unarticulated and articulated stocks of knowledge. Nonaka and Takeuchi also often equate articulation with

[63] This is the formulation Nonaka and Takeuchi use. By now, of course, it should be clear that, more accurately, traditional Western epistemology comprises also various phenomenological and constructivistic traditions, although they are not as broadly known as the "mainstream" positivistic, empiricistic and rationalistic Western traditions. Nonaka and Takeuchi refer to such well known Western phenomenologists as Husserl, Heidegger, James, Wittgenstein, Sartre, and Merleau-Ponty. However, references to their work are cursory, and their main contributions are not explicitly utilized.

verbalization or creation of explicit concepts (e.g. 1995:64). Therefore, their knowledge conversion model could better be understood using the Vygotskian approach, which specifically addresses those cognitive and social processes that underlie the emergence of symbols, concepts, language and conceptual systems. Indeed, the Vygotskian model of conceptual development that was presented before can be used to understand what actually happens when new concepts and conceptual systems are created.

In contrast to Vygotsky and Leont'ev, who extensively discuss the simultaneous emergence of language, inter-personal conceptual worlds, and higher cognitive functions, the SECI model takes language and culture as given. Therefore, it may be difficult to use the model to understand knowledge creation in multi-cultural organizations, or, more generally, in organizations where several communities of practice exist. It is possible to argue that the knowledge conversion cycle spirals within a community of practice; however, it is not clear what happens when the spiral hits the boundaries of meaning creation space. If language fundamentally exists within a community or practice, there is a major barrier to overcome when knowledge moves outside a community. Indeed, it seems that a more theoretically robust view would be that knowledge does not flow through the community barriers, but that there is a translation process going on between the communities. The problem of diffusion or "cross-leveling" of organizational knowledge then becomes the problem of adaptation of knowledge and a problem of integrating knowledge produced in one community within the practices of another community. Moreover, as there is no model of social activity within the SECI model, the motives for knowledge creation, and their relations to individual or organizational needs, remain obscure. Why some knowledge is created, and why some knowledge is not, remains an open question.

On a closer look, it is also difficult to see how the conversion modes of knowledge combination and explication differ. In some special cases, the meaning of explicit knowledge may be so fixed that various sources of explicit knowledge can be mechanically combined to produce new knowledge. This could happen, for example, when several databases are used to create reports that combine data. In cognitive meaning processing, however, explicit knowledge seems to be combined to explicit knowledge through a similar articulation process that underlies explication in the SECI model. Explication in the model seems to mean both generation of concepts, and organization of meaning structure as focal models, images, and

prototypes. Combination, in turn, seems to equal merging the created concepts into a pre-existing conceptual system, and metal-level processing of created focal knowledge by sorting, clustering, and categorizing it. According to previous discussion, however, we could say that new concepts emerge against an existing meaning structure, which includes the tacit background of already available conceptual structure. New concepts are not created in isolation and then put into the right place in the conceptual structure. Instead, they are meaningful solutions to problems that emerge as results to challenges posed by the social and physical environment. One could say that concepts are created to fill—or cover—holes that have become perceptible in the meaning structure.

Explication is possible only against a background of tacit knowledge (Tuomi, 1999a). Combination of already articulated knowledge into new articulated forms doesn't seem to fundamentally differ from explication in this sense. In explication, all available articulated and tacit knowledge is used to find a satisfying crystallization of meaning. In combination, a similar process of sensemaking and synthesizing is going on, relying on all available means to find appropriate and useful ways to reorganize meaning. In Vygotsky's terms there is continuous interaction between generalization and abstraction. Only if we assume that combination consists of putting together some "meaningless" pieces of information and data, the tacit preconditions of this conversion process can be neglected. Indeed, a better way of looking at the situation is to realize that the "meaningless" bits of data exist only because all their meaning is converted into tacit form, leaving explicit only some meaningless residues that can be manipulated as independent knowledge objects (Tuomi, 1999a).

If we use Vygotsky's theory of concept formation, we could say that there are two interrelated processes that underlie conceptual articulation. First, there is the development of generalization and combination that leads to collections, chain complexes, and pseudo-complexes. Second, there is the parallel development of abstraction that leads to the distinction of patterns, similarities, features, and conceptual features. Both require simultaneous and dynamic interaction between articulation and combination. Nonaka and Takeuchi propose, however, that combination is the process of systemizing concepts into a knowledge system. This is the Vygotskian process of spontaneous concept generation. Therefore, from the cognitive point of view, explication and combination are not two

different conversion processes or two different modes of knowledge creation that follow one another. Instead, explication and combination should be viewed as articulation that happens through simultaneous development of abstraction and generalization.

Although Nonaka and Takeuchi point out that combination creates conceptual systems, their examples include activities such as sorting, adding, and categorizing explicit knowledge. Here they imply that knowledge has become an object, and that it needs to be put into context after it is created. These activities are certainly important parts of sensemaking, especially when there already exists taxonomies and ontologies that provide the basis for sorting and categorization of explicit knowledge products. When we consider more widely the effects of knowledge creation as generation of competence and constraint, the development of conceptual systems should, however, be interpreted more broadly.

Knowledge that is articulated can become information for someone who tries to make sense of it. In this sensemaking process, information products can be used and "combined" to help in creating knowledge. For the sensemaker, this combination, however, equals articulation. It doesn't happen through simply putting together pieces of explicated knowledge, and synthesizing new knowledge based on such explicated knowledge products; instead, it is a process of using a large body of tacit knowledge, against which the explicated knowledge products make sense.

One could also similarly analyze the mode of internalization and argue that, from a cognitive point of view, internalization of conceptual knowledge equals to combining and connecting a new idea within an existing conceptual system. This in turn, is a process where an emerging idea is articulated as an element within an existing conceptual system.

On a more fundamental level, these difficulties emerge because Nonaka and Takeuchi argue that organizational knowledge creation happens in a process where the socialization, explication, combination, and internalization modes follow one another. To some extent, it is a similar cycle model than the other process models described above. However, the model is a spiral because it combines a cycle with an expansive process of knowledge diffusion. If we reject the idea that there are two different types of knowledge that are converted in the knowledge creation process, we may represent the Nonaka-Takeuchi model in a similar way than the previous learning models. Such a representation is shown in Figure 32. This representation makes also

visible the close similarity between Engeström's and Nonaka and Takeuchi's models. However, as Engeström (1999) has pointed out, in the SECI model the initial problem that starts the cycle is implicit. More generally, one can say that the Nonaka-Takeuchi cycle differs from Dewey's an Engeström's cycles as there is no concept of motive, need, or problem integrated in the model. Therefore, also a criterion for success in learning comes from outside the learning process. Learning has been successful if the results are accepted by decision makers and, finally, if there is a profitable product out in the market.

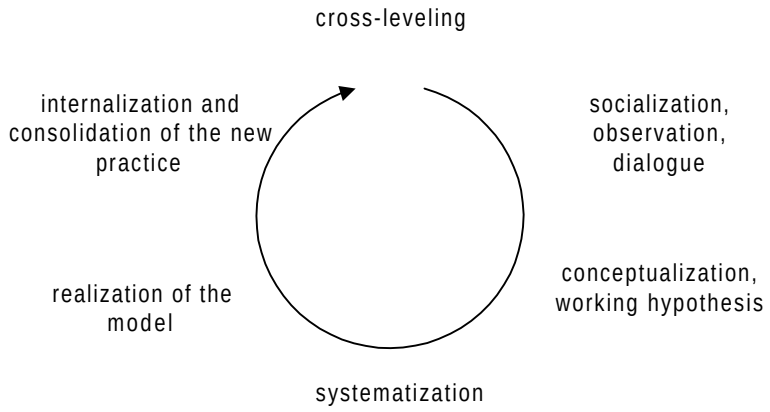

Figure 32. A reconstructed Nonaka-Takeuchi model.

This idea of knowledge "spiraling" from one mode to another, simultaneously connecting individual, team, organizational and inter-organizational knowledge processes, has the side effect that it is difficult to say when the model talks about individual or collective levels of analysis. This, however, could also be seen as one of the strengths of the model. Individual and collective levels come together in the social sphere of interaction, in some kind of collective cognitive space. As was noted before, Nonaka has been calling this domain of interaction *ba*, using the Japanese concept that according to Nonaka and Konno (1998) might best be translated as "space." In this space, the boundaries between individual and collective minds become diffuse, and the knowledge creation spiral can escape to a new level of analysis. However, the processes that create these shared cognitive worlds or ba's have not so far been discussed by Nonaka or his

collaborators. As we noted in discussing organizational knowledge creation units, an obvious choice here would be to apply Luhmann's theory of meaning processing, and combine it with the idea that a community of practice is the fundamental *ba*.

Indeed, Nonaka and Takeuchi simultaneously argue that knowledge is created by individuals, and between individuals. For example, internalization seems to be modeled after the conventional view that "externally" available knowledge needs to be "assimilated" into the cognitive structure of the individual knower to become real knowledge. Similarly, on the organizational level, knowledge needs to be internalized by the individual actors before it can be said to be "organizational" knowledge.

Underlying this explicit to tacit conversion seems to be the idea that knowledge products become knowledge only when their meaning is internalized by an individual. This is the conventional view, manifested, for example, in the idea that learning occurs by giving the learner a textbook and expecting the learner to internalize the knowledge that is "in" it. However, as is was pointed out before, in general such a view on learning is quite misleading. Internalization happens in a context of social practice and, in general, it requires the presence of a social sphere of interaction. Therefore, it is difficult to see how the modes of internalization and socialization actually differ in the Nonaka-Takeuchi model.

It seems that the appropriate distinction between the modes of internalization and socialization in the SECI model is not between tacit and explicit knowledge, but between the use of linguistically articulated knowledge products, such as text books, and knowledge that is embedded in social practice. This idea was discussed before, when we described the different layers of knowledge articulation.

However, even in the case of explicit-tacit conversion, it should be noted that making sense of verbally articulated explicit knowledge requires a lot of tacit knowledge. As Fleck (1979) noted, also textbooks assume a social practice. In many cases internalization could most easily be seen as socialization that happens through appropriation of those stocks of knowledge that underlie a thought community. A textbook may be just an excuse the get the process going. Moreover, it is not clear what components of these externalized social stocks we need to internalize. In general, it is not reasonable to expect that knowledgeable social action requires complete knowledge. Parts of the required knowledge may be internalized by other actors and some

knowledge may be embedded in artifacts. To put it in other words: We don't need to internalize a hammer, to be able to drive a nail.

Within the context of the previous discussion, a problem with the SECI model is that it still lingers somewhere between a social and an individual point of view. Although Nonaka and Takeuchi emphasize that the process of knowledge conversion is "social," their concept of knowledge is still individual and intrapersonal. As their concept of knowledge is intrapersonal, truth becomes a necessary aspect of knowledge, grounding intrapersonal knowledge into interpersonal reality. Despite their attempt to play down the importance of "truth" as a constitutive factor in "knowledge," (1995:58) their conception of individual knowledge makes such objectivity unavoidable.

As was noted before, the interpretation of this "objectivity" depends on the way the reader interprets the concept of truth. The various phenomenological and pragmatic interpretations might enable us to reject the simplistic realistic interpretations of the term. The problem is, however, that Nonaka and Takeuchi do not really explicate their epistemological position. This leads to a number of potential problems.

First, the role of communication in the creation and sharing of knowledge is difficult to discuss within the model. In a more constructivistic and phenomenological epistemology it would be natural to say that in the process of knowledge creation new worlds and realities are jointly created by organizational members. In contrast to Vygotsky's and Luhmann's detailed analyses on the structure of communication and its underlying meaning processing, the SECI model seems to conceptualize explication as a relatively straightforward process of putting tacit knowledge into words. A theory of this explication process, however, requires filling major theoretical gaps. For example, whereas knowledge for Nonaka and Takeuchi is about "meaning," using the Luhmannian framework we could say that communicative meaning is always actively managed as a part of the understanding-information-utterance triad under the conditions of double contingency. Using the Vygotskian framework, we could also say that major parts of this meaning structure are inherited results of our socio-cultural development. Language, and its dynamic is critical for any theory of knowledge creation, but, as was pointed out above, in the SECI model it is taken for granted.

Within the model, tacit knowledge is shared within a collective of people through socialization, but also through internalization of explicit knowledge. Knowledge, in the Nonaka-Takeuchi framework,

can be detached from its collective base and social practice, and different modes of knowledge conversion emerge as a result. These modes assume the existence of a community (socialization), an individual cognition (internalization), either community or individual cognition (explication), or the existence of external representations of knowledge (combination). Those knowledge sharing processes that are "detachable" from the social background complement "socialization," which is the primary mechanism through which tacit knowledge becomes shared. The socialization process, however, is merely a "contamination" of different pools of individual knowledge through copresence of individual actors. Within the knowledge creation spiral, the individual level therefore touches the community level and interacts with it. This, however, happens only in the socialization and externalization phases. The spiral travels through a social sphere, crystallizing into language, and becoming packaged into cognitive artifacts that an individual mind once again can assimilate into its thinking. Instead of being a "spiral" that would connect the various levels of analysis at the end points of each subsequent cycle, the SECI model could more accurately be described as a Moebius strip that ends where it starts—in an individual cognition.

The SECI model should, therefore, be augmented by adding to it one crucial component: that communally shared stock of knowledge that makes socialization, articulation, and externalization possible in the first place. This stock is built-up and replenished through social meaning processing. This process connects humans-in-society and communities through socio-cultural development, and also restricts the possibilities of meaning processing. Some of the new knowledge created is easily connected to existing meaning structure, whereas some knowledge disappears to oblivion without leaving any noticeable trace to the collective memory (Douglas, 1987).

Also intentionality, belief, and commitment associated with the concept of knowledge in the SECI model is understood as an individual stance. According to Nonaka and Takeuchi, knowledge has to be "believed" by the knowing individual. This implies some kind of reflective judgement on the correctness of the committed position. However, belief and commitment can not easily be understood from the individual point of view. For example, if we assume that meaning is processed simply at the individual level of analysis, we could be talking about "misrepresentation of facts" or lying; at the level of individual-in-society we would not consider lying to be untrue representation of matter-of-facts: instead, we would describe the

situation as manipulation of expectations.[64] According to Luhmann, such management of expectations is a precondition for all communication, and more fundamentally, it underlies the shared construction or reality. The social meaning processing view of knowledge would see commitment and "belief" on a lower level, not as an attribute of individual stance or statement, but as fundamentally social, as acceptance between communicators. More broadly, the three improbabilities that according to Luhmann underlie all communication—acceptance, understanding, and accessibility—are viewed as separate steps in the SECI model. For example, justification is introduced as a separate phase in the model, as an early phase in the diffusion of new knowledge. Maybe because of this, the discussion on media that could be used to manage these improbabilities and improve organizational knowledge creation is missing from the SECI model. This is also one of the reasons why the model is not easy to use to discuss knowledge creation when it is mediated by information and communication technologies.

The SECI model, therefore, combines in an interesting way a social view on learning and an individualistic conception of knowledge. In other words, it sees new knowledge as a collectively created novel design or fact, but it doesn't see knowledge in relation to social practice. The process is social, but the result is not. As a result of the individualistic view on knowledge, the SECI model runs into difficulties when we try to understand differences between articulation and appropriation processes. In the following section I propose a model that explicitly addresses these two different modes of learning and knowledge creation. In the Nonaka-Takeuchi model, the foundational unit of analysis is an individual and the process of knowledge creation is essentially what can be called articulation at the level of human-in-society: formation of self-referential models, most of which are "tacit," in the sense of being non-verbal. Therefore learning within the SECI model is conceptualized as individualistic internalization, without explicit social, institutional, or developmental foundation. This view on learning as "assimilation of knowledge" has difficulties in seeing knowledge fundamentally integrated with practices, which are social (Engeström, 1996; Hatano, 1993). Within

[64] This confusion, of course, underlies much philosophical discussion. If we would follow the lead given by Bergson, and construe knowledge on the basis of intelligent action, the liar of Zeno would not be an epistemological problem; instead he would be a social problem.

the model presented in the next section, on contrary, learning is naturally seen as development of skill within an environment of social systems of activity and practice.

It seems that if we conceptualize organizational knowledge creation units in the way that was proposed before, as almost autopoietic thought communities and systems of activity, also the ontological dimension in the SECI model needs to be reconsidered. Nonaka and Takeuchi define the ontological dimension of knowledge creation using the traditional organizational units of analysis. According to the model, knowledge spirals across the individual, group, organization, and inter-organizational levels. In contrast to the previous discussion, which proposed that we need to focus on the unbounded constructs of human-in-society, thought community, and society, and view an organization as a special type of community of communities, Nonaka and Takeuchi's main focus is on individual and team. One could argue—as I did—that these units are not the focal units of knowledge creation. For example, we can not understand interpersonal knowledge creation by looking teams, without considering the connections such teams have with various communities of practice, and society, in general. Therefore, only if we understand teams as special implementations of artificial communities of practice, we can talk about knowledge management in teams. Otherwise, combining the constructs of knowledge and teams would be a category error.

Based on the classification of the types of knowledge presented at the end of Part II, we could also refine the construct of tacit knowledge. Indeed, we should make a distinction between the structural and cognitive forms of tacit knowledge, and also—within the ontogenic self-referential knowledge—between verbal and non-verbal knowledge.

In contrast to Polanyi, who distinguished tacit knowledge as peripheral background or meaning context that is required for explicit knowledge to stand out, Nonaka and Takeuchi contrast tacit knowledge with articulated knowledge. This reading of Polanyi is, of course, possible and it has been typical in the artificial intelligence literature that often associates tacit with procedural and explicit with explicitly represented declarative knowledge. This reading, however, also easily reduces tacit knowledge into procedural skill. Although Polanyi also discussed skills as examples of tacit knowing, his concept of tacitness is broader, and essentially based on a relational conception of knowledge. As was pointed out above, tacit and focal meaning

components are integrated, dynamically interdependent, and not separable as two different sets of meaning and knowledge.

In addition to self-referential ontogenic knowledge, however, there are non-referential forms of sedimented knowledge, e.g., habits. There is also phylogenetic knowledge in the form of instincts. Most important, however, there are organizationally highly relevant "stocks" of knowledge in socio-cultural systems, tacitly embedded, for example, in symbolically generalized language and systems of activity. Within organizations, many of these—from the individual point of view structural—forms of knowledge can be actively managed. Indeed, this could be seen as one of the main reasons why organizations talk about their culture and why they manage language and formal organizational structure.

