

ORGANIZATIONAL FORMS & KNOWLEDGE TYPES: A COGNITIVE MULTI-ACTOR APPROACH

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ABSTRACT

In this article knowledge types are combined with organizational forms. Knowledge is something individual actors have. This paves the way for a semio-cognitive approach to actors. Organizations in which primary and organizational (secondary) processes are performed are viewed as multi-actor systems. Organizational processes consist of tasks, such as planning, control and administration. These tasks are performed by individuals with knowledge. With regard to knowledge not only content, but also type can be discerned. Three knowledge types are distinguished: tacit, coded and theoretical knowledge. In developing a conceptual framework for the cognitive analysis of knowledge management, I will illustrate and explain that the dominance of tacit, coded or theoretical knowledge matches well-known organizational forms with labels such as machine bureaucracy, simple structure, professional bureaucracy and market. Therefore, knowledge management is about the management of knowledge types and of representations of cognitive actors executing tasks in organizations.

INTRODUCTION

Three different perspectives on knowledge management can be distinguished. First, knowledge management can be seen as a part of human resource management. In that case the discussion is about the assessment of skills, abilities and intellectual powers of people (Weggeman, 1997). In a second perspective knowledge management is a kind of upgraded information management. Then knowledge management has a technical interpretation and refers to the relation between humans (and their knowledge) and information systems, such as management information systems, database systems, decision support systems and knowledge systems (Laudon & Laudon, 2000)

A third interpretation of knowledge management is related to organizational studies in general and is about the control, the assessment, the maintenance, the coordination, the division and the spreading of knowledge (and learning) as such (Jorna, 1998; Sorge & Warner, 2001). Starting points in this interpretation of knowledge management are organizations and processes. It is an approach that works from the top, organizational structures and processes, downwards to people and tasks. It seems, however, that the debate about knowledge management resembles the well known box of Pandora. Organizational researchers started a debate of which the consequences could hardly be overlooked. Knowledge and learning as such are not easy to define or operationalize. Moreover, in most organizational (and information systems) literature a conceptual framework dealing with knowledge and learning is lacking, especially when one takes a perspective that goes from the bottom, individuals and tasks, up toward the top, namely organizations and processes.

In this article, I want to argue that knowledge management is about the types and contents of knowledge (and learning) in which individual people with their minds, cognitive architectures and (mental) representations are the basic focus of attention. Humans as information processing systems behave intelligently and acquire, integrate and use knowledge.

Organizational and societal principles are on the one hand the expression of thought processes of human individuals. On the other hand they are present, active and relevant because of the individuals that interpret and represent principles as beliefs, opinions and knowledge. This argument requires a conceptual framework at another level of aggregation than is usual in discussions of knowledge and knowledge management in organizations (Laudon, 2001). Instead of departing from organizational principles, coordination mechanisms and organizational forms, we will start from individual actors with their avowed and tacit knowledge and interpretations and representations.

Discussions about knowledge and knowledge management can be in terms of the **content** of knowledge or the **type** of knowledge. The content of knowledge will not be discussed in this article. What I want to emphasize is that the **types** (forms) of knowledge and their distribution among and dominance over people in relation to tasks in an organization are important. The conceptual framework of knowledge types that is presented in section 3 is used to operationalize knowledge management. It is also used to match, as I will argue, various organizational forms in organizations.

In explaining this cognitive interpretation of knowledge management a conceptual framework dealing with (types of) knowledge within organizational settings is important. This framework is based on the view that an organization is a multi-actor system. I will discuss this view in section 2, in which also various kinds of actors will be categorized. This categorization has consequences for organizational forms. In section 3 I will discuss

various types of knowledge in detail. In section 4 I will relate the knowledge types to organizational forms. Section 5 gives conclusions in relation to knowledge management, innovation and information systems.