If we extend Vygotsky's general genetic law of cultural development to situations where adults create new knowledge, we could also say—in contrast to the Nonaka-Takeuchi model—that all knowledge is first created at the social level, and only after it exists, it can become an object of individual reflection.[65] Performance always becomes before the awareness of it. This, actually, provides an alternative motivation for the collaborative view on knowledge creation emphasized by Nonaka and Takeuchi. If new knowledge exists first at the interpersonal level, its articulation should be easier as a joint effort at that level. This contrasts with much of the knowledge management literature that sees a major problem in managing the subsequent steps of generating, harvesting, sharing, and using knowledge. Only if we assume that knowledge is a "truth" uncovered by an individual through observation, the problem of articulation becomes that of converting individually generated tacit knowledge into an explicit form that can subsequently be shared. In the view we have been developing above, in contrast, collective activity is where almost all knowledge creation starts. Intentional harvesting and sharing of knowledge exist, and can be facilitated in an organization. If, however, we think that knowledge can be explicated, packaged, and used

[65] This is so at least when we consider social knowledge. As was noted before, Polanyi includes perception as one form of "knowing" and on that level, of course, there are also non-social forms of knowledge. However, at the organizational level all knowledge is social. As Vygotsky pointed out, although the development of advanced forms of knowing may depend on, for example, biological capabilities for perception, these capabilities are transformed irreducibly as a result of individual development. For cognitively developed humans, no "pure" forms of perception remain that would allow us to perceive the "transcendental reality."

without considering the underlying meaning and activity structure that makes focal knowledge meaningful, such knowledge management projects probably run into difficulties both in theory and in practice.

Within the Bergsonian view, intelligence was unable to create knowledge. According to Bergson, intelligence always sees the world as something already known. Therefore, intelligence is only able to repeat what already has been there. In contrast, intuition is that function of cognition that can be in direct contact with world, and therefore it can also access that what is novel in the world. Fully developed, intuition can feed reflective intelligence with impulses that can change it. In the Bergsonian framework, therefore, one could argue that the SECI model should be extended to those knowledge creation processes where non-referential knowledge is converted into self-referential knowledge and integrated within the meaning processing system. Nonaka and Takeuchi's "learning by doing" comprises aspects of such conversion, although they consider learning by doing only as a method of internalization of explicit knowledge.[66] One could, however, wonder why learning by doing is reserved for explicit-to-tacit conversion, as it would also look natural that much of learning by doing occurs as socialization, i.e., tacit-to-tacit conversion, and also as articulation, i.e., tacit-to-explicit conversion. Indeed, one could say that the Nonaka-Takeuchi concept of internalization corresponds to appropriation at the level of human-in-society, and their concept of socialization corresponds to a mixture of articulation at the level of community of practice, and appropriation at the level of human-in-society.

Comparing the concept of "justification" used by Nonaka and Takeuchi with Berger and Luckmann's analysis of legitimation, one can also see that there is more deep structure in the concept than is visible in the SECI model. As Berger and Luckman pointed out, society becomes real only if its members accept and learn institutionalized stocks of knowledge, including the typology of roles

[66] Nonaka and Takeuchi don't explicitly discuss the relation between "learning by doing" and internalization. Instead, they point out that internalization "is closely related to 'learning by doing'" (1995:69). From their examples and discussion, however, one could conclude that learning by doing is the main method for changing declarative knowledge (know-that) to performance (know-how), and to make knowledge visible in action. This, however, also points to the fact that in the Nonaka-Takeuchi view, knowledge is not necessarily bound to action. Their concept of knowledge is fundamentally representational, in contrast to the action-based view that I have been using.

and expertise. This institutionalization is based on legitimation processes. The role of legitimation is to justify the institutional order by giving a normative dignity to its practical imperatives (Berger & Luckmann, 1966:111). But legitimation is not only a matter of "values." Legitimation always implies knowledge. For example, kinship structure may be legitimized and defined by taboos, but an individual must have knowledge of these taboos and structures to be able to position himself or herself in their context (Cohen, 1989). Legitimation, therefore, not only tells the individual why he or she *should* perform one action and not another; it also tells him or her why things are what they *are*.

Berger and Luckmann distinguished four levels of legitimation, which in everyday life overlap. First, as soon as a system of linguistic objectifications of human experience is transmitted, incipient legitimation is present. For example, the vocabulary that is used to describe kinship relations inherently defines a world where these kinship structures are relevant. In this way, fundamental "explanations" that legitimize the world are built into the language (Berger & Luckmann, 1966:112). This corresponds to Luhmann's idea of symbolically generalized meaning that was discussed before.

The second level of legitimation contains rudimentary theoretical propositions. For example, proverbs, moral maxims, wise sayings, legends and folk tales provide legitimation structures that can guide everyday action and cognition.

The third level of legitimation contains explicit theories. Through such theories social institutions get their meaning, as legitimate structures of differentiated bodies of knowledge. For example, there may be an elaborate economic theory of "cousinhood," its rights, obligations and standard operating procedures (Berger & Luckmann, 1966:112).

The fourth level of legitimation brings with it symbolic universes. These are bodies of theoretical tradition that integrate different provinces of meaning and encompass the institutional order in symbolic totality. With the emergence of a symbolic universe, all socially objectivated and subjectively real meanings become the reality where events transpire. Within this world, individuals explain, legitimize and interpret their behavior and make it intelligible for themselves and for other members of the society.

It is only this fourth level of legitimation which Nonaka and Takeuchi refer to with their concept of justification. Therefore, within their model those stocks of knowledge that underlie the lower levels of

legitimation are assumed to be static. However, if we for example talk about organizational renewal, and not only product innovation, creation of knowledge within these stocks becomes highly relevant.

In summary, then, one could say that the basic structure of Nonaka-Takeuchi model has some interesting possibilities for re-interpretation and extension. The concept of knowledge underlying the model is individualistic. Therefore, interactions and interdependencies across levels of analysis are difficult to describe, and organizational units used in the model do not necessarily correspond with those that create knowledge in organizations. The individual mind is assumed to be a static repository of changing knowledge, and there is no way within the model to discuss development of advanced cognitive functions, which are inherently collective. As knowledge is assumed to be essentially objective, there is only limited description of those processes that construct the world and make it sharable. As tacit and explicit forms of knowledge are assumed to be of different type, the dynamical interdependent aspects of stocks of meaning structure can not be discussed within the model. Partly as a result of this division to tacit and explicit knowledge, the various modes of articulation are not easy to discuss, and it is implicitly assumed that prototypical explicit knowledge is verbal. However, the role and restrictions of language and the impact of speech and written text on social or individual level knowledge processing are not discussed. For example, the role of language as a repository of culturally shared meaning remains outside the model. More broadly, the analysis of development and dynamics of social and individual stocks of knowledge, the enabling and constraining role of collective memory, culturally produced cognitive artifacts, and institutionalized signification structures, and the role of culture, in general, remain outside the model. Instead of simply pointing out that organizational knowledge creation depends on cross-leveling of knowledge, we could discuss in more detail the differences between conceptual worlds between organizational communities, diffusion of innovations across such communities, and, for example, the role of boundary objects in this process (Miettinen & Hasu, 1997). For example, when we try to understand knowledge creation in multicultural organizations that use electronic collaboration tools to develop new forms of meaning processing and activity structure, I would argue that we need to augment and extend the Nonaka-Takeuchi model. The next section introduces a model that tries to address these problems.

11 A model for organizational knowledge creation

11.1 The 5-A model of knowledge generation

When we discuss knowledge processes in organizations, it is often difficult to clearly define whether we are talking about essentially organizational level phenomena, or just about individuals within an organizational structure. This is because the units of analysis are usually not well defined, but also because they are inherently interdependent. As I argued before, humans in an organization are not individuals whose intelligence and knowledge processes could be understood without taking into account those collective systems within which they exist. Within a community of practice, for instance, the identity and knowledge of an individual are mutually constructed by the individual social actor and the community. A consistent model of knowledge generation, therefore, has to integrate both individual and social levels of knowledge generation. In other words, the basic constructs for knowledge generation should be "scale invariant."

We defined intelligence dynamically as the capability to generate knowledge structures. In this process, intelligence produces ontogenic knowledge.[67] This process can be triggered by environment, by society, or by the unit itself. More specifically, we can distinguish three modes of knowledge generation. I will call these *articulation*, *appropriation* and *anticipation*. We may have a model of a world, which suddenly breaks down and surprises us. This tension between our anticipation and observed world may produce new knowledge. Knowledge can also be produced by appropriating knowledge that exists in the society. For example, systems of "scientific concepts" and language can be learned by acquiring them in a joint effort by the learner and a more competent tutor. Knowledge can also be generated by articulating and reconfiguring meaning relationships within the meaning system available for an individual. These processes are depicted in Figure 33.

[67] To be exact, and as was pointed out above, there are two forms of intelligence, and corresponding forms of knowledge: instinct, which develops phylogenetically across generations; and self-referential intelligence, which produces ontogenic structural change, for example, motoric habits and changes in the meaning structures. Living beings, of course, do not have different "faculties" of intelligence corresponding to these forms; instead, intelligence integrates these forms in its ongoing process.

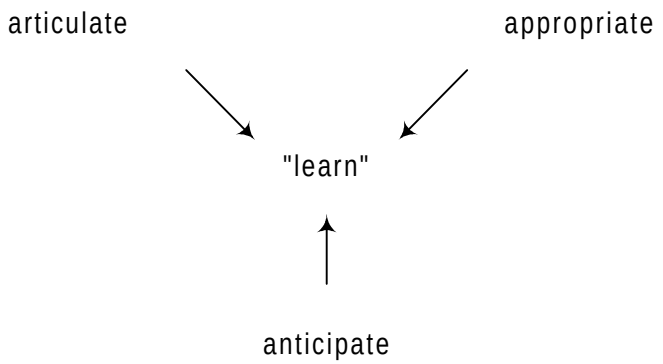

Figure 33. Three sources of ontogenic knowledge.

If we consider the relations between intelligence, knowledge, competence, and action, using the constructs shown in Figure 33, we can see that articulation, appropriation and anticipation are the processes that underlie the change in knowledge structures, and that this change is produced by intelligence. These dynamic processes transpire within a context of accumulated meaning structure and knowledge. Learning is always incremental, and possible only if there is memory.[68] Therefore we need to add to the Figure 33 the process of *accumulation*. As our definitions of intelligence, knowledge and cognition were based on the concept of effective action, we should also add to Figure 33 this process which grounds the rest of our constructs. The resulting model of knowledge processes is shown in Figure 34. I shall call it the "5-A model" of knowledge generation, for short.

Articulation and anticipation generate knowledge that can be new to the society. Appropriation, in contrast, generates knowledge that is available within the society but which is new for the focal learner. For example, a child learns language by appropriating linguistic

[68] Although learning in itself is necessarily and incremental process as a result of its accumulative character, its manifestations can be radical. When some central nodes in the meaning structure become reorganized, many meaning relations change. This can be seen as accommodative learning in Piaget's terms, or double-loop learning in the terms of Argyris and Schön.

knowledge, and clusters of meaning packaged into concepts. After becoming a proficient language user, he or she may also articulate new linguistic structures or concepts, thereby creating new language for others to appropriate.

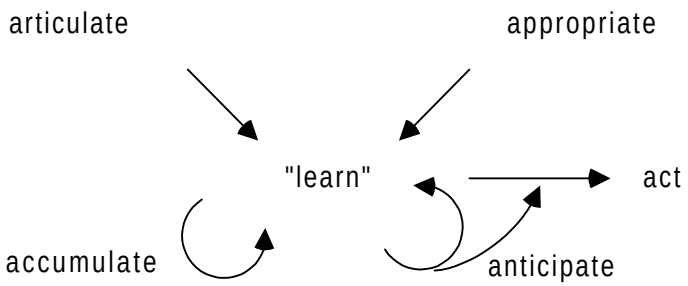

Figure 34. The "5-A model" of knowledge generation.

The generic model shown in Figure 34 can be further refined by considering its manifestations within the different units of analysis. I shall do this in the next section.

When we compare the model with theory developed in the previous chapters, we can see some internal structure in it. For example, articulation involves a simultaneous operation of generalization and abstraction. As Vygotsky (1986:135) pointed out, the formation of concepts requires that one organizes discrete elements of experience into groups that provide the basis for generalizations. At the same time, however, fully formed conceptual thinking requires that some aspects of the experience are singled out, abstracted, and viewed apart from the totality of the concrete experience in which they are embedded. Conceptual articulation, however, is only one possible form of articulation. Previously we defined a non-verbal mode of meaning creation that we called imagination, and which should be included in the model. On the other hand, as Polanyi noted, articulation requires that some meaning is attended as focal, at the same time leaving some other meaning relations subsidiary and peripheral. Underlying the

articulation process, there is a constant and dynamic tension between the focal and subsidiary components of meaning. As a result of these processes, some subsidiary meaning emerges as focal, and tacit components of knowledge become explicitly articulated.

Appropriation happens in the same way as articulation, using the same meaning processing capabilities of the learner. However, the process of appropriation may happen through unintended socialization, or through sharing of meaning structure using communication. In both cases, the learner is able to move within the zone of proximal development. In appropriation, however, it is also possible that the movement within the zone of proximal development is facilitated by a more competent individual. Both articulation and appropriation can use other individuals as cognitive tools thereby making the process distributed. For example, it is possible that the presence of another person brings a new perspective, enabling the learner to apply meta-level strategies that help in the learning process. In articulation, the "scaffolding" process is, however, different from the one discussed by Vygotsky: the person who tries to articulate something sets up other actors as his or her scaffolds to get the articulation done. For Vygotsky, scaffolds were always put in place by a competent adult helping a child to learn. In articulation, the process of scaffolding is similar to one where a young artist would ask her parent to hold a scaffold so that she can put a canvas in place for painting.

Acts in Figure 34 can mean both internal and external action. Internal action corresponds to reflective thought. External action comprises two integrated kinds of behavior: communication and production. All action has both communicative and productive aspects. The first is related to the meaning of action, the latter to its transformative function. It is assumed that all action emerges in the context of activity.[69] Therefore all action has meaning within the social context, and action, in itself, always implicitly coordinates social behavior. All action also produces change as a transformation of some aspects of the world. In some cases, of course, production itself may be communication.

Accumulation and memory underlie all meaning processing. In some cases, accumulation is based on physiological change in the

[69] We are therefore here talking about actions that rely on "advanced mental functions" in Vygotsky's sense, i.e., actions that are irreducibly social and knowledge-based. The argument is that, for well developed thinkers and learners, no action remains that would be independent of socio-cultural inheritance. For a young child, the situation may be different.

cognitive system. It can also happen through change in meaning relations. In some cases such change can be "purely" cognitive, in the sense of being a change in the state and configuration of self-referential meaning relations. This type of accumulation we have, for example, when a cluster of meanings is crystallized into a concept. In other cases, accumulation may happen by utilizing external cognitive tools and auxiliaries. In addition to serving as mediated means to augment meaning processing, these external artifacts may also be used to organize social practice.

A more detailed picture of the knowledge generation process could then be represented as in Figure 35.

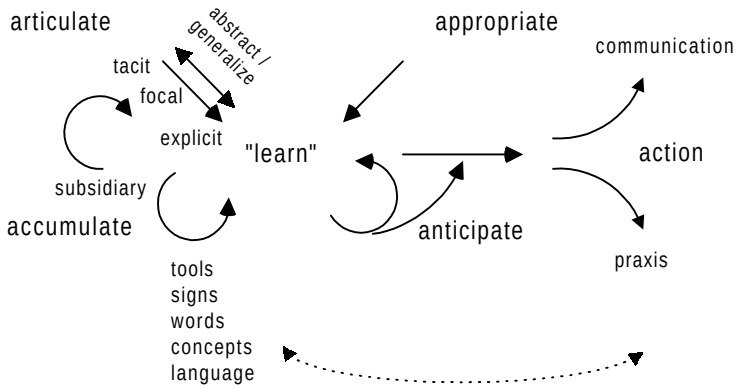

Figure 35. Detail structure of the 5-A model.

Even in those cases where knowledge is not articulated in language, knowledge is expressed in acts that, in themselves, can be viewed as articulations and which lead to artifacts that also articulate and embed knowledge. In addition to being written down, knowledge emerges as plans, anecdotes, language, habits, models, practices, and institutions that guide action. If action can be viewed as the fundamental constitutive dimension underlying intelligence, articulation can be called the constitutive dimension for knowledge generation.

Articulation underlies anticipation as the basis for explorative action and generation of plans. Appropriation of knowledge happens

through acquisition of externally generated knowledge that is articulated in communication, tools or action. Most important, accumulation of knowledge requires concept formation, combination of knowledge, and for example, explication of knowledge in language. Although accumulation does not necessarily require representation, when knowledge is represented, meaning processing can use such representations to develop qualitatively new forms of advanced thinking. Representation also enables symbolic communication and collective meaning processing, either through sharing meaning references, or by sharing knowledge artifacts. As a result, knowledge about knowledge becomes possible.

In the accumulation of knowledge, meaning processing produces artifacts which can become objects of organizational action. These can be viewed as cognitive tools, in the sense of Vygotsky, by which some meaning processing is off-loaded to the environment. Commonly distinguished articulation processes include abstraction, categorization, combination, explication, refining, visualization, and reflection. However, all these can be described as a simultaneous process of abstraction and generalization, combined with the process of imagination that underlies non-conceptual articulation. Knowledge structures are articulated as concepts, tools, metaphors, images, models, and stories. These in turn, accumulate as practices, languages, designs, integrated histories, and organizational culture, for example. Finally, when written forms of language become available, some of these accumulated knowledge structures may be represented as documents.

Documents, therefore, should be viewed as attempts to articulate some aspects of underlying accumulated stocks of knowledge in written linguistic form. Cognitively, document creation is a very demanding activity that assumes both large bodies of accumulated knowledge and skilled use of those stocks. In most cases, textual representations are only minor parts of the full underlying knowledge structures, and their interpretation always requires knowledge about culture, practices, and language specific to the focal organization and the community of practice.

11.2 Knowledge production at the various levels of analysis

By making the distinction between articulation and appropriation explicit, we were able to link an individual learner to other cognitive meaning processors within the 5-A model. More generally, this structure makes it possible to connect the various levels of analysis in a consistent way.

Within an organization, knowledge processes transpire on three fundamental and irreducible levels: those of human-in-society, community, and community of communities, i.e., a society. Articulation processes at the individual human-in-society level are those processes that create nexes of meaning that can be reflected upon. Such self-referential non-collective processes may be defined as thinking, and—to put it simply—when thinking leads to a new thought we have articulated some meaning. In advanced thought processes thinking is influenced by a system of concepts that has been acquired during the development of the individual and therefore also individual articulation is inherently social. As was noted before, thinking, however, is not only verbal or linguistic. It can also create nexes of meaning as non-verbal mental models and images. An important special case of thinking is, however, within the linguistic sphere: the formation of spontaneous concepts. When the generated nexes of meaning are integrated within the system of language, they become parts of a socioculturally developed system of meaning references. They can, for example, be used in metaphors, analogues, and models. Most important, such verbally articulated nexes of meaning can be communicated using language as they already are integrated within the inter-personal shared meaning structures.

Articulation in a community, in contrast, is based on dialogue and mutual sensemaking. The various individual articulations are fused into collectively formed concepts, which, in turn, are appropriated as community specific dialects. Articulation of knowledge happens at the community level also as formation of artifacts, practices, and tools that are used in these practices. Such tools are always meaningful in relation to the specific community, although often they can also be used in other communities. Within one community, however, a tool is always conceived of as a community specific tool-in-use.

At the next meta-unit level—community of communities, or society—articulation happens through languaging and formation of

social institutions and practices. Social institutions, therefore, could be viewed as articulated structures of social knowledge. The main difference between a simple community and a society is that the latter may comprise several functionally differentiated communities. Social institutions may therefore also be understood as boundary objects that link together several communities. As Giddens pointed out, social structures are continuously reproduced by actors who have knowledge of this social knowledge, and whose activities are both enabled and constrained by social institutions and practices.

Individuals, therefore, do not only appropriate knowledge from other individuals in their communities, but they also appropriate collective social knowledge, for example, knowledge related to collective social activity. One could say that—in addition to being members of communities of practice—individuals are also members of interest groups within a society. More generally, appropriation at the individual level happens through imitation, acquisition of knowledge through language and systems of theoretical concepts, and through development of models about social behavior. Appropriation at the community level happens through utilization of individually generated innovations and interpretations, and through community generated practices, tools-in-use, and dialects. The individual members "feed" the community with their potential contributions, but knowledge that underlies the structures of the society are also appropriated by the community. Each community within a culture relies on existing institutions and it can develop its own dialect only on the basis of the language provided by the culture. Indeed, functionally differentiated communities can not exist without a larger society that they are part of.

At the level of society, appropriation processes have their source in the structural drift of the society, or in appropriation of knowledge created at the individual and community levels. As humans-in-society are already fully integrated within the society as a result of their socialization during childhood, much social "appropriation" is actually collective social "articulation." At the level of society, however, the world outside the society can trigger changes in those structures that constrain its activities and practices, therefore also changing its institutions and language. In practice, such society-wide change probably happens through formation of new communities, or as a paradigm change within an existing community.

Anticipation, in turn, underlies all self-referential intelligent action. Action is directed toward objects that are constructed as objects by intelligence based on their anticipated use and potential for fulfillment

of needs. But as was discussed before, “isolated” actions are always components of meaningful activity. At the individual level, action both connects to the activity defined at the social level, and breaks into a sequence of operations. Therefore an action is bound to previous acts as well as to its anticipated continuation. When the result of action surprises the actor by not leading to its anticipated effect, the difference between an assumed world and an actual world becomes visible. This was Claparède’s law: we become aware of what we are doing in proportion to the difficulty we experience in adapting to a situation. The flow of action guided by tacit knowledge breaks down, and our knowledge becomes explicit.

At the community level, anticipation happens through planning of coordinated action, but also by community “habits,” i.e., routines. Similarly, at the level of society, anticipation consists of social routines. At the social level, in theory at least, anticipation can manifest itself also as self-referential meaning processing. As we don’t know the thoughts of this “collective mind,” however, it is difficult to describe the ways such reflective anticipation happens at the social level. One implementation of such a process might be the political process where various social interest groups negotiate their interests.

Accumulation at the individual level produces what we commonly refer to as memory. It is the complement of anticipation. Both anticipation and memory emerge as capabilities to live in a time-scale that is independent of the behavioral time-scale of the unit in question, and therefore their existence requires a cognitive subsystem, as defined before. We could also say that memory and anticipation mutually construct each other. Memory, as a capability to bring the past to bear on the present, consists of habits, experienced ontogenic history, and accumulated meanings that are used to interpret that history and to impregnate the present with meaning. The system of meanings may be non-verbal “mental models,” or nexes of meaning references in the form of a concept. In general, we could say that individual memory comprises traces of episodes and accumulated abstractions (Tuomi, 1995).

Accumulation at the community level comprises practices, tools, stories, metaphors, paradigms, thought styles, systems of concepts, and dialects. These emerge as articulations of community experience, but also as a result of mutual coordination. Their resistance to change is inherently bound to their collective nature and constant reproduction. In a sense, they are media that are generated in the ongoing activity of a community, inseparable from the praxis of the community. Using

Giddens' terminology, one could say that there is a duality of structure between accumulated community media and its ongoing practice, both constituting each other in mutual interaction.

Accumulation at the level of society happens through cultural production and reproduction. Communities, themselves, could be seen as accumulated products of social differentiation. Societies create culture, with customs, institutions, systems of activity, and language.[70]

At all levels of analysis, communication is the main process underlying social activity. Communication, indeed, is the process that glues the various levels together, which recreates the self-producing social system, and which connects the various levels of analysis. At the individual level, action may also manifest as operations. These operations may be "un-social" behavior that is directed toward the environment that is perceived to be outside the society. Most behavior, however, is essentially social action within a socially meaningful activity. At the community level, such activity manifests itself as practices. At the level of the society, action happens through reproduction of culture and language, and as integration of communities of practice. These different instances of knowledge processes are summarized in Figure 36.

[70] In contrast to the common usage, which often sees cultures as accumulated stocks of cultural achievements, such as artwork, buildings and libraries, I would argue that such "cultural" products are actually generated by underlying communities, not by the society, as a whole. To give a practical example, ancient pyramids could be seen as produced by a community that manages institutions of power. The fact that such construction may require commissioning of several communities of practice within a society simply makes such projects difficult to launch from outside this specific community "in power," without implying that they are produced by the society, as whole. Here, other communities can simply used as tools. Without excessive coercion, however, such utilization of communities requires that the various communities have mutually compatible motive systems.

	Human-in-society	**Community of practice**	**Society**
Articulation	Conceptualization; imagination	Dialogue; development of collective concepts, tools-in-use, practices, dialects	Languaging; production of institutions and practices
Appropriation	Imitation; acquisition of language and systems of theoretical concepts; socialization	Integration of boundary objects; interpretation; adoption of institutions; adoption of language	Structural drift; expansion of community practice
Anticipation	Creation of models; formation of habits	Formation of routines; creation of plans	Formation of routines; legitimation of institutions; negotiation of interests?
Accumulation	Models; habits; history; abstractions	Praxis; tools; stories; metaphors; paradigms; systems of concepts; dialects	Culture; customs; language; institutions
Action	Communication; practical action	Communication; practical action; activity	Communication; reproduction of culture; integration of communities

Figure 36. Knowledge processes at the different levels of analysis.

11.3 Integrating the 5-A model across units of analysis

When we consider organizational knowledge generation as an integrated whole, as a process where knowledge flows in parallel and simultaneously on the various levels where knowledge processors exist within an organization, the communal aspects of knowledge, as well as the role of communication must by taken into account. Communication is the fundamental underlying activity that binds the various units of analysis together.

As was pointed out earlier, the open constructs for units of analysis are inherently integrated across the various phenomenal levels. For example, humans-in-society are always members of communities of practice. However, using the 5-A model we can discuss some of the interactions between the levels of analysis that are essential for organizational knowledge creation. In Figure 37, the processes that integrate the two levels of individual human-in-society and community of practice are depicted.

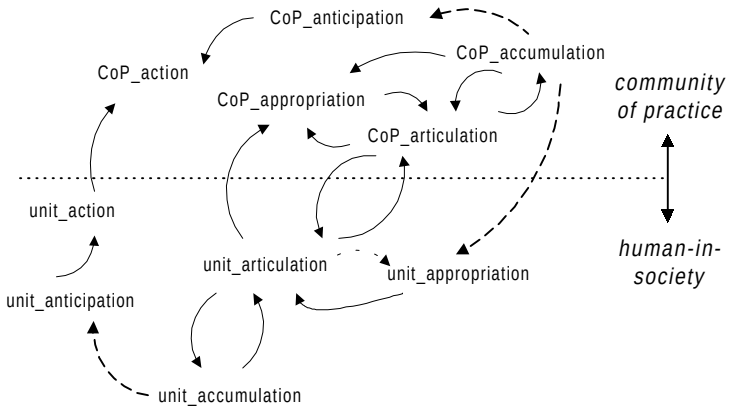

Figure 37. Interactions between individual and community levels.

In Figure 37, articulation is interpreted as the process of integrating new knowledge structures within existing structures. As was noted before, articulation, therefore, is not only "verbalization" of thoughts; instead, knowledge can be articulated as tools or directly as behavior. Articulation is the process of forming ways to proceed intelligently in a given situation. In some cases it may consist of finding good concepts or expressions, whereas in other cases it can simply be manifested, for example, as an effective and skillful way to handle a hammer. Articulation is also always an interactive process within the process of accumulation. Articulation happens in the context of accumulated knowledge, and its results may become a part of that accumulated knowledge.

Figure 37 embeds a claim that an individual human-in-society always appropriates knowledge through articulation. This equals to claiming that appropriation requires sensemaking, and that sensemaking always happens against an accumulated context of tacit meaning relations and explicit knowledge structures. Appropriation, therefore, is a process of "re-interpreting" some extant meaning from the perspective of the learner.

The arrow from community accumulation to unit_appropriation represents the process where an individual appropriates knowledge that has been accumulated within the community. The dotted arrow from unit_articulation to unit_appropriation corresponds to those processes where the individual "externalizes" his or her meaning structures, and subsequently appropriates them. Therefore the dotted arrow from unit_articulation to unit_appropriation in Figure 37 connects the cognitive system with the world outside the cognitive system. Such external representations of individual meaning structures can be understood as Vygotskian cognitive tools.

Anticipation happens within the context provided by the accumulated meaning structure. The fact that there is no direct connection between unit_articulation and unit_anticipation indicates that most of the time anticipation does not require articulation as a separate process. Instead, the anticipated flow of events is directly reflected in the action. When the world behaves according to our expectations we do not need to articulate its behavior or become conscious of it. The expected behavior of the world is inherently embedded into the meaning relations.

The interactions across the levels of analysis occur, for example, as a human-in-society appropriates knowledge that has been articulated within the community, and which has become an element in the

community stock of knowledge. There is, however, also a mutual process of articulation, within which new knowledge is constructed simultaneously within the community and within the individual. Appropriation at the community level always also articulates meaning at the community level. In comparison to the same process at the unit level, we can say that the line between articulation and appropriation does not need to be a dotted one at the community level: in collective appropriation/articulation, meaning is always externalized and distributed within the community. In addition, the community may appropriate knowledge articulated by its units. Finally, the individual's actions become integrated elements of action within the community.

Community knowledge is not simply a sum of knowledge of its units. All individual knowledge is not necessary appropriated by the community, nor it is necessary that individual intelligent action would lead to intelligent community action, as judged using the various stocks of knowledge available within the community. Knowledge may be articulated differently by individuals, anticipations of the individuals may differ, and knowledge accumulated by the community does not equal to the total knowledge available for the individuals of the community. Indeed, as the community action is not simply a sum of unit actions, but irreducible to them, there may exist knowledge that can not be reduced to the knowledge for the lower-level units. An example of such community level knowledge could be a factory layout that facilitates production, or an organization implementation of logistic network that embeds knowledge on effective ways to make and move things to customers. However, as the humans-in-society are coupled to the community through their mutual interactions, humans can reflect on such community level knowledge structures, and, for example, plan and design them.

11.3.1 Cycles of meaning processing within the 5-A model

When we compare Figure 37 with the previously presented models for learning, we can see that there are also cycles within the 5-A model. These, however, are different from the ones proposed by earlier models. Some cycles are relatively micro-level cycles that represent continuous interaction, for example those between accumulation and articulation, or appropriation and articulation. Some cycles occur through mediating processes and connections through higher-level units, for example, the cycle that links community-level accumulated

knowledge to community-level articulation through individual appropriation and articulation. In general, it is obvious that the 5-A model is not as simple as the cycle implied in, for example, Nonaka and Takeuchi's model. Indeed, it reflects the argument made earlier that the different "knowledge conversion modes" can not be separated based on the distinction made between tacit and explicit knowledge. It also illustrates the point made above that in, for example, Dewey's learning cycle, there are recursive cycles that underlie the various steps in the cycle.

If one compares the Nonaka-Takeuchi model with the 5-A model, one can say that the units of analysis separated within the SECI model are not actually separated from the knowledge creation point of view. One can also see that the different phases in the knowledge creation spiral are not tightly linked, and there are gaps in the SECI cycle. This can be seen when the various phases of the SECI model are highlighted in the 5-A model, as is done in Figure 38.

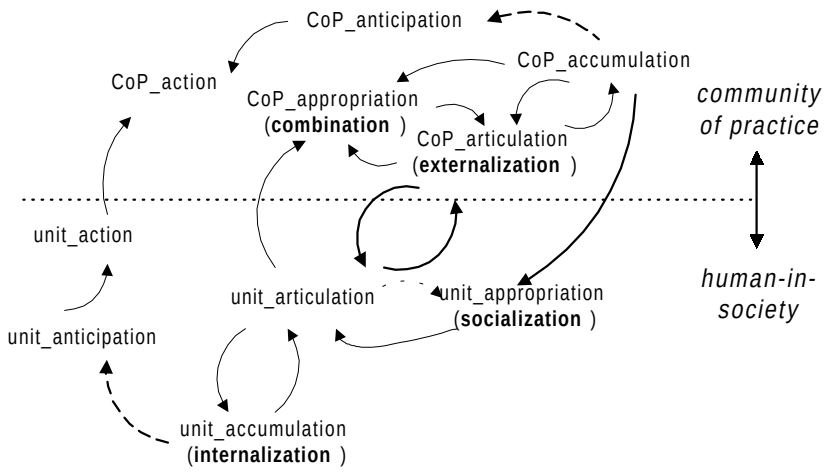

Figure 38. Phases of the SECI model within the 5-A model.

Using the 5-A model we can therefore describe the SECI cycle in more detail. The socialization phase that starts the cycle relates to the process of appropriation at the unit level. As was discussed above, this requires an active process of articulating appropriated knowledge

within the context of accumulated meaning structure. The next step in the SECI model is a collective explication of models and concepts, i.e., the process we called articulation. This also happens against the accumulated stocks of knowledge. The third step in the SECI model is combination, which most clearly relates to the process of community level appropriation. However, the notion that combination creates systemic knowledge indicates that it is also a process of articulating new conceptual knowledge within an existing conceptual system. The relatively mechanistic collection, sorting, and adding processes discussed by Nonaka and Takeuchi do not easily fit the 5-A model as separate meaning processing steps, and one could argue that this is because there is no explicit to explicit conversion, as all explicit knowledge exists only against a context of tacit meaning structure.

When we compare the 5-A model with Dewey's or Engeström's models, we can also see that in the 5-A model learning does not happen as an event that could be separated from the overall activity of intelligence. The 5-A model is not a stage model. In this model learning is a continuous process of meaning creation, and not a separate cognitive activity that has a start and an end. Indeed, the same idea has been implicitly embedded in all cycle models, as they assume that the cycle keeps rotating, or that it actually represents one layer in the spiral of expansion of knowledge.

However, the 5-A model is fundamentally compatible with the Dewey's conception that learning occurs as a result of interruption in routine action. Indeed, the question what happens in the learning and knowledge creation process is a separate one from the question what drives this process. The 5-A model is similar to the SECI model in the sense that they both try to describe what happens when knowledge is created. They do not explicitly model the drivers that launch these processes nor the criteria for successful learning. However, in the 5-A model we use constructs that implicitly incorporate both the criteria for successful learning as well as the drivers for the process. This is explicitly represented by the fact that in Figure 38 there exist two constructs that were invisible in the SECI model: anticipation and action. Learning, as a separate knowledge creation activity starts when a problem emerges that requires conscious meaning processing; successful learning leads to intelligent action, as defined before; and the driver for action is the motive within the activity system. We could therefore say that successful learning has happened when constraints for action or operations have been overcome, and when the way this was done becomes a part of the accumulated stocks of knowledge.

11.4 Knowledge processes at the organizational level

Knowledge is often viewed in itself as a product that is needed to keep organizational processes going. For example, innovations may lead to designs that can be manufactured and sold to customers. Or, production volumes and schedules may be planned, and the results need to be shared with managers of distribution networks, finance, and purchasing. Knowledge sharing via documents is so prevalent in all organizations that sometimes knowledge management is considered to be a new name for document management.

Using the constructs and model developed above, we may now refine the statement that knowledge is the media between organizational stability and organizational change. Knowledge generation may be viewed as the generator and maintainer of structures that enable both organizational stability and its change. The main processes related to change can be defined as *innovation*, *renewal*, and *growth*. These three aspects of organizational self-maintenance are closely inter-related. The main processes related to organizational stability and reproduction can, in turn, be defined as its operations, and those support and integration processes that make its operations possible. These relations are schematically represented in Figure 39.

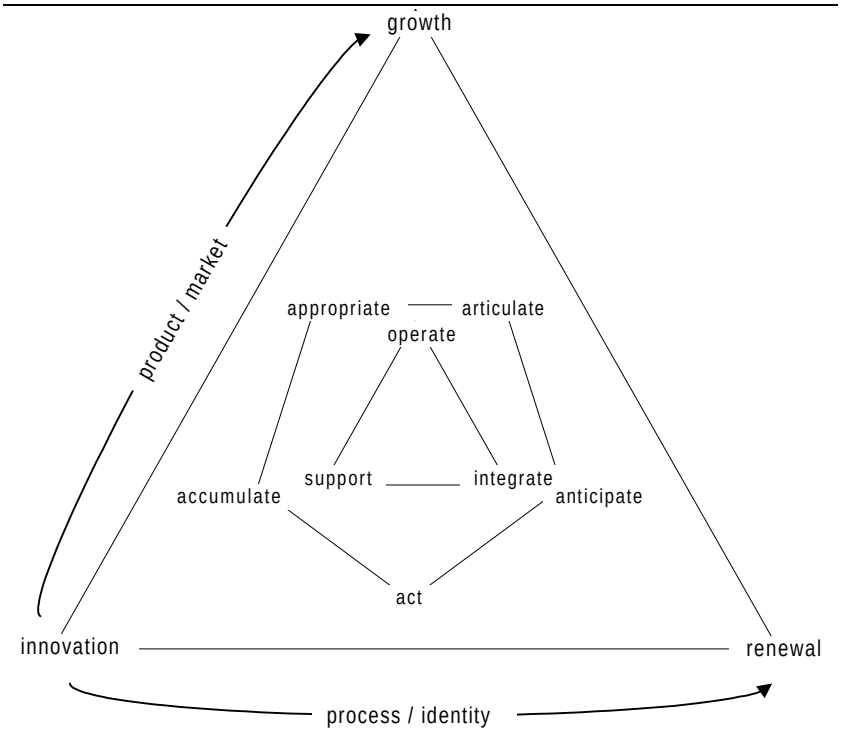

Figure 39. Knowledge processes within an organization.