ACTORS IN A MULTI-ACTOR PERSPECTIVE ON ORGANIZATIONS

Sorge (in Sorge & Warner, 2001) distinguishes two meanings of organization: 1. organization may refer to a social unity (or collectiveness) and 2. organization may refer to organizational properties. In other definitions of Aorganization@ processes (and their coordination) are mentioned as cornerstones (Thompson, 1967; Gazendam, 1993). A process is Aan action in its progress@ (van Dale, 1995, p. 2378). I want to argue that in the analysis of processes - that is the collection of progressing actions - the executing entity in the form of the human information system often is neglected. A process needs a material carrier. A process runs on something, just like software runs on a computer. In production environments the carriers are the machines, the instruments, the tools, the computers and of course the employees. In service and administration environments the material carriers of processes are the employees and the computers. It is interesting to see, however, that both the details and the interpretations with regard to what the employees are and what mental mechanisms are involved in performing tasks are vaguely formulated. In many organizational studies the realization of the process(es) is often a highly abstract, almost metaphysical affair (see Sorge & Warner, 2001). From a knowledge (management) perspective in particular, this abstract meta-individual perspective is odd, unwanted and unnecessary. Even if one views knowledge from a Platonic supra-individual perspective, it still is directly connected to the human mind. Individuals, alone or in groups, execute tasks by which they use interpretation, intelligence and knowledge. Even coordination, planning and control as separate tasks - normally called the organizational processes (see section 4) - are, so to speak, in the minds (and hands) of individuals.

Furthermore, an organization originates from the individuals who are part of the organization and who can think of that organization. Without thinking of an organization, there is no organization, even if there are constructs and artifacts as buildings and machines. As Sorge (2001, p. 7) says AOf course, there would not be any organization behavior without human behavior.@ My proposition is that the basic ingredients of an organization are the intelligent - cognitive - actors. This means that there exists a nesting of a) actors within organizations and b) organizations within actors. The first nesting means that an organization always consists of a collection of actors. This makes an organization a multi-actor system. The second means that a set of actors can form an organization, but only in the sense that an actor can think of and reason about the role of the other actors. The other actors in turn have opinions and beliefs, that is to say representations, about the first actor. This implies that an organization as a construct consists of the sharing of individual representations. The key notions, here, are representation and interpretation. An organization is a representation (and an interpretation) in the eyes of (intelligent) actors. This means that an organization as a human-made conceptual construct is not an object such as a car, a bridge or a computer. If we speak about actors with representations and interpretations, the actor is the concrete human individual and not some metaphorical entity. Properties as Awill@, Aognition@, Amemory@ and Amotives@ apply to individuals. Literally, or materially speaking, only individuals have these characteristics. Organizations as such do not have a memory, knowledge or the ability to learn. In the remainder of this article an organization is conceived of as a multi-actor system consisting of natural actors and coordination mechanisms.

If we look at actors we can ask what it means to be a cognitively and psychologically plausible actor. Or more neutral, what kinds of actors can be discerned and how are they structured? Later we will discuss the building blocks of actors in general and of intelligent actors in particular. In general three kinds of actors can be discerned: a) response function actors, b) representational actors and c) representational response function actors (see Figure 1).

An actor is an acting entity. We speak about a cohesive, structured and organized unit. This entity operates in an environment. This entity is an actor, because it is self-contained and strives toward continuation. Looking at the psychological characteristics, it has perception and interaction including the possibility of learning in the sense of habit formation. This kind of actor does not have internal representations. Its cognitive domain is absent or empty. I call this actor a **response function system** (RF-system). It can be compared with the ant in the sand (Simon, 1969). In discussing complex behavior of systems Simon stated that the behavior of an ant on the sand can be called complex, although not intelligent, because the behavior is a function of the complexity of the irregular sandy environment that the ant has to cross.

Another kind of actor is what I call a **representational system** (7-system). This actor has representations and is able to internally transduce external events into its cognitive domain. This representational system has representations, autonomy and transducer components. The interaction or the social context is problematic, which means that there is no device that semantically interprets causal input and output. As far as we speak about interaction it is merely a low level reaction to stimuli. If we look at present day cognitive science, most linguistically and logically oriented researchers have such a kind of actor in mind (Phylyshyn, 1984). In most classical cognitive science the social environment is not the subject of research (Clancey, 1997). Representations

and reasoning mechanisms are investigated in the cognitive environment of the individual and not in its social world.