By growth, I refer to two ways an organization can grow: extension, which is driven by entrepreneurial activities within the organization, i.e. doing different things or things differently; and expansion, which is growth by doing more.[71] Extension depends fundamentally on innovation of new product concepts and pursuing opportunities external to the organization. It is therefore related to a change in the underlying activity system. Expansion, on the other hand, fundamentally depends on increasing the volume of operations. In most cases, there is a trade-off between extension and expansion, which needs to be managed to keep organizational growth in balance, and to maintain the organization. For example, expansion leads to increase in system complexity as it leads to increased division of labor, which in turn leads to increased need for coordination and

[71] Using this terminology, Engeström's "expansive learning" should therefore be called "extensive learning."

communication. Extension, in contrast, leads to increased need for sensemaking and knowledge creation, and increased tensions in the system of motives. Therefore, whereas expansion generates the need to manage complexity in coordination, extension generates the need to manage complexity in meaning processing. The first leads to increase in bits and to automatic data processing; the latter leads to increase in dialogue and to collaboration systems.

Innovation is required for growth, but also for organizational renewal. If growth is the main mechanism for self-maintenance of the organizational system, renewal, in contrast, is fundamentally redefinition of organizational identity. Therefore, growth may be seen as closely related to operating in existing "markets," i.e., what the organization "does," and renewal can be conceptualized as reflective change of the organization itself, or creation of new markets. Innovation, therefore, may be conceptualized as two conventionally distinguished types of innovation: product and process innovations. Together these simultaneously change the things an organization does, and the organization as a doer of these things.

The stability of an organization is driven by its routines which reproduce it as a social system of activity. By definition, these routines are its operations. It should, however, be noted that usually only those routines that directly relate to the productive activities in the organization are recognized as such. This is also an example of tacitness: focal routines are defined as operations of the organization, and as a result, most organizational routines become parts of the background and become visible only when they inhibit change. Those organizational operations that are focal are conventionally conceptualized as the "main" processes of the organization in question; "the rest," then, is viewed as "support" processes. To maintain the system of social action, and its division of labor, some of the activities of the organization may also be viewed as integration processes that keep the recurrent operative actions coordinated. In Figure 39, the assumption is that the level of analysis is organizational, and that we consider the organizational system as self-maintaining productive system. Therefore, the core of Figure 39 consists of those processes that maintain the stability of the organization as a productive system. This is a somewhat simplified picture of the actual social processes that underlie organizational self-production. A more elaborated representation would show those routines that maintain communities that overlap with the organization in question.

We saw above that knowledge underlies all activity. Traditionally, this role of knowledge has not been the focus of the organizational or management theory. Instead of asking what underlies productive activity, both managers and theorists have emphasized the activity itself. In this view, organizations are systems of coordinated action, and they can be understood as productive processes. This is, of course, a natural point of view for business organizations, which can sustain themselves only if they transform inputs into outputs in an economically feasible way.

When organizations are viewed as systems that generate products, a natural way to analyze organizations is to decompose them into processes. Indeed, if the main function of an organization is to transform raw materials into finished products, we get the traditional industrial engineering view on organizations.

Process abstractions, however, are always abstractions of only some aspects of organizational life. When organizations are considered only in the production dimension, process abstractions do not say very much about learning, or about those competences that make operations and processes possible. Not infrequently, the approach has been to add the word "process" after existing "functions," resulting, for example, in discussions on the marketing process, financial process, service process, and R&D process (c.f. Davenport, 1993:29). Such processes, however, are not necessarily related to the underlying social systems of activity.

The attraction of the process-based view is that conceptualizes the building blocks of the organization as tasks, instead of roles. In other words, employees are defined based on what they do, instead of who they are. This view is important when we try to increase the efficiency of work. At the same time, the traditional functional decomposition has lost some of its relevance, and it has been increasingly attractive to focus on work activity. Activity, however, has been understood not as social activity, but as productive activity. Indeed, from this point of view, most social activity is seen as inefficiency.

In practice, social activity, however, underlies knowledge processes in organizations. Whereas the process-based view tends to see knowledge in organizations only as transfer of coordination information that is related to pre-defined processes, extant theory and practice in knowledge management has, in contrast, focused on the enablers of knowledge generation and use. Its emphasis has been on "learning" and "competence development," but so far it has paid relatively little attention to the ways knowledge is used in

organizational processes. These two perspectives are therefore complementary. Their main areas of emphasis are compared in Table 12.

Knowledge	Process
Focus on:	Focus on:
Competence development	Coordination of activity (what, how, when)
Maintenance and accumulation of knowledge stocks	Productivity (with given organizational goals)
Effective utilization of available competences	Predictability and anticipation
Innovation and renewal	Speed (time-based competition)
Strategic sensemaking	
Relates to "style" not outputs	Has (more of less) well defined outputs
"doing intelligent things with world-class skill"	"running the perfect machine"

Table 12. Two complementary perspectives on organization.

Implicitly, the process and knowledge views have been integrated in attempts to define models for concurrent engineering. These models are to a considerable extent driven by the needs for knowledge sharing and collective knowledge generation, although their emphasis is on the process, and its outputs. In contrast to the simple process view, team-based approaches to organizing have also implicitly tried to combine the activity and knowledge dimensions. Typically, a team has well-defined goals, but the way it achieves them is left more or less open. An implicit assumption is that a team can integrate various stocks of knowledge, generate knowledge collectively, coordinate activity, and support learning of its members.

The problem with the process abstraction is that in its ultimate form it leads to a machine view, where the knowledge dimension disappears. All knowledge becomes then embedded in the design of the process, and only simple coordination messages are needed to enable transactions within this well-defined process. An organization

becomes a set of functions that implement a single overarching motive of the designer of the organization.

Champy (1995:112) notes that we have to subject each task in an organization to fearless questioning, asking what is it for. That, according to Champy, is "the question underlying all other questions." Process abstraction, therefore, presumes that we can define social activity as acts that are clearly and unambiguously related to organization level goals. This, however, is not a valid assumption in general. Although someone may actually define and abstract an organization as a set of processes, i.e., as sequences of tasks, this, of course, doesn't change the ontological status of the social system in question. In practice, business process re-engineers have found this out when they have changed "processes" and nothing has changed, except maybe their level of frustration. The easiest processes to change are indeed the traditional areas of industrial engineering: repeating production processes, where activity can be to a large extent be reduced to mechanical tasks following one another. However, in other areas the process abstraction easily breaks down. Most important, this is so in sensemaking and other knowledge related processes, which are fundamentally social in their nature. Indeed, based on the theoretical considerations discussed in the previous sections, one can argue that viewing organizations purely in the process perspective overemphasizes the "product" perspective on knowledge, to the extent that the resource and constraint perspectives are almost invisible within the process view.

Organization level process abstraction is, however, useful exactly in that area where its motivation lies: in describing drivers that underlie organizational level action. Processes articulate organizational goals, and show how they are implemented through actions. More generally, however, we have to integrate three different aspects of organizational activity: the motives that drive organizational activity, the production processes that transform its input into output, and the meaning processing that accompanies these. Figure 40 represents these three inseparable dimensions of organizational life.

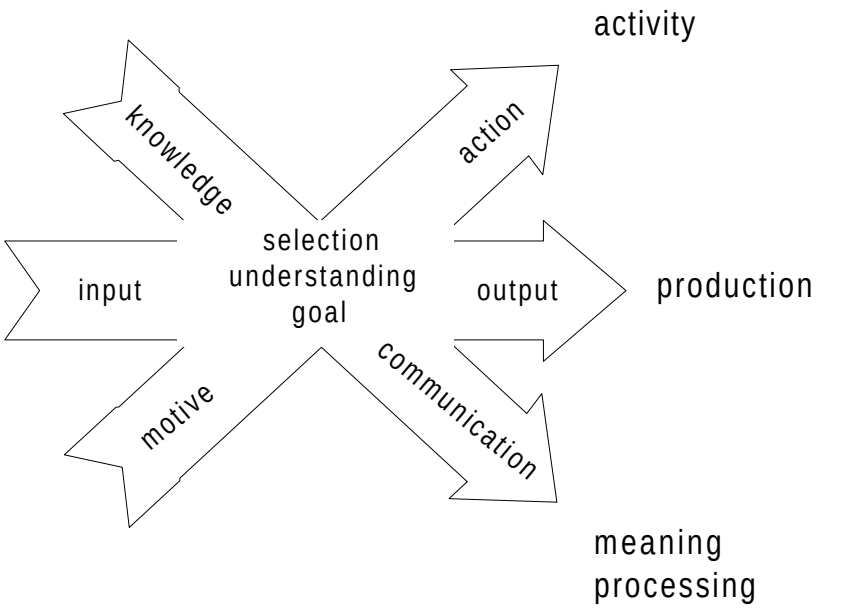

Figure 40. Three dimensions of organizational activity.

Polanyi argued that "we can know more than we can tell." In Polanyi's terminology, knowing emerges in dynamic interaction between focal and subsidiary components of meaning. According to Polanyi (1967), subsidiary knowledge consists of subliminal and contextual cues, from which we cannot be aware as such. Instead, these subliminal and marginal cues provide the context against which focal knowledge gets its shape. For example, eye-muscle movements have to remain subliminal for perceptional stability to be possible. Similarly, there exist marginal cues "at the corner of the eye," which we see, but without being able to "know" them directly unless they become focal, and which we know only through their influence in the focal perception. Thus our awareness of these subliminal and marginal cues can only be subsidiary to our focal awareness. According to Polanyi, marginal cues include both peripheral cues seen "at the corner of the eye," but also cues that result from our previous experiences and our expectations. As was discussed before, this background component Polanyi also called tacit knowledge, arguing that it acts as the necessarily unarticulated background against which all focal meaning is distinguished (c.f. Prosch, 1986).

In the context of the theory presented above, one could go further than Polanyi and say that an organization can know more than any of its individuals. Knowledge gets articulated at several phenomenally irreducible levels. At the social level, tacit knowledge consists of those institutional structures of meaning that have been sedimented as cultural background so that they are taken for granted. Although language is an important medium for articulation of meaning at the social level, in many cases social knowledge is not articulated in language. Instead, it forms the tacit background for collective knowing and articulation. In contrast to the examples given by Polanyi on highly dynamic interaction between marginal and focal perception, tacit social knowledge can be more rigid as its collective nature makes it difficult to change subsidiary social knowledge to focal. Even if someone within the society may focus his or her awareness to a particular aspect of tacit social knowledge, to make it socially focal requires change in the collective meaning processing structure. As Fleck (1979) pointed out, a new thought community has to emerge. This in turn, often requires negotiation of meaning, which in most cases requires the use of language. As Engeström and others (Engeström, 1999; Engeström, 1987; Virkkunen, Engeström, et al., 1997) have shown, such processes can also be institutionalized and managed within an organization, thus creating a learning organization.

Using Polanyi's terms we could say that the production processes of an organization are part of its focal and explicit knowledge structures. The social systems of activity that make these production possible in the first place could then be called tacit organizational knowledge structures. And, as was pointed out by Polanyi, most of the knowledge is of this subsidiary, peripheral, and unattended nature.

12 A framework for knowledge management

As those who work in organizations know, organizations are not homogenous entities where grand theoretical systems are easily put in place. Change is difficult. A special challenge in deploying knowledge management is that is requires systemic change. Isolated initiatives fail, but is also impossible to revamp the whole organization in one sweeping wave of change.

A consideration for a knowledge management framework, therefore, is that it needs to address systemic change in organizations. In practice, the framework has to provide a coherent language and a point of view that enables the various organizational actors to see their activities within the overall effort to develop organizational knowledge management. This requires that the current state and the vision of the organization can be seen together, in a way that enables the organization developers to bridge the gap.

Moreover, we need to take into account the simultaneous existence of several competing frameworks. In any large organization, it is impossible to develop one single approach to knowledge management and simply roll it out. Knowledge management is already happening, and much of the organizational development is working on solutions to its problems. When we deploy knowledge management, we have to be able to show how it relates to the ongoing initiatives in the organization, as well as to point out those areas where new thinking is required. Those frameworks that do not take into account change, or address issues of migration and co-existence of old and new concepts, practices, and tools, rarely generate major impact.

I proposed before that the answer to the question of knowledge management is that we want to make organizations more intelligent. There still remains the question how are we going to do this. In practice, knowledge management can be viewed as consisting of several dimensions where change is needed, and we have to address all these to get knowledge management deployed. To understand and manage knowledge in organizations, we need to understand what knowledge is, how it is used, what does its management consist of, and how we could improve organizational knowledge processes. The first dimension, therefore, is *conceptual*. We have to develop a set of integrated constructs that can be used to discuss knowledge in organizations. As we have seen in the previous chapters, this is a challenge in itself. The theoretical and conceptual basis for knowledge

management requires a multi-disciplinary approach and rather sophisticated theoretical discussion. In practice, we can not expect that everyone within the organization becomes an expert in the theory of organizational cognition, meaning processing, or activity theory. Therefore, we have to package the theory in a way that suits the needs of the organization in question.

Second, as I pointed out above, we need to explicitly address *change*. Change is closely related to stability. Therefore, a knowledge management framework has to say something about institutions and their evolution. As was discussed before, change, in itself is created when knowledge changes. Before new knowledge changes knowledge structures and systems of activity within an organization, knowledge has to be accessed, understood, and accepted. Knowledge management framework, to change the organization, needs to include concepts for change management.

One major aspect of change management is migration of old forms of activity into new forms. This requires coexistence of activities that are different versions of each other. In most cases this means that new activities are piloted as limited and isolated experiments, which in due course can be deployed more extensively within the organization.

Change often creates resistance. I would argue that in many cases this resistance actually, in itself, is a knowledge management problem, which results from problems with accessibility, acceptability, understanding, but also from problems in the management of attention. In effective organizations, people are busy doing those activities that they have understood to be the most relevant and urgent. Therefore any suggestions for new activities are competing with an existing set of relevant and urgent activities. In many cases, the newness of novel contributions of knowledge management is sufficient to make them less relevant and less urgent than items on the current agenda. This means that in practice there has to be some re-evaluation of priorities in the organization if the organization is going to deploy knowledge management practices. This, in turn, requires that the organization changes its vision so that it explicitly includes some aspects of knowledge management. For example, the organization can create a vision of itself as an intelligent organization, and look back from its strategic needs to see how it should prioritize its organizational development activities.

In research organizations, one commonly used approach to deal with the problem of change is to keep the number of possible projects so large that there exists alternatives if the priorities change. This

approach is used to make it easier for the researchers to develop their work identity around a strategic vision of the organization instead of specific "pet-projects" that for various reasons may change their priority. A similar management problem exists also for organizational development and innovation. To overcome this problem, the organization may develop a strategic vision from which a manageable portfolio of knowledge development projects are selected. At the same time there have to be processes that re-evaluate priorities from time to time. In knowledge management programs it is often reasonable to generate a set of high-priority implementation projects, and develop organizational knowledge management systems using a portfolio of strategically selected projects. Within each such project, change management, however, needs also to be addressed separately.

When organizations need to change, often the most scarce resource is time. Knowledge management is therefore also about management of time. This is so both at the macro-level and at the micro-level. At the organizational level, there has to be time to reflect on the organizational priorities and practices. If the organization is overloaded with current activities and existing initiatives, there is not much that can be done to manage organizational attention, and focus it toward knowledge management.

Time is critical also at the individual level. Learning requires that there is time for cognitive re-arrangement. Often, however, the drive for efficiency means that there is not much time devoted for reflection. A critical tool for knowledge management is, therefore, allocation of slack. Such "unallocated" time, however may need to be institutionalized and its use directed towards the strategic goals of the organization. If a strategic goal of an organization is to increase its intelligence, however, strategic allocation of slack may equal to making sure that there is enough time for consolidation of experiences, and radical reframing of existing knowledge structures. In a knowledge intensive organization, appropriately allocated slack may be its most productive investment.

It would be unwarranted to think that one organizational actor can design and implement change. As knowledge management touches more or less all the areas of organizational development, this leads, in practice, to the requirement of involvement of stakeholders in any knowledge management initiative. One way of doing this is, for example, to systematically integrate the change laboratory concept in knowledge management initiatives.

An especially important organizational institution is its system of incentives. This is also one of the major tools by which organizational change can be implemented. More generally, the third dimension in the framework relates to the problem of *measurement* of knowledge. Measurement is an important integration mechanism within organizations that directs managerial attention within an open field of potential interventions. Each measurement system implicitly defines a point of view. Therefore, the design of a measurement system is one of the most fundamental statements of organization's goals. Measurement also enables us to see whether we are moving towards these goals. I discuss this dimension in the next chapter in more detail.

The fourth dimension is informal and formal *organizational structure*. For knowledge management we have to be able to view organizations as knowledge processes, and discuss ways to implement formal, informal and communication structures that improve organizational knowledge processing. This includes defininining new roles and responsibilities that are required for effective knowledge management. Such roles may include, for example, knowledge owners, knowledge publishers, knowledge harvesters, and community coordinators. In many cases, these roles exist in any given organization, but they are not institutionalized or supported. Much of the most important knowledge management work is currently done simply because people in the organization understand that it is useful and should be done. Often, however, such work is invisible, and instead of promoting and managing it, organizations make it difficult and unrewarding.

The fifth knowledge framework dimension is that of *knowledge content*. If we view knowledge as a product in itself, the resulting product can be classified and categorized in various ways. To manage the products of knowledge processes, we need compatible and complementary typologies for knowledge. Content can also be related to skills of people. To manage content we may develop expertise directories, skill management systems, knowledge maps, or other meta-models of knowledge content. For example, categorization principles used by information services professionals embed decades of research on knowledge categorization. Especially in electronic environments, however, also issues such as version control and document reliability, quality, and life-cycle require conscious effort.

The sixth dimension of knowledge management is *tools*. These include various knowledge management methodologies and their representations, but also infrastructure that makes effective knowledge

management possible. Most important, such infrastructure includes information and communication technology that can be used to support organizational knowledge processes and their management. For example, knowledge management may be supported by collaboration tools, document management systems, organizational memory support systems, innovation support systems, information retrieval tools, and data discovery tools.

As was noted before, although knowledge management is often seen as a technological issue, in practice it is widely understood that technology is a relatively small part of any successful knowledge management program. This is so because a tool can not be utilized without the corresponding practice. Although organizational change can sometimes be arranged around the introduction of a specific tool that symbolizes change, manages attention, and structures discussions, the criteria for successful deployment is behavioral change. For example, if the explosive growth of intranets, for example, would be measured by some quality criteria, we might see that the relative amount of actionable information, by any reasonable criteria, is decreasing. We might analyze this situation as a simple example of a situation where the link between knowledge products and activity systems that produce and use these products do not exist. Information is often produced without any clear model why someone would need it. More generally, in knowledge management similar waves of excitement and frustration follow each other when technology gets too much attention compared to organizational practice.

The dimensions of the framework are summarized in Figure 41, and the interpretation of the various dimensions is summarized in Table 13.