The third kind of actor is the **representational response function system (RRF-system)**. This actor incorporates a really intelligent, interactive and cognitive system. It is able to perceive, interact, represent and be autonomous. Cognitive processes include symbols, operations and semantic interpretable response functions. RRF-systems behave on the knowledge level, as Newell called it. "There exists a distinct computer systems level, lying immediately above the symbol level, which is characterized by knowledge as the medium and the principle of rationality as the law of behavior." (1982, p. 99) Newell is proposing this knowledge level for natural (humans) as well as for artificial (computers) intelligent systems. The actor equipped with the integration of representations and responses has knowledge. "Knowledge", says Newell, "is whatever can be ascribed to an actor, such that its behavior can be computed according to the principle of rationality." (Newell, 1982, p. 105) The principle of rationality is expressed in the belief that an acting person will undertake those actions by which his goals are reached (Simon, 1947/76).

KINDS OF ACTORS

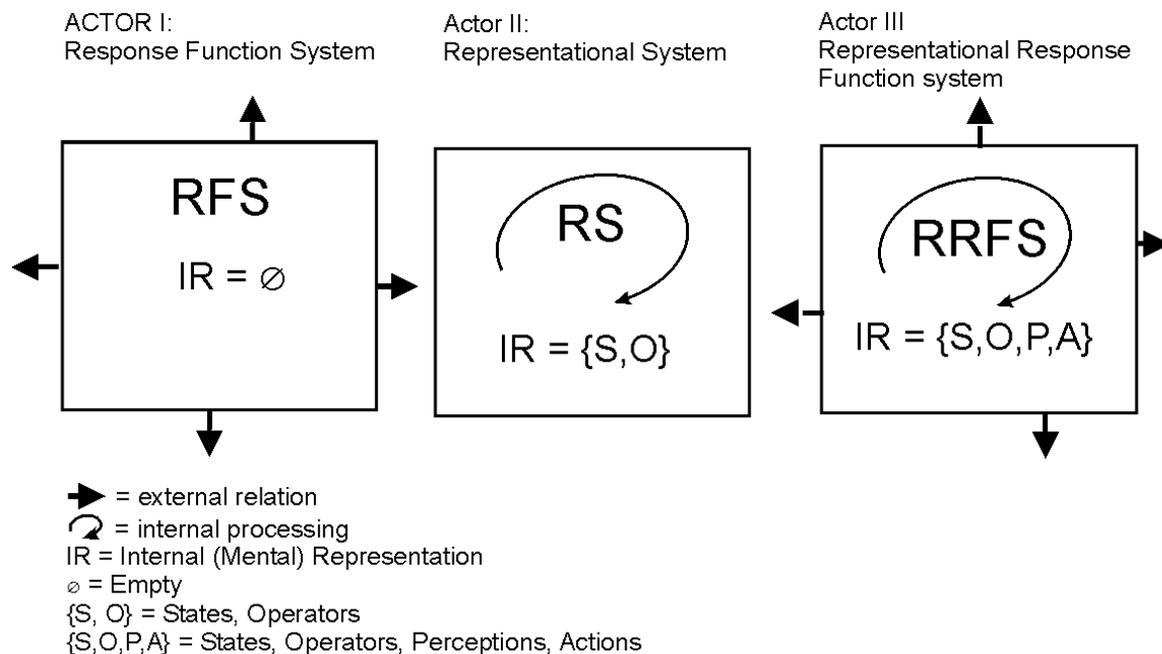


Figure 1; Overview of Kinds of Actors

The sub-division in kinds of actors is based on (cognitive) psychological components, namely: a) perception, b) interaction (including learning in the sense of habit formation), c) representation and interpretation (including learning in the sense of chunking and creation) and d) autonomy and self-consciousness (self-representation).

With perception I mean that a system must be able to accept input in a general sense. This input may include visible, audible and tangible stimuli and the accepting system may vary from a lobster to a human being or even a computer system.

Interaction is the process by which a system has contact with its environment resulting in actions and motor behavior. Stimuli as input in the system lead to output in the sense of responses. The reaction patterns of the system may result in learned behavior, that is the formation of habits.

A system that internally symbolizes the environment is said to have and use representations. Representations consist of sets of symbol structures on which operations are defined (Jorna, 1990). Examples of representations are words, pictures, semantic nets, propositions or temporal strings (Kosslyn, 1980; Anderson, 1990). A representational system learns by means of chunking mechanisms and by the creation, transformation and manipulation of symbols. Details of the components can be found in cognitive science literature (Posner, 1989; Newell, 1990; Stillings et al., 1995).

A system is said to be autonomous, self-organized and self-conscious if it is able to have a representation of its own (physical and conceptual) position in the environment. This means that the system also has self-representation. An autonomous system has reconstructing representational interaction patterns.

Actors in the form of response function systems, with only perception and (stimulus-response) interaction, are at the lowest level and can not be called intelligent actors. Actors, such as representational response function

systems, have self-organization (self-representation), including perception, interaction and representations and are at the highest level. This form is what we regularly call an actor that is reflective, intelligent and thoughtful. Human beings are instantiations of these intelligent actors. Computers are said to have representations, but not self-organization and self-representation. If computers can do tasks for which it is indicated that humans perform these tasks with intelligence, computers - according to cognitive scientists - have intelligence, at least to a certain degree.

The componential structure of actors is only one part of the conception of an organization as a multi-actor system. The other part consists of coordination mechanisms, including communication, that is used to regulate, control, attune and adjust the multitude of actors (Gazendam, 1993). Coordination mechanisms are realized in so called organizational forms. It should, however, be borne in mind that coordination mechanisms also exist as representations in the cognitive system of actors.

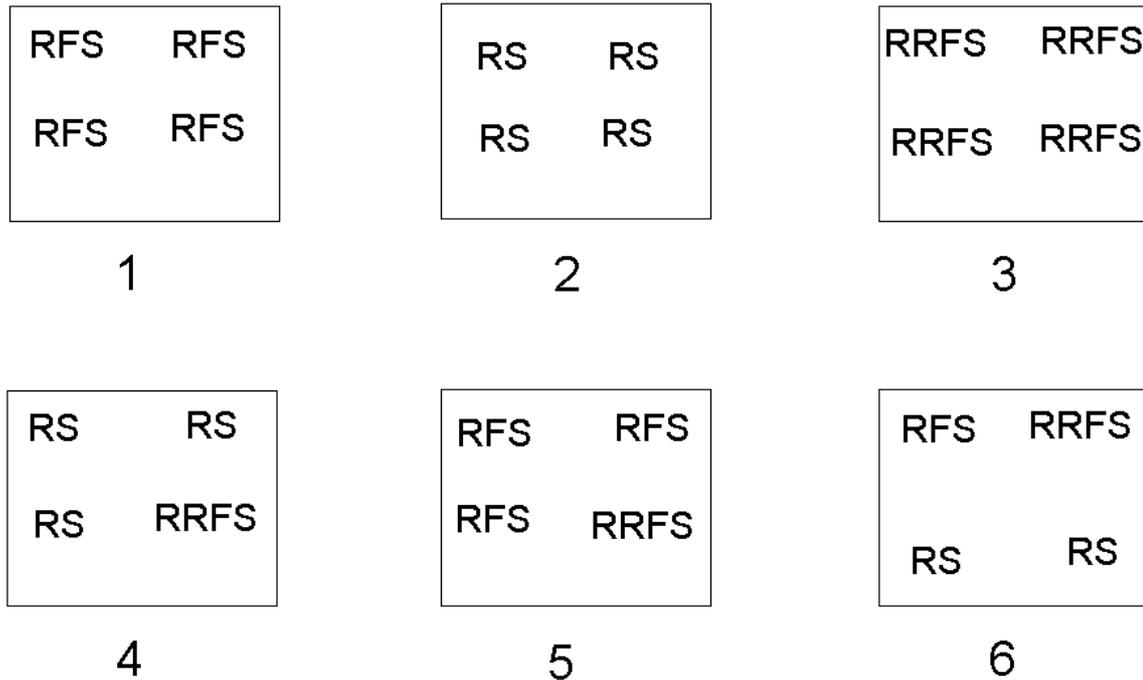
Various coordination mechanism can be found, such as the standardization of tasks or products, the top-down structuring of hierarchies or the implementation of trust and loyalty. I will return to the details of these mechanisms in section 4. Coordination mechanisms also have to match with the various kinds of actors in the multi-actor system. We can make a distinction in homogeneous and in heterogeneous multi-actor systems. Homogeneous means that all actors are of the same kind. If, for example all actors are response function systems, the actors have perception and interaction. To take up the example of Simon's ant we are referring here to a group of ants perceiving and interacting with each other. Coordination is only defined in terms of reactions to the behavior of other actors. To make a provocative statement, I state that although organizational theory and the larger part of economics speak about the coordination of multiple intelligent actors, in actual practice the actors behave as response function systems. Interpretation, representation and cognitive components are not used to found the overt behavior of individuals (Klos, 2000; van den Broek, 2001).