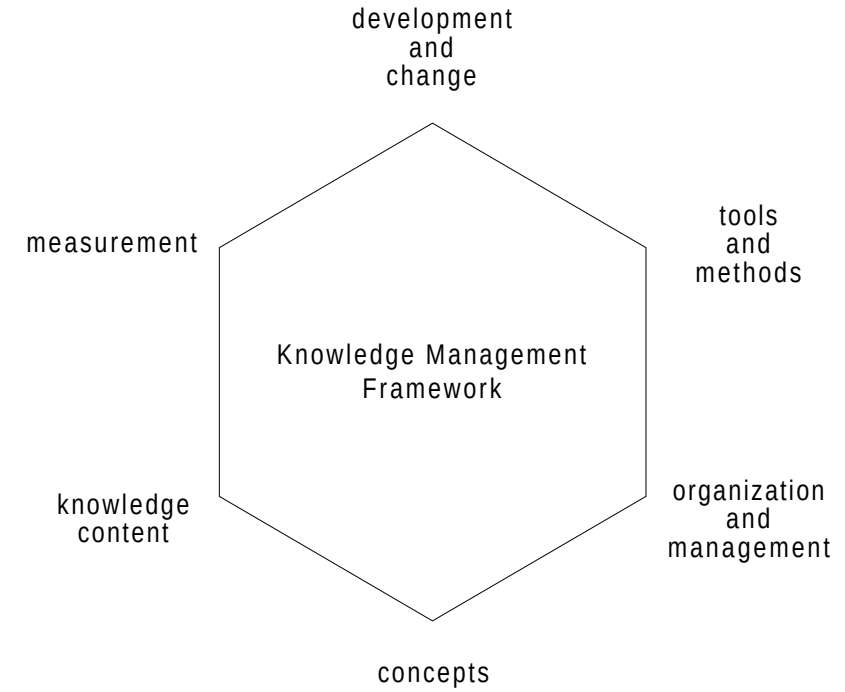

Figure 41. Framework dimensions.

Framework dimension	Interpretation
Concepts	an integrated set of constructs for understanding knowledge and its management in organizations
Development and change	migration and co-existence of knowledge frameworks, processes, tools, and behavior
Organization and management	integration and institutionalization of formal, informal and knowledge processing structures; knowledge management roles; organizational institutions, including incentive structures, knowledge sharing policies, and culture
Content	characteristics and typologies of the products of knowledge processes
Measurement	valuation of knowledge content, capabilities, and potential opportunities for their utilization; measuring knowledge processes, and locating areas of improvement
Tools and methods	methodologies, organizationally tailored "communication packages," information systems

Table 13. Interpretation of the framework dimensions.

In the next two chapters, I discuss in more detail two of the dimensions. First, I introduce the topic of measurement, and describe how the theory develop in earlier chapters can be used to develop a measurement system for knowledge management. After that, I show how the theoretical concepts presented can be implemented as new organizational structures that support knowledge creation. These two examples illustrate how the conceptual work done in the course of this work can be translated to organizational practice.

13 Measurement in the intelligent organization

13.1 The value of knowledge

It is intuitively clear that knowledge is one of the key generators of value in any business organization. However, when we try to put a number for this value, it is difficult. How could anyone have calculated the net present value of a steam engine two hundred years ago? What could be the worth of the innovation and insight that led to the development of the first transistor? What is the value of a new revolutionary computer algorithm that will be history tomorrow when an even better one emerges?

Knowledge, as such, has no intrinsic value, and only in relatively exceptional cases we can fix a price tag on a specific piece of articulated knowledge. The value of knowledge depends on a complex social system of activity that creates value using knowledge, and often knowledge transforms into value only at a later time and only for agents that have complementary resources available. We have know for almost a century how to make computer memory from magnetic materials; this knowledge just has not been worth much before there were computers.

The value of knowledge depends on the accidents of history and therefore it is impossible to accurately predict its worth. Examples of this phenomenon include the QWERTY keyboard design of typewriters (David, 1985) and the MS-DOS operating system (Arthur, 1989; 1996; 1990). Technological innovation creates competing designs for new products, and dominant designs emerge through increasing returns, network externalities, and complementary product designs that boost each others' sales (Utterback & Abernathy, 1976; Romer, 1998a; 1998b; Utterback, 1994). At best, it seems that we can heuristically estimate the worth of investments in knowledge as options that may enable future earnings opportunities.

The value of knowledge is difficult to estimate because of a fundamental problem: knowledge simultaneously underlies the social division of labor, enables effective action, and is the basis from which value is perceived. When new knowledge is created, it makes new ways of working possible. Social activity can be coordinated in a new way, and work can be made more efficient using the created knowledge, either directly, by knowing how to do things better or by

using it as an intermediate product; or indirectly, by embedding created knowledge into more efficient tools. Knowledge, however, can also change the perceived value of products generated. Generation of knowledge changes the value system, and therefore it is difficult to forecast the value of new knowledge. Moreover, the value system changes almost by definition when the product created in the work process is itself knowledge. This system of interactions is depicted in Figure 42.

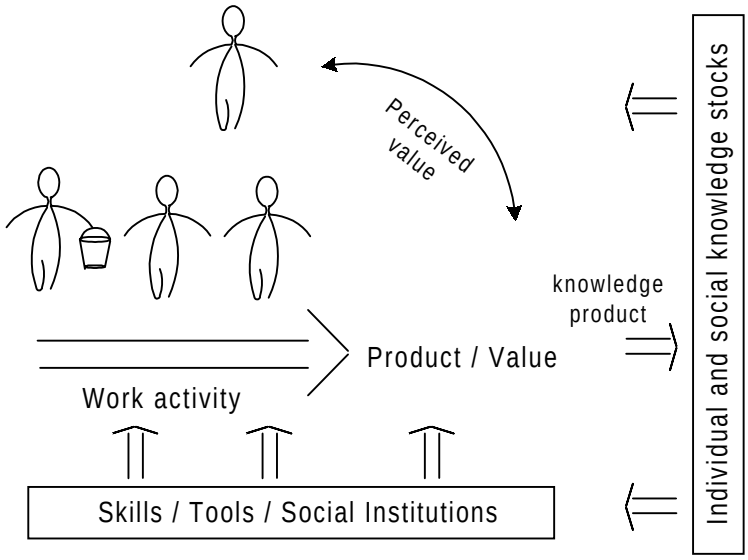

Figure 42. Components of the value creation system.

However, even if the value of knowledge is something we can not know in general or absolute terms, we still need to be able to measure organizations in the knowledge dimension. If knowledge is the key to effective action in intelligent organizations, we need to be able to tell how the organizational knowledge system works, where its bottle-necks are, and how the system could be improved. We also need to be able to show that our knowledge management efforts generate more benefits than costs.

The problem of valuing knowledge in an organization is not about finding an absolute value, but in finding the contribution that

knowledge can provide in the context of a specific business strategy. Valuation of organizational knowledge is not about finding some absolute cash value or replacement cost, but of understanding the potential contribution within a given organization. Therefore, valuing knowledge in a business organization is tightly bound to the specific strategic goals and needs of the company. Although sometimes knowledge can be sold as licenses, goodwill, or as a product, majority of the knowledge capital in an organization does not have external market price. For example, knowledge embedded in business processes, corporate culture, best practices, core competencies, skills, or strategic visions are critical parts of the total stocks of knowledge in an organization, even when they can not be traded in the market. Even in those cases where articulated knowledge has a market price—for example, when a specific product design can be sold to an outside company—this price rarely reflects the value of the same knowledge can create within the focal company.

The value of knowledge is time-dependent, and new knowledge often generates benefits to the society as a whole. If the creator of knowledge has a good change of appropriating value created as a result of generating new knowledge, there exist clear incentives to take risks and invest in knowledge creation (Von Hippel, 1982; Teece, 1986). Sometimes the private and public benefits of knowledge are difficult to optimize simultaneously, as, for example, wide shearing of new ideas may limit the possibilities of the inventor to appropriate the value of invention. In such cases, society may set up institutions that both guarantee that there remains incentives to create new knowledge, and to promote the sharing of new knowledge so that their social benefits can be realized. Academic institutions of publishing new scientific findings and intellectual property rights are prime examples of such social institutions.

When a business organization invests in the creation of new knowledge, the appropriability, however, remains a problem. The results of R&D investments usually leak from the investing company in a few years, making it difficult to appropriate the “full” value of the investment (Griliches, 1995:78; Mansfield, 1985). Earnings capacity erodes over time as better products and processes become available, and when competitors learn to imitate and bypass protected knowledge. Therefore, quick appropriation of knowledge may be necessary to generate any value.

Sometimes the appropriability of knowledge may also result from foreknowledge. Discovery (recognition that something exists which

will not automatically be revealed by events) and foreknowledge (advance knowledge that something will happen) both lead to social and private benefits. As new knowledge may be used for various purposes in the society, the social rate of return may exceed the private rate of return. However, foreknowledge may enable one individual to gain at the expense of others, therefore creating private rates of return that often exceed the social rate of return. Specifically this is so for the inventor, who has foreknowledge of the potential uses and value of the invention. The inventor therefore can appropriate part of the value of the discovery using his or her foreknowledge (Geroski, 1995:93).

Based on the discussion above, we might therefore say that knowledge has no intrinsic value. This is simply because knowledge itself defines the values in any society and system of activity. Only after we have fixed some institutional stocks of knowledge we can talk about the incremental value that can be produced by some new knowledge. To the extent that this new knowledge does not considerably change the underlying institutions that provide the foundation for the value system, it may be possible to estimate the worth of knowledge. However, in general this is not possible. Therefore also the attempt to find a universally valid definition for the value of knowledge is futile. This is a rather radical conclusion as it means, for example, that the economic concept of utility is unfounded in theoretical terms. In the Bergsonian perspective on cognition we could say that life is in some fundamental sense creative, and there are no theoretical guarantees that the value system remains within any given constraints. Sometimes small perturbations may lead to small effects, sometimes not.

In the economic theory, Schumpeter argued that innovation and entrepreneurship that underlie the capitalist system "incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism" (quoted in Elliot, 1980). Similarly, Marx emphasized that capitalism is a dynamic process that repeatedly revolutionizes the systems and relations of production and society. Whereas Schumpeter saw the innovator as the primus motor in this change, to Marx and Engels the bourgeoisie, as a social class, was the source of this constant revolution in the capitalist system. The bourgeoisie:

> …cannot exist without constantly revolutionizing the instrument of production, and thereby the relations of production, and with them the whole relations of society. The need of a constantly expanding

> market for its product chases the bourgeoisie over the whole surface of the globe. The bourgeoisie, by the rapid improvement of all instruments of production, by the immensely facilitated means of communication, draws all nations, even the most barbarian, into civilization. (quoted in Elliot, 1980)

New innovations destroy the value of old knowledge and change the social institutions that define values within social systems. This is also true for the economic value of new knowledge. In practice this means that the value of knowledge should be seen as a potential within a given situation and a system of social activity. When the situation changes the value may change as well. The realization of that potential depends on our own actions. Moreover, there are risks and unpredictability inherent in the utility of knowledge, and many—if not most—benefits of new knowledge may be unintended. Although we may predict that there is high potential value in some knowledge, there is no guarantee of that value or our ability to realize it, nor a single social system of activity that could put an objectively valid price-tag on it. Instead, we can believe that there exists an opportunity, estimate its value based on some articulated and many unarticulated assumptions, and trust that we can realize it with a reasonable risk.

It therefore seems that valuation of knowledge capital is in important ways a different task, and more difficult, than valuation of traditional marketable assets. This, however, does not mean that measurement of knowledge would be impossible or unimportant. Indeed, there are several alternative reasons and ways to measure knowledge.

13.2 Intangible assets and knowledge capital

During the 1990's, organization strategy has been focusing on organizational capabilities and competencies that underlie competitive advantage (Barney, 1997aTeece, Pisano, & Shuen, 1997; Tuomi, 1998b). One key enabler for organizational competencies is the aggregate of competencies of its employees. Therefore the measurement of skills in the organization has been viewed as a critical aspect of the measurement system of a knowledge-based organization. If we have highly skilled employees, and their skills are in areas that support the business strategy, the organization has a good basis for success. If there are gaps in skills, either development of skills is needed or we need to recruit people with the right skills.

Measurement of human capital in organizations is closely related to earlier attempts to measure human capital on the macro-economic level. Since 1950's there have been several attempts to measure individual skills and knowledge, and the return of investments in education and training (Kiker, 1966; Miller, 1996; Nordhaug, 1994). A recent OECD study on measurement of human capital defines it "as the knowledge that individuals acquire during their life and use to produce goods, services or ideas in market or non-market circumstances." (Miller, 1996:22) According to the study, there have been three common approaches to measure human capital. One method is to look at the cost of acquisition of certified knowledge, e.g., the cost of schooling and training. The second method is to test people for their competencies. The third approach has tried to estimate productivity increases based on achievement indicators, such as a person's income level, job security, occupational status, and past references. According to the OECD study, all these have had problems, and currently there do not exist effective systems that would provide accurate information for individuals, firms, and governments when they make investment decisions concerning knowledge and learning.

James Quinn has argued that there is little question that the intangibles of databases, know-how, technological understanding, communications networks, market knowledge, brand acceptance, distribution capabilities, organizational flexibility, and effective motivation are the true assets of most companies today and the primary sources of their future income streams. Yet, the asset value of these

intellectual and service infrastructures is nowhere to be seen on a corporation's balance sheets. Quinn goes on to say:

> …the value services contribute is often disguised (or treated only as an expense) by accounting conventions that allocate all benefits to product outputs. Increasingly, these accounting and economic measurement conventions are leading to poor managerial practices and to misguided national policies…These conventions, designed in the past, assume that capital—not talent or intellect—is the resource in short supply. (Quinn, 1992:243)

Although it is quite clear that the current accounting conventions do not create information that would be needed to make effective investments in intangibles, some recent literature on intellectual and knowledge capital has argued that markets do, in fact, estimate the value of organization's intangible assets (e.g., Edvinsson & Malone, 1997; Sveiby, 1997; Strassmann, 1998; Stewart, 1997). One source of this idea is James Tobin's observation that the market value of firms rarely reflect the value of their fixed and financial assets. Tobin's Q, the ratio between the market value of a company and the replacement value of its fixed assets, is a measure of this difference (Tobin, 1978). Some examples of market versus book values are shown in Figure 43.[72]

[72] The data in the figure comes from http://biz.yahoo.com/research/indgrp/.

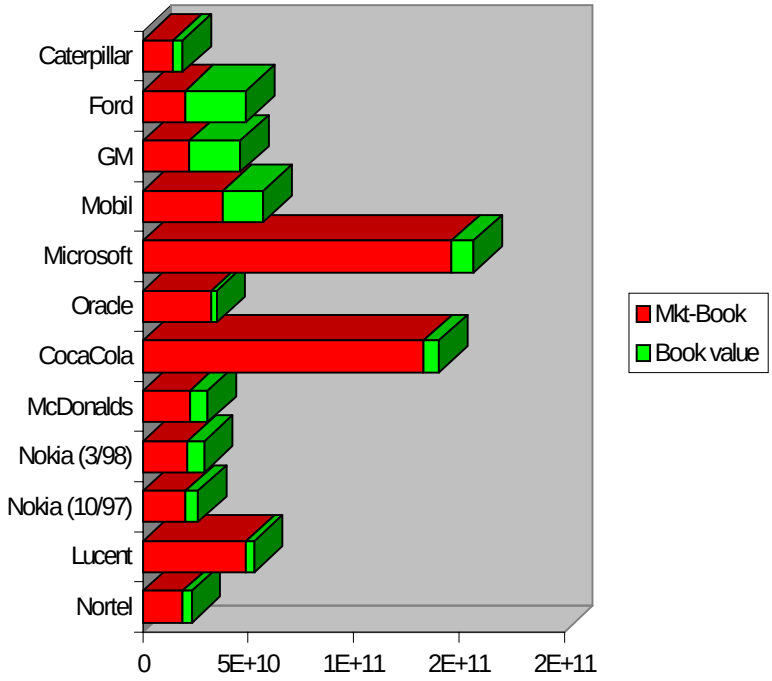

Figure 43. Market and book values of some companies.

In the discussions on intellectual capital, Tobin's idea has been developed further. If the stock market values a company right, the difference between market value and book value could be taken as a simplified measure of the value of its intangible assets. As a first approximation, we could then argue that this difference is exactly what we mean by intellectual capital. This approach has been used, for example, in Skandia (Edvinsson & Malone, 1997:52). Paul Strassmann (1998) applies a similar idea in his definition of knowledge capital. In this view, knowledge capital or intellectual capital is the source of economic value added by the organization, over and above the return on its financial assets. The obvious counter argument, however, to such market based corporate level valuations of knowledge capital is that it assumes that markets really can and do value the intangible assets of a company. If the problem in the first place was that companies should start measuring their knowledge capital as this major asset is not

known well enough within the company, it is, however, unclear that it is better known and more accurately valued outside the company.

Human capital has been viewed as one of the main forms of knowledge capital. More broadly, knowledge capital is usually understood to comprise different complementing types of accumulated intangible capital (c.f. Lynn, 1998; Amidon & Skyrme, 1997). Sveiby (1997:10) uses the terms internal structure, external structure, and employee competence. Brooking (1996) uses the concept of intellectual capital, and decompose it into market assets, human-centered assets, intellectual property assets, and infrastructure assets. Edvinsson and Malone (1997) also use the concept of intellectual capital and compose it into human capital and structural capital. Hubert Saint-Onge (c.f. Edvinsson & Malone, 1997:36) refines the intellectual capital model, and distinguishes two types of structural capital, separating customer capital from organizational capital. Roos and Roos (1997) further explicate the intellectual capital model, dividing organizational capital into process capital and renewal capital.

There is considerable overlap in these conceptualizations, and some opportunities for confusion as well. There is broad consensus, however, that knowledge capital can be depicted as three overlapping circles, one representing human capital, another organizational capital and the third customer or relational capital (c.f. Lynn, 1998:16). Combining this visualization with Sveiby's typology of knowledge assets we get Figure 44. In this figure, internal structure denotes those intangible assets or accumulated capital that can be understood to reside at the organizational level. Examples of such assets may include processes, ways of working, best-practices, organizational culture, organizational structure, and information systems. Competence, in contrast, denotes human capital in its traditional form, including know-how, capabilities, skills and expertise. The third form of knowledge capital is that of external structure. Various authors emphasize different aspects of this external structure, focusing, for example, on customer capital that includes customer satisfaction, loyalty, level of backorders, and brands.

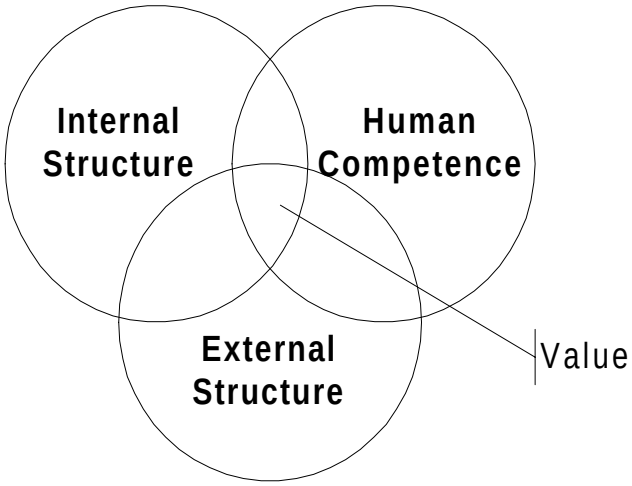

Figure 44. Three components of knowledge capital.