Another example of a homogeneous multi-actor system is the one where all actors are representational response function systems. Each actor has perception, interaction, representation and autonomy and (inter)acts in a semantically rich and intelligent way. A collection of human information processing systems is an example of such a multi-actor system. This is what we normally call an organization in which various coordination mechanisms regulate the interaction.

As can be imagined many multi-actor systems are heterogeneous. Most actors in such a system may be representational response function actors, however some are only representational and others are merely response function actors.

My argument is that the only meaningful incorporation of actors in organizational theory is in the form of a representational response function system. This allows for the use and integration of cognition, knowledge, interpretation and sign (symbol) manipulation. This combination of terms has consequences for knowledge management and refers to cognitive science (Posner, 1989) and to semiotics (Nöth, 2000; Michon, Jackson and Jorna, 2001). The coordination and communication between actors is expressed in signs. This implies that an organization is also a semiotic entity. It is semiotic as an entity, because of its participants, its processes and outcomes. With semiotic I mean that an organization as an artefact, a construct or a representation, is basically a sign type or sign token. The interesting thing about looking at an organization as a semiotic entity is that it reveals the many different sorts of signs turning up in the communication and information structures between the various actors.

In the discussion of knowledge management in organizations the basic approach has to be to look at the actors as human information processing systems. Managing knowledge not only means managing behavior, but it also means managing representations in one way or another. Knowledge is inherent to cognitive systems. Managing this knowledge is therefore related to suitable coordination mechanisms. Not every coordination mechanism is suitable in every multi-actor situation. Furthermore, managing knowledge is not in the first place related to the content of knowledge, but especially to the **type** of knowledge. Managing the **content** of knowledge is inherent to the internal structure of the domain under consideration. Managing types (or forms) of knowledge is essential in (the operationalization of) knowledge management. I will discuss the various types of knowledge in the next section.

Single Actor:**RFS: Response Function System****RS: Representational System****RRFS: Representational Response Function System****Multi-Actor System (the four actors within a box (environment)):****homogenous: 1, 2 and 3; heterogenous: 4, 5 and 6****Figure 2: Homogenous and heterogenous multi-actor systems****KNOWLEDGE AND KNOWLEDGE TYPES**

Knowledge, information and data are closely connected. The raw material of data is the unformatted unstructured material in the world (Jorna & Simons, 1992; Schreiber a.o. 2000). Data are such things as the various signals - acoustic, visual, tactile and otherwise - that are around us and that can be interpreted as (consisting of) information. The formal relation between data and information is that information is a structuring of data that reduces uncertainty. The more a message reduces uncertainty, the higher its information value. In a more informal way it could be said that information is interpreted data. Knowledge is the interpretation of information of an individual using his own history, experiences and interpretation schemes. That is the reason why the same information may lead to different knowledge for different individuals. Formulated more dynamically, the relation between data, information and knowledge is as follows: a person (a human information processing system) receives data, and through the knowledge he or she possesses, data are turned into information. Ultimately, this process changes the former knowledge of the interpreting person.