Value is created only when the different forms of intangible assets complement each other. For example, skills, know-how and capability often exist only in relation to organization's internal structure. Human knowledge can create value only if it is complemented with systems of activity where this knowledge can be transformed into intelligent action. Some forms of human competence are idiosyncratic to the specific organization, whereas other forms may be usable in other organizations, or even in the society outside organizations. In many cases we are specifically interested in highly idiosyncratic forms of employee knowledge, as those forms of knowledge that require a tight match between idiosyncratic internal structure and organization specific competencies are usually the most difficult to imitate by competitors.

The external structure could probably be best conceptualized as those structures that enable the organization to produce value, but which are not "internal" to the organization or which are not reducible to the competencies of its employees. Examples of external structure would therefore include external logistics, customer relations, reputation, alliance networks, inter-organizational sense-making networks, negotiation power, and other forms of capital that have been

accumulated through the history of the organization. Although most authors on knowledge capital do not address institutional systems that underlie profit making—such as legal institutions that enable contractual relations or educational systems that provide basic skills—these social and institutional forms of capital may in some cases be highly relevant forms of external capital. In contrast to most categorizations of intellectual capital, it would also appear logical to include patents, copyrights and trademarks into external structure. These are used to limit competition and negotiate licensing agreements within the network of inter-organizational actors. Internal capital should, however, include product and process designs and trade secrets that are used in value generation. Sometimes trade secrets, for example, are treated in the literature as "intellectual property" along with trademarks, and both are included as forms of organizational capital (e.g., Lynn, 1998:14).

Developing the Skandia intellectual capital valuation scheme, we can represent knowledge capital as shown in Figure 45. In this decomposition the main distinction is between accumulated employee competence and organization level accumulated intangible capital. Competence is enabled by skill, but mobilized through attitude. One component of human capital is also intellectual agility, which refers to the flexibility of using knowledge in different contexts (Roos, Roos, Dragonetti, & Edvinsson, 1997). Some skills, for example, may be highly flexible and easily transferable, whereas some may be highly idiosyncratic and lose their value when the situation changes. Structural capital, in turn, is composed of capital accumulated in internal and external structure, and also of renewal capability that underlies flexibility and learning of the organization.

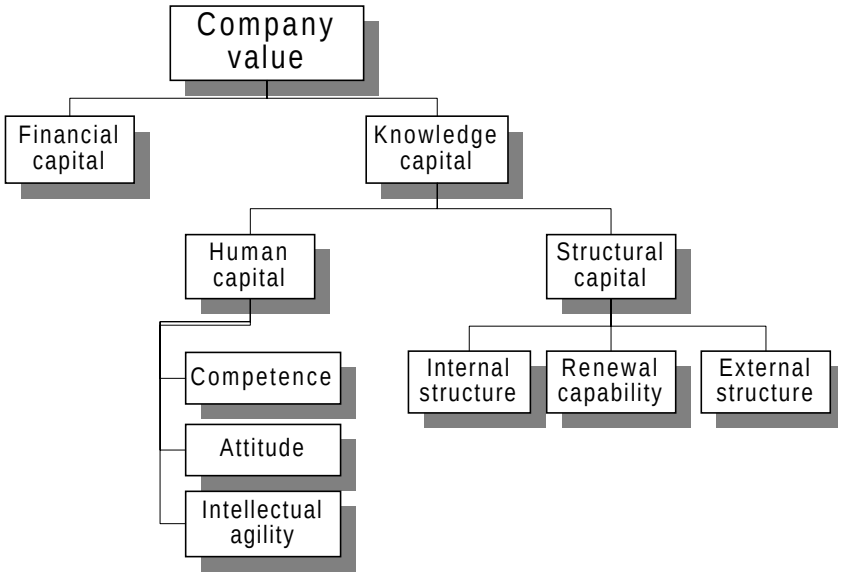

Figure 45. The components of knowledge capital.

13.3 Measuring knowledge

When we try to measure organizational knowledge, it is not sufficient that we understand the nature of knowledge, in abstract terms. In addition to the object of the measurement we have to consider the subject, as well. An intelligent measurement system is related to the needs of the measurer.

There are several starting points for developing a measurement system. Some visible knowledge management initiatives have focused on improving financial accounting conventions so that investors, customers, and other stakeholders could better value knowledge and competencies in the company. In other cases, companies want to benchmark their knowledge processes, understand the impact of their knowledge management initiatives, develop core competencies, or estimate the value of accumulated intellectual property.

In general, when creating a practical system for knowledge measurement within an organization, one has to start with the strategic vision of the organization. Only if we know what is the purpose of the organization and organizational development, we can device a set of measures that tell us whether we are moving in the right direction. In addition, the measurement system needs to include diagnostic, process maturity, and result measures. Further, knowledge management initiatives need to be connected to existing organizational practice, and therefore also the measurement system needs to be connected with existing measurement approaches and practices. In addition, the various motives for measuring knowledge have to be integrated within a common framework that binds the different actors together on a conceptually robust foundation that can adapt to the changing business environment, tools, and practices. Utilizing such measurement systems within and across communities of practice, we can also get meaningful measures that are directly related to specific practices and the actual work done within the organization.

Table 14 summarizes some of the motives to measure knowledge in organizations. The best practices mentioned in the table are discussed in detail in (EIRMA, 1999).

Stakeholder	Why	Best practices
Stockholders (current and future)	Helps underpin expectations Return on their investment Transparency Understand market value vs. asset value	Tobin's Q Strassmann Skandia Navigator
CFO (CEO)	Value acquisitions and divestments Raise new capital easily Avoid financial surprises Current systems are imperfect Leading indicator of performance Price global transfers of IPR (taxation etc.)	Tobin's Q Strassmann DOW IAM Balanced scorecard Brand valuation
Strategic management and business development	Measure health Differentiate options Analyze strengths / weaknesses / opportunities /gaps Benchmark against competitors Articulate new options Measure knowledge sharing vs. strategy Level of investment in knowledge activities	IHI KMAT StageGate Sveiby / Celemi / Balanced scorecard Knowledge options
Organization Development / Change agents	Justification of activities and projects Learning Benchmarking of knowledge processes Spread of best practice Tools and diagnosis for culture issues	Success stories KMAT IHI StageGate Knowledge markets
Line management	A way to value employees & teams Competence management and development needs A dimension to appraisal Prioritize resource allocation Improving efficiency of knowledge work Stimulus and change	Modified EFQM Business Excellence Model Knowledge-sharing rewards

Table 14. Reasons to measure knowledge (EIRMA, 1999).

Within the intellectual capital framework, measurement focuses on the value of knowledge-related assets. More generally, measurement is

planned observation, and it is used to improve understanding of a specific system or to control its behavior. The system of measurement articulates major assumptions about the purpose and structure of an organization, and therefore the system of measurement is also one of the main statements of the priorities of an organization. In theory, a mission statement may try to crystallize the overall intent and identity of an organization; in practice, the measurement system makes such a mission statement either meaningless words or everyday organizational reality. As a consequence, the measurement system is also one of the main tools by which an organization can change itself.

For example, if an organization starts to measure the effectiveness of its knowledge sharing processes and enablers for knowledge creation and organizational learning, it becomes able to monitor and improve these aspects of the organization. Only those aspects of organizational action that can be observed, i.e., measured, can be used to control the organizational action. In practice this happens, for example, by providing incentives and goals that signal organizational priorities.

The system of measurement, therefore, needs to be derived from the strategic vision of the organization. It also needs to be distinguished from accounting measures (Johnson & Kaplan, 1987). As Quinn argues:

> With few exceptions, standard accounting practices have not only been of little value in evaluating intellect but have often had a significant negative influence. Rather than regarding expenditures on intellectual or service developments as being investments in assets of enduring value on which one expects returns and then systematically quantifying these returns, accounting practices have classified them as "expenses" to be written off—and minimized if possible. (Quinn, 1992:248)

R&D, for example, can be measured as a generator of "opportunities to exploit." According to Quinn, this is much like evaluating a gold mine. Using the best available techniques, one estimates the likely cash flows one could achieve from exploitation and discounts these based on the probabilities and risks involved. The company can also determine what it actually did with these potential values. Based on this, one can calculate an "exploitation ratio," which may lead to insights on the effectiveness of R&D activity (Quinn, 1992:247).

As was pointed out above, there is no single way to measure intellectual assets or knowledge-related processes. In many practical

cases, there are several correlating phenomena in an organization that can be measured and it is not clear which indicators would be the most useful. Instead of looking for the single right measurement system, one should, therefore, look for one that enables the management to know whether the organization is moving toward the overall strategic vision.

Quinn proposes that an organization should try to put value to its intellectual assets using several complementary approaches. The organization can estimate the price the company would be willing to sell off the entire activity; estimate how much it would cost to rebuild from scratch the portions of the R&D unit the company would like to keep; assess how much it would have cost the company to buy from outside sources the "opportunities to exploit" R&D created; estimate the asset value of a continuing stream of created "opportunities to exploit." In addition, the organization should measure the quality and productivity of knowledge processes as well as their outputs (Quinn, 1992:249).

The measures that are used should also be relevant. They need to give feedback on the development of the organization in strategically important dimensions, and therefore the measures should be able to distinguish change in those dimensions. For example, if rapid deployment of best practices is important for a company, the measurement system should be able to tell something about the speed and extension of the deployment of best practices. More generally, specific measures should reflect the critical factors that have to be in shape for the organization to succeed. In addition, the measurement system should have adequate coverage, so that there are no important gaps in the measurement system. As the measurement system can not be complete or final, it also needs to be revised regularly so that it reflects the current priorities of the organization in question.

In summary, then, the criteria for a measurement system can be stated as follows. It has to be based on measures or indicators that are related to strategy. Moreover, the indicators have to be relevant, complementary, dynamic, and cover those areas that are important for the organization.

13.3.1 Types of measurement

In general, measurement can focus on three different types of issues. First, it is possible to measure results or outputs. Second, it is possible to measure the quality, efficiency and stability of the process that

produces these results. Third, it is possible to measure inputs, tasks, and other enablers that are needed to generate the results. These are schematically depicted in Figure 46.

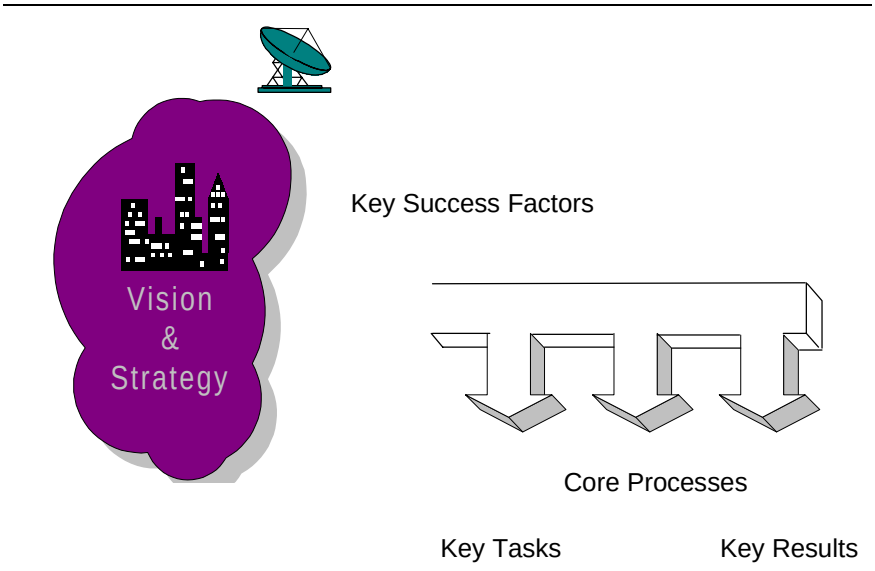

Figure 46. Three areas of measurement.

There are several different types of measurement that provide information on the working of an intelligent organization. Traditionally, knowledge has been measured at the macro-economic level by R&D inputs and estimated rate of return (Stoneman, 1995). At the organizational level, the focus has been of R&D effectiveness and human capital. According to a recent survey on over 100 publications on measuring R&D performance, both quantitative and qualitative metrics have commonly been used to assess R&D (Werner & Souder, 1997).

Any organization both tries to run an effective machine and to renew itself. Therefore it needs to operate in several modes simultaneously, and these modes require different measurement systems. For some organizations, innovation is the key to success, for others it may be marketing or production. These need different measurement systems. Often, production focuses on efficiency, whereas R&D focuses on effectiveness.

Hansen, Nohria, and Tierney (1999) proposed that there are two generic knowledge management strategies. The knowledge codification strategy focuses on codification of information. This strategy seems to be most appropriate for companies that are able to invest in developing a knowledge asset that can be efficiently reused. Another strategy, knowledge personalization strategy, is appropriate for companies that rely extensively on tacit knowledge, or which offer customized products that can not easily be standardized. An extension of the model proposed by Hansen et al. might include a third strategy, which is appropriate for companies that compete by creating new knowledge, and products that define a novel product category. These three types of knowledge management strategies are shown in Figure 47. For companies that emphasize the codification strategy, an appropriate measurement system would focus on measuring knowledge products and knowledge packaging processes. For companies that emphasize knowledge personalization strategy, the appropriate measurement system would focus on communication and knowledge adaptation processes. For companies that emphasize knowledge creation, the measurement system could include components that diagnose factors of organizational culture that are critical for knowledge creation, dynamics of its ba's, or social interactions that facilitate innovation.

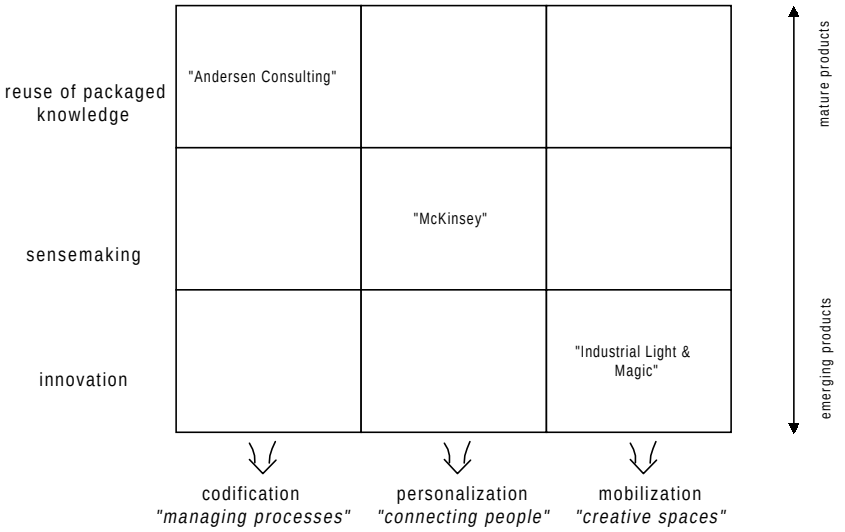

Figure 47. Three knowledge management strategies.

Different views on the organization lead to different measurement systems. If we consider the organization to be a machine that produces outputs from given inputs, a natural approach is to focus on efficiency. In a closed system, we can measure and manage the functioning of the system by getting feedback from the system, and by intervening when necessary. However, only when we have pre-defined goals, we can measure efficiency, and its complement, waste. This may be rather straightforward in those parts of an organization where production is the main objective, and where repetitive tasks and processes make it easy to improve performance through reduction of waste and "non-value adding" activities.

If we, however, consider the organization to be an adaptive system that evolves across time, organizational learning, flexibility and value creation may be natural aspects to measure. Then we may focus on measurement of effectiveness and impact, but also on strategic options that enable these in the future. Instead of waste we then measure the actual value added.

In actual practice, one key task for the management is to define the priorities for different areas of activity within the organization, and implement a measurement system that reflects the strategic

requirements of the organization in question. Some parts of the organization may need to implement a measurement system that emphasizes renewal and innovation, other parts may need a measurement system that gives feedback on knowledge reuse.

In Table 15 three different types of measurement are listed. A complete system of measurement needs to cover all these aspects of measurement, in a way that reflects the organizational strategy.

- Results
  - Effectiveness (value)
- Diagnostics
  - Efficiency (waste)
  - Flows & Stocks
  - Enablers (e.g., culture, values, behavior, organization)
- Process maturity
  - Defined core processes ("what we do...")
  - Quality of approach ("...and how we do it...")
  - Scope of best practice use ("...compared to world-class")

Table 15. Three types of measurement.

Given the discussion above, one could also see that a too strong emphasis on the production dimension and business processes may easily lead to excessive focus on efficiency measures. In practice, efficiency measures tend to overflow also to those parts of the organization where they don't fit well. This happens because it is relatively simple to measure processes where inputs and outputs are defined, and also because the traditional industrial organization was focused on efficient production in relatively slowly changing product-market environments. In many important cases the situation, however, is more complex. Instead of a set of well-defined processes the organization may sometimes better be described as controlled chaos (Cheng & Van de Ven, 1996; Volberda, 1996). Measurement systems that focus on efficiency are relatively common in unsuccessful R&D organizations (Brown & Eisenhardt, 1997). Organizational innovation and learning often occurs outside any defined processes and it is, for example, known that most of the benefits of information technology in organizations are unintended. A measurement system that is able to observe the value of such unintended benefits or chaotic and creative

activities should have a broader coverage than a measurement system that focuses on efficiency.

13.3.2 Measuring knowledge processes

When we define measures for knowledge-related processes it becomes clear that these processes are difficult to define. We don't have a clear input-output model of what happens when a new insight is generated, for example. In such cases we can evaluate the result after it exists, but it may be difficult to tell what were the inputs, or how efficient the process of generating the result was.

In general, it may be easier to have some idea about those activities that do not add value. Even when we can not tell what is the "process" that generates the result, we may be able to tell that some activities do not contribute in its creation. Therefore, we may heuristically categorize some activities as waste. For example, we can leave open the question how to model and specify the processes that underlie insight and creativity, and at the same time we can eliminate some forms of activity that do not improve creativity or produce insight.

If our understanding of knowledge processes is wrong, however, we easily make wrong judgments about the nature of different organizational activities. A random discussion in the company cafeteria may be extremely valuable, and yet be commonly categorized as inefficient use of time. Similarly, if we don't realize how critical well managed slack is in the organization, we may think that slack should, by definition, be minimized. This is a rather generic problem as our abstract models of organizational activity rarely take into account that social activity that underlies knowledge creation and development. Measurement systems that try to measure efficiency of knowledge processes, or their inputs, run the risk of destroying them.

As Quinn suggested, we can also try to measure the exploitation ratio of opportunities. This can be done, for example, by estimating the potential value of generated new ideas and compare this with the expected value generated from these ideas. This would reveal underutilized opportunities, and provide some understanding of the appropriateness of allocation of knowledge generation resources.