It is almost impossible to define types of knowledge unambiguously. Traditionally conflicting epistemological, psychological and cultural categories can easily be distinguished (Nooteboom, 2000). To avoid debates, we start from a semiotic perspective. We choose the semiotic stance because we believe that sign production and sign understanding are fundamental in human cognition and human communication. Based on the information concepts of Boisot (1995), we define a dynamic model for knowledge types (for details see: van Heusden & Jorna, 2001). We start with three types of (semiotically inspired) knowledge: a) tacit or perceptual, b) coded, and c) theoretical knowledge. This division in knowledge types refers to the number of semiotic dimensions involved in the representation.

The first type is **tacit** or perceptual knowledge. It starts from a perception of difference. The first semiotic step is always to recognize the situation in terms of a situation (or state of affairs) you already know. We find ourselves, at this point, at the level of *Asense making@* (Eco, 1976; Weick, 1995, Choo, 1998). Perceptual knowledge as one-dimensional representation underlies what Michael Polanyi has coined as *Apersonal knowledge@* (Polanyi, 1966). He describes the process involved in this tacit knowledge as being *Aaware of that from which we are attending to another thing, in the appearance of that thing@* (p. 11). Tacit knowledge often is *bodily knowledge*: *Awhen we make a thing function as the proximal term of tacit knowing, we incorporate it in our body - or extend our body to include it - so that we come to dwell in it@*(p. 16). This type of knowledge can not be coded, it is about concrete experiences, and it can be shared only with those who are co-present.

Differentiation of this type of knowledge can be done by the measurement of detail; some of us have an acute sense of differences; they are intense perceivers (detailed tacit knowledge), while others tend to overlook most differences and concentrate on identities (broad tacit knowledge). Knowledge of details is of course relative to a certain domain, and to the knowledge of others in the same field. Thus a professional will be able to perceive more when looking at a certain activity than an amateur. One cannot rely upon verbal reports. Personal knowledge has to be determined through the analysis of behavior, that is, of what someone is able to do in a certain situation.

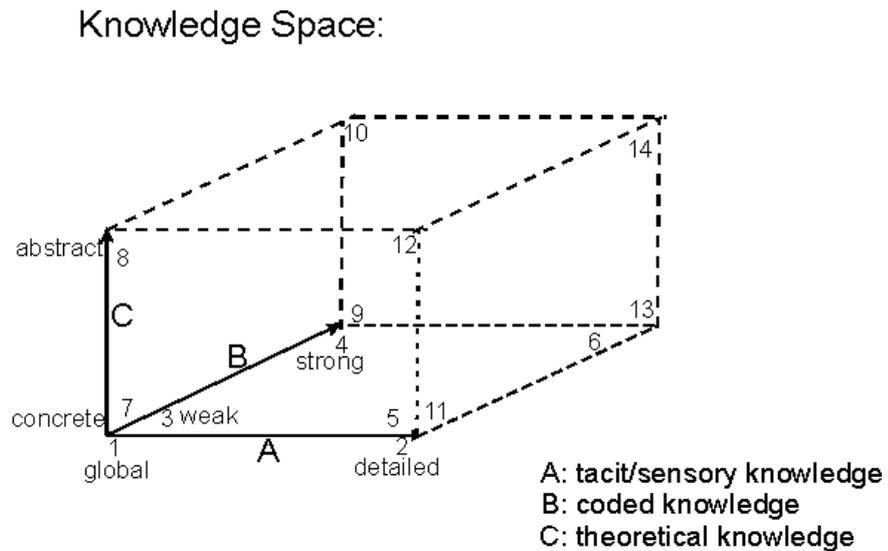
A knowledge type becomes two-dimensional when, out of the relation between the two events in the process of representation, a new dimension emerges. This new dimension is the dimension of the sign as **code**. Codes range from an undefined set of icons or diagrams to a well-defined set of mathematical symbols. Differentiation in codes is constituted by the size of the set, the well-definedness of the elements in the set, the concatenation rules and the degree of disambiguation. The two-dimensional sign requires communication and makes communication easier. The two-dimensional sign is therefore basically a social sign.