It is, however, not obvious that a high exploitation ratio is always optimal. We can, for example, measure how many of the patents generated in a company will be utilized in its business, or count how many R&D project proposals lead to projects. It is, however, known

that when a business firm competes in rapidly changing product-markets, its flexibility in re-allocating its competencies may be a major competitive advantage (Volberda, 1996; Teece, Pisano, & Shuen, 1997; Brown & Eisenhardt, 1998). Renewal often means that an organization does something that it didn't do before. Exploitation of new knowledge is not always similar to that of making risky investments in a gold mine, as Quinn (1992:249) suggested. Sometimes it is more like sitting on top of an oil-field, before there are any known economic uses for that sticky black substance.

When we try to measure knowledge creation processes themselves, the main problem is that there has not been theoretically robust models of knowledge processes in an organization. Researchers working with the idea of intellectual capital have mainly focused on the static aspects of intangible assets. Roos et al. (Roos, Roos, Dragonetti, & Edvinsson, 1997:52) try to correct this by proposing measures for the flows between different forms of intellectual capital. Others have tried to describe "the knowledge process" as a sequence of phases where knowledge is created, codified, disseminated, adapted, and used. Such models, however, are not theoretically well founded, and the measurement systems built using them have, for example, problems in making distinctions between the various levels of analysis.

Using the 5-A model of knowledge creation, it is, however, possible to show some key knowledge processes that can be measured. The conventional view on intellectual capital focused mainly on knowledge accumulation. In Figure 48, two types of accumulation are distinguished. First, knowledge can accumulate as knowledge products, i.e., tools, designs, and documents. It is, for example, possible to measure the generation of new design proposals at individual, community, and organizational levels. Second, knowledge can accumulate as expertise. Similarly, appropriation may me measured, for example, by reuse of knowledge, time devoted to mentoring, or use of training. Anticipation, in turn, can, for example, be measured by the number of lessons learned in situations where the world didn't meet our expectations.

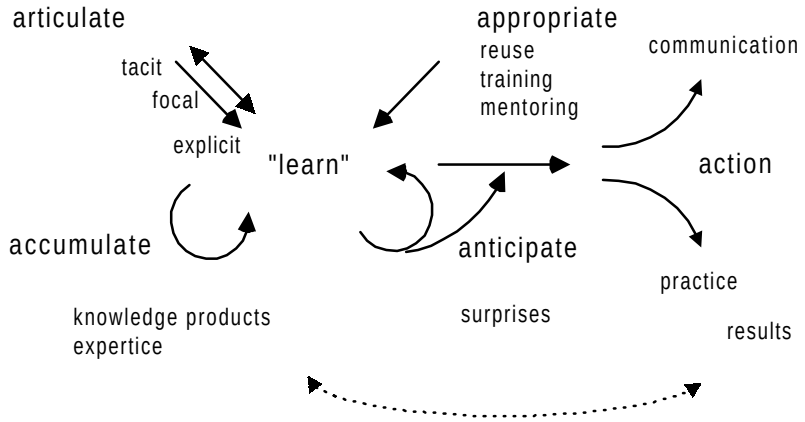

Figure 48. Some example areas of measurement in the 5-A model.

A simple aggregation of the measured factors is not possible, as the value of knowledge depends on the underlying system of activity. For example, expertise is always related to a specific community of practice, and tools may be used in different ways in the activity systems of different practices. It is however, possible to develop meta-level measures that, for example, count the number of people in different levels of expertise within the organization. For example, Linder and Davenport proposed that engagement is a critical factor when information is shared in a company (Davenport, 1997:92). According to Davenport, engagement has five levels: read/view, act on/discuss, argue/defend, present/teach, and simulate/live. Similarly, Dreyfus and Dreyfus (1986:30) proposed a five level model of the development of expertise.

When we analyze the information engagement model from the Vygotskian point of view, we can say that the different levels of engagement require different forms of advanced thinking. Reading of a document requires only peripheral participation in the community. Discussion, in turn, requires commitment in addition to the capability to read a document. To discuss, one has to have a position concerning the topic at hand. Argumentation requires that, in addition to one's own position, one has to be able at least partially to understand another position and interpretation: that of the opponent. Teaching and

presentation further require that the presentator not only knows another point of view—that of the student—but is able to actively manage the differences and movement within the zone of proximal development. An effective teacher, therefore not only understands the position of the student, but also understands what are the student's capabilities in changing this position. On the fifth level of the engagement model, an expert is able to creatively transcend the current world view, and produce new realities.

Combining the expertise development model and the information engagement model, we could then use it as a practical definition of levels of expertise. Indeed, we can argue that if the levels proposed by Dreyfus and Dreyfus are discontinuous, there probably exists a similar structure also in the social sphere. This means that it should be empirically possible to find five different "cognitive classes" of people in all fully formed communities of practice. As the level of expertise is a key structuring factor in a community, we should also be able to detect corresponding initiation rites, signs of class membership, and sub-practices, that could be used to categorize people in the different levels. The modified engagement model is depicted in Figure 49. The use of the modified engagement model within the context of communities of practice is discussed in more detail in (Tuomi, 1998b).

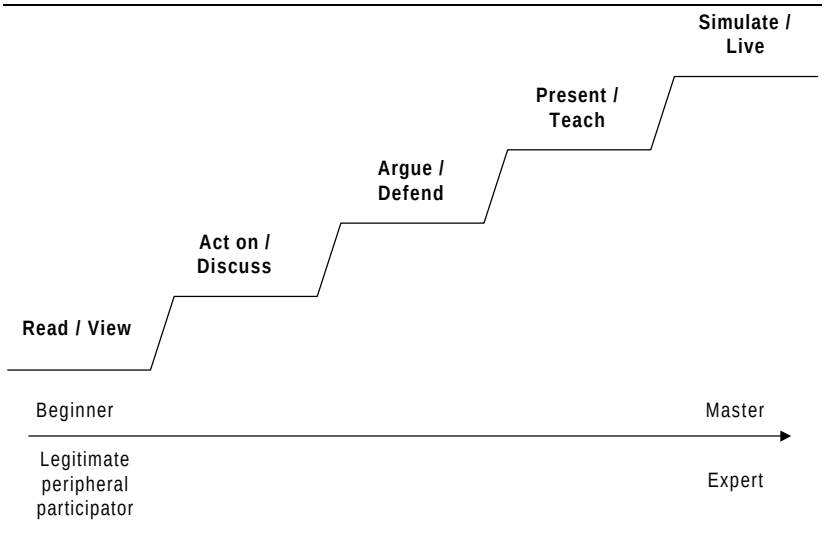

Figure 49. Levels of engagement and the development of expertise.

14 Organizing for strategic knowledge creation

Often the limiting and enabling factor in organizational renewal is the organizational skill-base, and its capability to adapt. Therefore organizational-level mechanisms for adaptation, innovation, knowledge generation, and learning have been intensively studied during the last few years. The need to regularly change organizational processes and structures has led to competence-based strategies, team and process-based organizations, and discussions on novel organizational forms that provide flexibility (Prahalad & Hamel, 1990; Powell, 1990; McMaster, 1996; Pinchot & Pinchot, 1995; Miles, Snow, et al., 1997; Nonaka & Takeuchi, 1995; Volberda, 1996). One of the drivers underlying interest in organizational learning and knowledge management has also been the fact that many companies have downsized their operations, losing accumulated skills and knowledge in the process. Together these challenges mean that there is considerable interest in improved ways to manage both existing competencies and developing new competencies that provide strategic competitive advantage for the organization. The previous chapter discussed measuring and diagnosing existing intellectual capital. In this chapter, I will focus on new organizational forms that support the development of knowledge and competencies.

The organizational dimension of the knowledge management framework presented above deals with questions on processes, structures, roles, and responsibilities. Previously I argued that when we consider organizations as units that are capable for effective intelligent action, we should abstract an organization as a fractal community that comprises several communities of practice. From the knowledge and competence development point of view, the fundamental unit of analysis is a community of practice. It defines what counts as knowledge within the community, and acts as a focal unit for knowledge creation. In many cases, these communities extend beyond the boundaries of a legal organization. Even in those cases where the community consists of people with contractual relations with the legal organization, the community may in many ways be out of the scope of control of the organization.

An organization can, however, form units that approximate communities, and which it can control and define as accountable agents. Such bounded approximations of community I earlier called teams. Teams are organizational structures that collect together

members of those communities of practice that have developed knowledge and skills that are needed to get a job done. As teams are viewed as agents, they can have goals, as well as criteria for success. Indeed, the standard definition of a team is a tightly integrated group with complementary skills, mutual accountability, and a common goal (Katzenbach & Smith, 1997).

In actual organizations we therefore need to integrate four units of analysis: the legal organization, its communities of practice, teams, and individual humans-in-society. Knowledge management requires mobilizing knowledge at all these levels, as well as managing their interdependencies.

There is no single concept that would solve the questions for structuring and institutionalizing activities within the organization once and for all. However, one relatively generic way to organize for knowledge creation can be derived from the theory developed above. This organizational design is discussed in the following section.

14.1 Team-based communities

As was pointed out above, meaning processing in organizations overlaps the conventionally used bounded constructs of individual, team, and organization. These bounded constructs are not appropriate, as such, for understanding organizational knowledge processing. When we take the fundamental unit to be a human-in-society, the appropriate meta-level system is a community of practice or a society. When we understand society as a collection of functionally diversified communities of practice, which form the centers for knowledge production and re-production, an organization may be understood as a legally and institutionally bound subset of such communities. Specifically, all the members of an organization are practitioners within one common community: that of the organization itself.

Recent discussion on organizational learning and knowledge creation has emphasized the role of project teams in knowledge generation. As was pointed out above, teams are bounded units, and therefore they can be managed as autonomous units. Teams can be held accountable, responsibility may be allocated to them, and they can have goals. Although teams are not, by default, real communities of practice, in practical organizational settings they approximate communities. Therefore they may also bring some of the benefits that result from collaboration, for example, in the form of improved knowledge appropriation and collective articulation. However, the analysis I have presented in the previous chapters suggests that teams are not the best possible constructs when knowledge generation is considered.

When a team has a well defined goal and most of the knowledge required to fulfill the goal already exists within the team, it can be an effective way of "getting things done." Therefore, teams are well suited to the prototypical cases of project implementation. However, for the broader task of supporting organizational learning and knowledge generation, team-based organization has problems. The construct of team makes those communication relations invisible that actually form the basis for its knowledge generation. Although teams rely on networks that bind the team members to communities that provide knowledge and expertise to the team use, these informal networks are based on social ties that are not managed. Indeed, often

the development of such social communities is discouraged by organizational practice.

From a developmental point of view teams are problematic because there is no concept of graded membership for teams. In a team, you are either in, or out. The full external accountability of the team requires that its members are collectively accountable, and therefore all team members are full members with responsibility for the shared goal.

Conventional teams are also problematic as much of the knowledge generated in the team is knowledge only in relation to systems of activity within wider communities of practice. Therefore, teams usually have to "implement" and "communicate" their results as a separate activity. Finally, as teams are bounded constructs, there is no natural way to get to a meta-level unit from using a team as a basis. An organization is not a team of teams, and it can not be effectively managed as a network of teams. In the knowledge perspective, the construct of team leads to a question of effective organization for inter-team knowledge sharing. The question does not have a good answer, as the question is misplaced.

However, if the generic goal of teams was to improve learning and knowledge sharing while keeping the units of activity accountable, we can ask whether we can combine the centers of organizational learning, i.e., communities of practice, with some forms of accountability. In general, a community of practice was an emergent division of work and identities within a culture. It is therefore not normally set up by any decision maker, nor does it have accountability. Although it may be possible to find explanations and legitimation for the existence of functionally diversified communities of practice, as such, they do not have externally defined "goals." On the other hand, teams do have goals, but their structure limits the possibilities for the team to generate knowledge, and for the organization around it to appropriate the knowledge generated by the team.

One solution to this trade-off between communities and teams is to define organizational units that combine the characteristics of teams and communities of practice. This can be done, for example, by simultaneously extending the concept of team to include a periphery that is not responsible for the goals of the team, and by extending the concept of community of practice so that teams can be community members. When we compare a traditional community of practice, a team, and the proposed combination of these, we get an organizational

unit that can be represented as in Figure 50. I will call the resulting unit an *organizational community*.

Figure 50. Combining the community of practice and team constructs.

The idea underlying organizational communities is simply that some of the members of the community are given organizational responsibility over some of the activities of the community. Using organizational communities, therefore, we can combine the processes for knowledge generation at the community level, and the accountability that is needed for the organizational level distribution of work and responsibility. Similarly, we can measure knowledge processes within an organizational community using the community level knowledge processes, as was discussed in the previous chapter.

A special case of organizational community is the traditional team, where there are no formally legitimated peripheral participants. Also in that case, the team typically needs contributions from experts outside the team. From the organizational point of view, however, the problem

is left to team members to take care of. Indeed, often the members of the team are selected because of their known ability to mobilize resources outside the team, and their capability to use their "informal networks." In practice, team members use their existing memberships in communities of practice to recruit services from outside the team. In many cases, these services come from within the focal organization, but often the recruited contributors may come from scientific communities, industry practitioners, associations formed around common interests, or, for example, from a golf club membership. However, as the team construct assumes that teams are autonomous, there is no institutional support for managing such external connections.

Another special case of organizational community is a pure community of practice. It has no formally defined core, nor does it have externally assigned goals. These are the foci of organizational knowledge generation, but as they have no formal legitimation, they usually have no institutional support. Sometimes such communities of practice are viewed as beneficial for the organization, and they have some legitimacy. This is specifically so when the community of practice is actually a community that is based on the division of labor within the organization. Even in such cases, however, the community is often conceptualized as a functional division. Therefore, its social dimension is reduced to production dimension, and the community is understood as a set of people who share the same tasks. In many cases communities of practice are institutionalized as various types of coordinating mechanisms, such as "steering groups" and "forums," which, more accurately, should be viewed only as expressions of the existence of an underlying community of practice.

Most organizational communities fall somewhere between these two organizational forms of a team and a community of practice. From the organizational point of view, they also require different institutional support. To the extent that freely emerging communities of practice increase organizational knowledge and support its renewal, an organization may want to allocate support for such communities. However, if the organization wants to assign responsibility for a community, is needs to provide sufficient resources.

The appropriate way to organize for effective knowledge creation would then be to combine the various types of organizational communities according to the strategic needs of an organization. In practice, the organization can, for example, develop legitimate roles for various types of community membership, provide infrastructure for

forming communities, and reserve a suitable amount of its resources for community activities. For example, an organization could define standard types of communities, with pre-designed roles, rules, and uses. A set of such possible types of communities is shown in Table 16.

Type of community	**Intended use**	**Expected life-time**	**Mode of emergence**	**Institutional support**
Interest group	thought community	long	emergent	basic
Expert community	action-group	long	emergent	according to strategic needs
Extended team	community with accountability	long	by fiat	extensive
Team	closed team	order of project time cycle	by fiat	total
Light-weight team	extended team, task force	short	by fiat, ad-hoc	basic-total

Table 16. Possible standard community types in an organization.

14.2 Community based core competence development

Prahalad and Hamel defined core competencies as organization-wide largely tacit intangible assets that deliver clear customer benefit. This definition, however, has proven to be problematic in several ways. For example, it includes only proven and validated assets, and therefore the idea of strategic development of new core competencies is somewhat contradictory. Also the organization-wide nature of core competencies is ambiguous. As Boisot (1998) notes, it is not clear what is the unit that possesses the competence: is it in the heads of a few individuals working as a team? Or is it widely distributed within the firm? What makes core competence a source of competitive advantage, instead of making it a core rigidity? (Leonard-Barton, 1992)

I have analyzed the problems of conventional core competence strategy in detail elsewhere (Tuomi, 1998b). Here I will focus on making some suggestions on how to organize for effective strategic competence development.

The conventional approach to core competencies tried to find components of core competence from a list of abstract skills that were detached from the organizational practice. If these skills can not be developed or learned in isolation from the practices they are part of, the approach, however, should be modified. Instead of breaking a core competence into sets of skills, we should analyze a core competence into its constituent communities of practice. Therefore, a specific core competence would not be created by putting together a set of skills, but a set of functionally diversified communities of practice.

When we conceptualize organizational competencies based on their underlying communities of practice, we can more easily understand the way core competencies emerge and develop. At some point of time an organization may include only employees that are peripheral members of a specific community. At that time most world-class competence is outside the control of the focal organization. Through recruiting and competence development, however, the company may eventually acquire a substantial part of the community, thereby becoming able to control the practice. Most important, knowledge development within a community is based on social interaction that leads to the creation of new concepts, models, and language; but also socialization of newcomers into the community practices. This situation is presented in Figure 51.

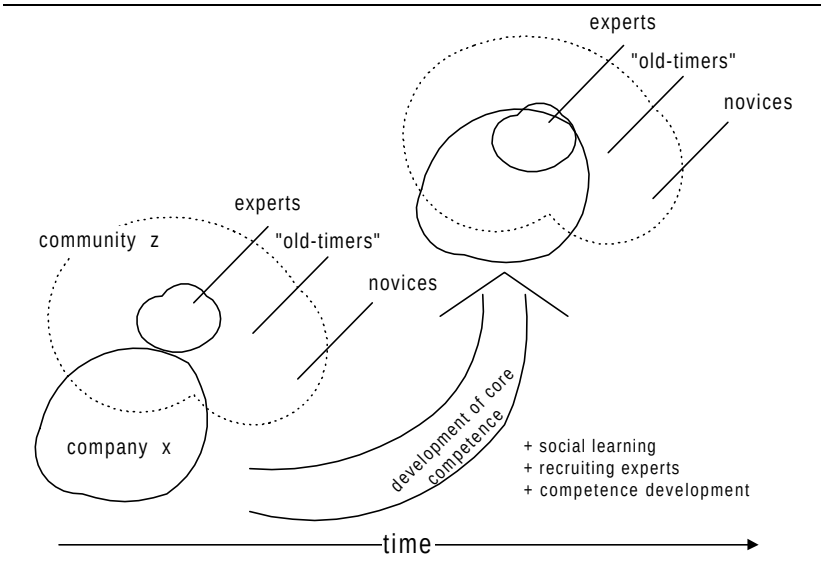

Figure 51. Internalization of a competence community.

In practice, organization level core competence in most cases comprises several communities of practice. The development of core competence, therefore, requires that a portfolio of communities needs to be managed. We have to understand what are the constituent communities that underlie a core competence, and facilitate knowledge development within these communities if we want to develop the core competence in question.

More generally, such an analysis of communities of practice may reveal latent core competencies. As core competencies emerge through combined activity of the underlying communities of practice, it may be that a specific complementary practice is missing that is needed to bundle the community practices into a core competence. Therefore, strategic development of core competencies may require intentional development of a specific missing community. This can happen, for example, by recruiting community experts, or even by giving a competent group of people the task of becoming experts in the area. Or, if there already exist some experts within the organization, they may be given the task and time of mentoring novices so that the community learning process is accelerated.

Development of core competencies can therefore happen through development of communities of practice. This is a natural approach to organizational development as learning in many cases happens through communities of practice. Those stocks of knowledge that need to be learned exist within the community, as well as experts who are able to guide novices in acquiring needed knowledge and praxis. Strategic development of core competencies, then, becomes strategic management of communities of practice. Based on the vision of the organization, its top management may define some areas of practice as strategically important, and manage a portfolio of communities of practice. As these communities of practice are inherently bound with their systems of activities and roles of people, there are also obvious ways to integrate knowledge development, work, and organizational roles and responsibilities.

These communities of practice could be characterized as spaces of meaning processing. These spaces are fundamentally social and cognitive. Their stocks of knowledge are accumulated through a sociohistorical process, and their knowledge creation can be described using the 5-A model. Using Nonaka's concept of *ba* we could say that these are the fundamental ba's of a knowledge creating organization. However, in most cases these ba are not completely contained within the focal organization, and, indeed, could not be if the organization wants to provide value to the society around it.

14.2.1 Implications for skill management and organizational design

It is interesting to consider how these concepts lead to novel managerial practices. As was argued that the beginning of this work, this actually is one criterion that we can use to see whether these theoretical developments have been worth our effort. In a very compressed form, we could note that, for example, the current conceptualization of competence management leads to the analysis of their constituent skills and skill sets. The community- and activity-based view on organizations, however, implies that skills are not something that can be analyzed independent of the underlying social system. This means that skills, in a very concrete sense, exist only within communities of practice. Their value, in turn, is defined through those systems of activity where these skills are utilized. Moreover, the appropriation of skills is a process of social learning. Major

components of relevant knowledge are tacit and bound to practice, and implied in "knowing-in-action," to use Schön's term. To develop organizational skills, it is therefore inappropriate to rely on those models of training which assume that knowledge is transferred from someone who knows to someone who doesn't yet know. Instead, both appropriation and articulation require spaces of social interaction. The development of organizational level core competencies, in turn, requires the management of portfolios of knowledge communities. If we use the generic name community of practice to denote those homogenous communities that underlie the organizational competence base, some of these observations can be summarized in the following way:

- processes and systems for skill management should be organized around communities of practice
- competence development should be supported by institutionalizing roles and incentives that reflect the level of expertise and engagement within communities of practice
- social learning within communities of practice should be supported by tools and processes that make it easy for community experts to accelerate competence development of novices and newcomers
- social learning and diffusion of innovations within communities of practice should be supported by facilitating communication within the community
- learning across communities of practice should be supported by creating mechanisms for inter-community knowledge sharing
- utilization of knowledge should be supported by providing mechanisms that enable communities to access expertise and knowledge created in other communities, e.g., by publishing meta-knowledge on community competencies and translations of knowledge created within communities
- core competencies should be developed by defining their constituent communities of practice, by facilitating social learning within the communities, by facilitating learning and communication between the constituent communities,

and by recruiting central members of the communities in question

- core competence strategy should be based on analyzing the opportunities and ability to internalize communities of practice
- organizational renewal should be supported by facilitating the registration of latent communities of practice, and by regularly giving latent communities opportunities to show their relevance for organization

The list above gives some proposals on how to manage knowledge creation and core competencies in practice. One should, however, note that although homogenous communities may underlie organizational competencies, their competencies are realized through systems of activity. Therefore, in practice, it is also important to analyze those inner contradictions that make the realization of competencies difficult. On a more abstract level, and organization may also develop a meta-level competence, for example, in the areas of organizational learning, or knowledge management.

Of course, the implementation of these ideas in any actual organization depends, for example, on its current strategic priorities, culture, and information systems. The list is provided mainly to show that the theory presented can be translated into practical organizational initiatives. Core competence development is not only analysis of competencies, or selection of those capabilities that an organization decides to use to gain competitive advantage. It is also facilitation of those processes that underlie the creation of expertise and knowledge. In practice, this leads to new organizational structures, managerial approaches, measurement systems, incentives, as well as new design requirements for information systems.

It is instructive to compare this approach with the hypertext organization proposed by Nonaka and Takeuchi (1995:160-96). According to Nonaka and Takeuchi, organizational knowledge creation and utilization can be supported by an organizational design that combines several interconnected contexts where people work. The central layer is the “business-system” layer where routine operations are carried out. Since routines are efficiently conducted by organizational hierarchy and bureaucracy, this layer is organized as a hierarchy. On top of this hierarchy, however, there exists a dynamic “project-team” layer. On this layer multiple project teams engage in

knowledge creating activities, such as new product development. Nonaka and Takeuchi propose that the team members are brought together from the different organizational units according to the requirements of the team, and for the life-time of the team. This project team layer is, according to Nonaka and Takeuchi, the primary source of new knowledge.

In the hypertext model of Nonaka and Takeuchi there is there is also a "knowledge-base" layer. This layer does not exist as an organizational entity; instead, it is embedded as corporate vision, organizational culture, and technology, including databases. One could then say that the knowledge-base acts as a repository that maintains organizational knowledge, both in its tacit and explicit forms. According to Nonaka and Takeuchi (1995:167), "while corporate vision and organizational culture provide the knowledge base to tap tacit knowledge, technology taps the explicit knowledge generated in the two other layers." The hypertext organization can be represented as in Figure 52.

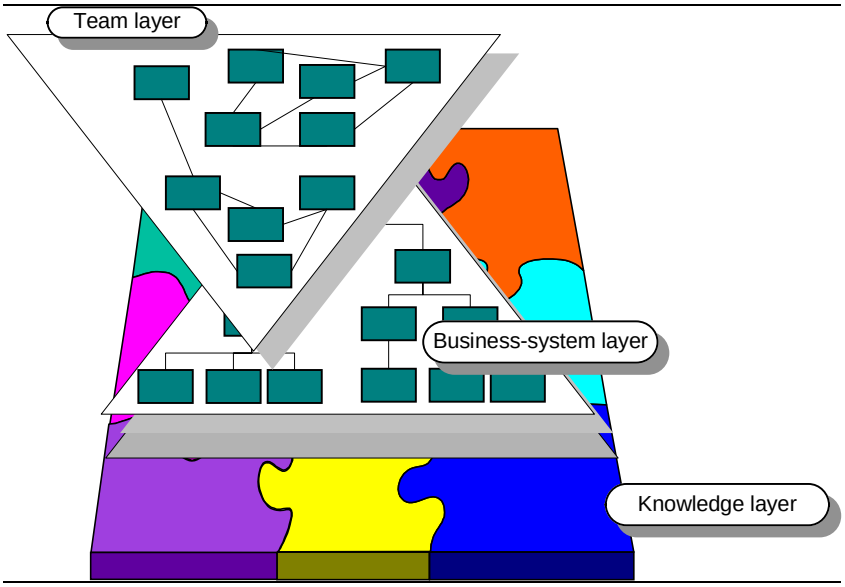

Figure 52. A community-based hypertext organization.

In the light of the discussions and theory presented above, the hypertext model proposed by Nonaka and Takeuchi should, however,

be reinterpreted in the following way. Instead of conceptualizing the knowledge-base layer as a repository of organizational knowledge it needs to be conceptualized as a set of communities of practice. My claim is that the knowledge layer, in any organization, is essentially bound to such communities. Therefore, in contrast to the original proposal by Nonaka and Takeuchi, the knowledge layer should not be conceptualized as a repository of documents, technologies, or "corporate culture." Instead, the knowledge-base layer of the hypertext organization should be interpreted as a social meaning processing space. This space is not a homogenous repository where organizational knowledge is accumulated. Instead, it consists of the various communities that create and recreate organizational meaning and knowledge structures. Therefore, I have also modified the original representation of the hypertext organization so that the knowledge-base layer has some structure. One could read the representation as saying that the knowledge layer is formed by a set of communities of practice. I have also renamed the bottom layer to reflect the idea that the knowledge layer is not only a "knowledge-base" or a repository, but that it is actually the layer where knowledge is actively processed and created. As social systems, the communities that form the knowledge layer can, of course, also use cognitive artifacts, including documents and tools, to store some of their knowledge and meaning structure.

This modification also means that the way knowledge work is organized becomes quite different in the original hypertext model and in its modified form. Nonaka and Takeuchi proposed that knowledge work is organized so that people have a "home-base" in the hierarchy of the business system layer, and that they are moved to project teams when there is some project work that needs to be done. Such project-based way to organize facilitates dynamic allocation of competencies and promotes knowledge sharing and knowledge creation in teams. However, whereas Nonaka and Takeuchi assumed that new knowledge is created mainly on the project layer, and shared on the knowledge-base layer, the modified model suggests that much knowledge creation also happens on the knowledge layer. As was pointed out before the focal unit of collective knowledge development is a community of practice, and a team is only an organizational artifact that tries to emulate some aspects of community knowledge processing.

Indeed, it seems that the more recent work by Nonaka around the concept of ba would be easy to integrate with the idea of the hypertext organization when the knowledge-base layer is conceptualized as a set of ba's. However, this would also require that the concept of ba is

reinterpreted as a social meaning processing space, as I suggested before. Therefore, the concept of ba also becomes at least to some extent incompatible with the SECI model.

In practice, the main difference between the original and modified forms of the hypertext organization is that the latter indicates that people need to have a "home-base" at the community level in addition to the home-base at the business system layer. This means that memberships and participation in the communities need also to be managed within the organization. Moreover, people are typically members in several communities, so that the Figure 52 gives a rather simplified picture of the structure of the knowledge layer. Indeed, one could say that finding the rights practices and tools for the management of the knowledge layer is one of the key challenges for knowledge management in the coming years.

15 Conclusion

At the beginning of this work I said that my ultimate goal was practical: how to conceptualize knowledge in an organization so that it can be managed and mobilized well. I pointed out that this requires careful rethinking of many concepts that are central for our understanding of knowledge, intelligence, and organizations. I told that I will rewrite some of the most prominent theories underlying the current discussions on organizational learning, organizational information processing, and knowledge management.

The main result of the work, therefore, is an integrated set of concepts and a new language that can be used to describe knowing in organizations. A phenomenological and constructivistic view on intelligence was combined with the sociohistorical and developmental view, and extended to social systems using autopoietic theory and Luhmann's theory of social systems. This language was used to describe organizations as recursive communicative social systems. The idea was implemented through the definition of organizational knowledge creation communities.

The introduced constructs were then applied to define theoretical basis for organizational knowledge management. A novel typology of knowledge was described and several models of learning were described and discussed. The knowledge creation model proposed by Nonaka was analyzed in detail and several areas where this model could be enhanced were pointed out. Based on the limitations of extant models, a new model of organizational knowledge creation—the 5-A model—was presented.

These theoretical considerations were then applied in a practical context. Organizational knowledge processes were described, the complementary views on organizations as productive processes and knowledge systems were discussed, and the three dimensions of organizational activity were defined.

The various disciplines of knowledge management were summarized and integrated within the three views of organizational intelligence, organizational development, and organizational information processing. Using these, a novel framework for knowledge management was described. Two aspects of this framework were discussed in detail: measurement of knowledge-based organizations, and organizational structures that support innovation and knowledge creation. A new approach to measuring knowledge creation was

proposed based on the 5-A model, and a novel organizational unit—an organizational community—was described that combines aspects of communities of practice and organizational teams. The community-based approach was then used to describe a new conceptualization of organizational core competencies, and it was shown that this leads to new management approaches that integrate organizational strategy, action, and learning in a natural way. The community-based view was also used to reconceptualize the hypertext organization proposed by Nonaka and Takeuchi, and it was shown that this reinterpretation leads to novel practical recommendations for supporting organizational knowledge creation. For example, it was pointed out that the concept of *ba*, discussed by Nonaka and Konno, can be reinterpreted as a community of social meaning processing, and that knowledge generation can be described as occurring within such *ba*'s. As was noted, however, this interpretation shows that a knowledge creating *ba* is not, strictly speaking, compatible with Nonaka's knowledge creation model.

During the course of this work, several lines of research have been introduced that help us in building a theoretically sound basis for knowledge management. After a review on epistemological traditions and methodological issues that need to be considered in knowledge management research, we started from Bergson's conceptual analysis on the phenomenon of knowing. The reason was that Bergson's epistemology is founded on the idea that knowing is an active process that is directly related to the needs of a living being. Therefore, Bergson was able to radically criticize those epistemological positions that understood knowledge as objective facts and justified true belief. Instead, Bergson's epistemology was based on the question how living beings construct the world that becomes the object of their knowing, and how the process of this construction creates the world as a meaningful world. Although Bergson's philosophy has to a large extent been forgotten and misrepresented, he addresses important questions that describe how we can build a theory of knowledge that binds intelligent action with the process of knowing. This was the epistemological layer from where we started. It is also the point from which constructivistic and phenomenological approaches to epistemology make sense. In practical terms, it is an important point as it enables us to connect knowing with intelligent and competent action, which is something we want to do in organizational knowledge management.

From the practical perspective of organizational knowledge management, it is not sufficient that we have static theories about knowledge. It is also important to understand how knowledge is created and how the various forms of knowing develop. For this reason, we introduced Vygotsky's ideas about sociocultural development, as well as his theory of conceptual development. This brought us to discuss the social and collective aspects of knowing. In the course of the work it was shown that Vygotsky's ideas are highly relevant for both the theory and practice of organizational knowledge management. Indeed, one underlying theme in this work was that knowing is to a large extent a social phenomenon, bound to systems of social activity, and reflected in social practices, tools, and language.

To understand the processes that underlie social meaning processing, we then reviewed Luhmann's theory on social systems. This enabled us to discuss in detail the nature of communication and collective meaning processing. Luhmann's theory explains the evolution of meaning processing systems towards increasingly complex forms with their inherent tensions and mechanisms that release these tensions. It is an abstract theory because it does not use those everyday concepts that we believe to be concrete. Luhmann's theory is based on radically different conception of social systems from those conceptions that were the foundations for many earlier theories. Indeed, it is based on phenomenological epistemology, and a phenomenological theory of living cognitive systems.

Luhmann's theory is closely related to the theory of autopoietic systems. We discussed the basic concepts of autopoietic theory, and developed several extensions to it. A major result of the discussion was that the basic thesis of the autopoietic theory can not be right: living systems can not be strictly autopoietic. Therefore also the question whether social systems are really autopoietic or not emerges in a new light. To overcome this problem we developed the idea of almost autopoietic systems, and defined social systems as self-maintaining meaning processing systems. Here we actually combined two independent but fundamentally compatible insights from Bergson and Vygotsky: when we try to understand cognition, knowledge, and intelligence, we have to approach the question from the perspective of time, instead of space. This approach characterizes the path we traversed towards the theoretical foundations of knowledge management also more generally. To understand knowing, we have to understand its genesis and development.

Based on this rather extensive analysis on the phenomenon of knowing, we then moved to apply the theory in organizational contexts. Whereas in the beginning the focus was on the nature of knowing, in the third part the focus was on applying the developed concepts to formulate a theory of knowledge management, as well as on showing how this theory can be translated into practice.

Indeed, I think we were able to see that it is possible to reconceptualize existing theories of knowledge management, and that this reconceptualization makes a difference in practice. I also think that we were able to answer the research problems stated at the beginning. There is a link between knowing and action, the knowing subject can be understood as a socially embedded human-in-society, and the radical constructivist interpretation of the principle of object-relatedness opens a way for epistemology that can combine meaning and transformative productive activity. We can make organizations more effective users and producers of knowledge by developing theoretically consistent frameworks for knowledge management, and, for example, by changing the ways we measure knowledge and organize knowledge work. This, however, also requires new models of knowledge processes within organizations. I developed one such model, the 5-A model, based on the theory presented. I am aware that this model is not fully articulated at this point of time, but its main function here is to show that the concepts developed in the course of this work lead to new theoretical conceptualizations.

At the beginning I also pointed out that my approach was intentionally a bold one, and that it is obvious that no single individual can cover all the relevant theory. My methodological choice was in line with the epistemology developed in this work: the creation of new knowledge requires a concentrated effort to solve a problem that requires solving. As I pointed out, a theoretically sound criterion for successful knowledge creation and learning is that a problem is solved or a constraint is overcome, so that it is possible to proceed with action.

It seems to me that there are many ways to proceed with practical knowledge management, based on the work done above. I discussed two examples in some detail, describing how new measurement concepts and organizational structures can be taken into use. Both these require more discussion, but I hope these examples give a taste of those new approaches to knowledge management that can be developed on the basis of this work.

Within a heavily epistemological work, such as this one, the problem of methodology is an interesting one. Indeed, a major goal of this work was to create new understanding about what knowing is and what knowledge means. In a sense, we have to bootstrap the methodology at the same time as we create the conceptual language that is used to describe the phenomenon under study. As this work was critical for the empiristic conception of knowledge, the results could not have been based on induction or deduction. Instead, the results emerge exactly as was described in the course of this work, and as was shown in the 5-A model. Knowledge is created in a learning process where existing conceptual systems are used as the basis for articulating new meaning and new concepts. This process is not mechanical combination of extant truths or ideas, but an active and creative process where intellect and intuition are constantly tested by the success of generated concepts. Sometimes the criterion for success is simply the coherence of the argument. Finally, however, our theories are tested in practice. The final judge, therefore, is also the reader. If he or she learns something new and finds new effective ways to behave as a researcher or a manager, then new knowledge has been created.

A methodological limitation of this work is, of course, that at many points it is highly speculative. There can be no facts that could prove a claim that we have to change the way we understand and manage organizations. Such facts can only emerge after we have implemented those organizational forms and practices that have been described above, and compared the success of these with other organizations.

Indeed, in this sense this work has been a philosophical and conceptual study. At best, we can show that there is a reasonable basis for the argument, that the argument itself is coherent, and that it leads to novel insights. Indeed, this methodological choice reflects my view that empirical results are useful mainly within a given research problem, and not when we are trying to formulate the problem in a new way. In the latter case, empirical evidence can mainly be used to indicate anomalies within existing theories. The success of this work, in my opinion, depends very much on whether it creates new insights for the reader, and whether it enables the reader to move on with the practice of knowledge management. For some readers, this practice may be development of theory, for others it may be the deployment of knowledge management concepts in actual organizations.

Some highly important areas of knowledge management were not covered in this work. For example, organizational motives and

incentive systems are extremely important for practical knowledge management. Although these topics were briefly mentioned, they deserve both further theoretical study and new managerial approaches. Another area that requires further discussion is information systems that can be used to support knowledge management. One reason for leaving this topic out of this work was simply space limitations. It certainly would have been of great practical importance, and it was indeed one of my starting points, but it would have extended the current work too much. I have published and presented some work on this area that I would have liked to revisit and rewrite in the context of the theory developed in this paper. For example, I think there are very interesting questions that relate to how organizational sensemaking can be supported in global organizations using information systems (Paajanen & Tuomi, 1992; Tuomi, 1991; 1992a; 1992c; 1993c; 1993a; 1993b), how we should design effective systems for organizational memory (Tuomi, 1995; 1996; 1999a), or how collective knowledge creation can be supported by information and communication technology (Tuomi, 1998a). I hope I can return to these topics later.