Although categorization in codes is (mostly) conventional and rests upon the grouping of features, this knowledge enables us to communicate about our experience. In other words, the diffusion of knowledge becomes easier where codes are available (Boisot 1995). Externalization and diffusion require coding. The two-dimensional sign is also tied to a context, but this is not any longer the context of a concrete state of affairs. In terms of Boisot (1995): the diffusion of the sign now takes place along the lines of a social community.

Codes can be differentiated by taking into account the number of elements and combination rules a code consists of, as well as the degree of ambiguity allowed. Thus musical notation systems are more strongly coded than natural languages. At the lowest level of codification, codes tend to dissipate into concrete, that is, one-dimensional perceptual knowledge. Therefore, in the use of images and metaphors, coded knowledge comes closest to the non-coded concrete knowledge of the first phase. Further details about the operationalization of weak and strong codes can be found in Goodman (1968; see also Jorna, 1990).

The third type of knowledge, **theoretical** knowledge, emerges when to perceptual difference and codification a third dimension is added, which is that of the logical or formal relation. Knowledge is theoretical when coded signs relate to the events represented, not on the basis of a convention, but on the basis of formal or structural qualities. Basically, theoretical knowledge is knowledge about the necessary relations between events and categories of events. Most scientific knowledge belongs here. It is often the result of answers to the question: why? It should be clear that theoretical knowledge makes diffusion even easier than does coded knowledge; theoretical knowledge is not, in principle, conventional, but universal. Although codes are needed to communicate theoretical knowledge, the knowledge goes beyond coding. Codes are the vehicle. However, theoretical knowledge is basically independent of historical and personal contexts. Various attempts to differentiate theoretical knowledge can be found. One such a differentiation is in terms of levels of abstraction. The more entities belong to a concept the more abstract the concept is. Mammal is more abstract than dog which is more abstract than poodle. Another proposal is the more complex the knowledge is, the more abstract it is. Details of the operationalization of theoretical knowledge can be found in Bunge (1979).

In van Heusden & Jorna (2001) we developed a Knowledge Space for the different types of knowledge (see figure 3: the K-Space). All forms of sensory (tacit) knowledge are on the horizontal axis. This knowledge is not yet coded, it is not theoretical, and it ranges from the very rough or broad to the highly detailed. In the horizontal plane we find coded knowledge, which is not yet theoretical. However, codes presuppose sensory knowledge and therefore the horizontal axis is part of this plane. Finally, in the three-dimensional cube we find all kinds of theoretical knowledge, ranging from the concrete to the highly abstract. Again, as theoretical knowledge presupposes coding and sensory knowledge, the two axes are also part of the theoretical cube. Movements through the knowledge space can now be schematized as movements along the one-dimensional linear axis of perceptual knowledge, movements through the two-dimensional plane of codification, and, finally, movements through the three-dimensional theoretical space. Conversion of knowledge, in our view, occurs when one passes from one dimension into another, e.g., when tacit becomes coded.



Insert Figure 3: The Knowledge Space

One can schematize different learning processes within this scheme: the learning of a skill means moving along the sensory knowledge axis. The learning of codes, that is, moving through the codification plane, eventually goes together with a movement along the sensory knowledge axis. The learning of abstractions is through a movement upward, eventually in combination with two other movements toward the right end of the sensory knowledge axis and the far end of the codification plane. Scientific experiments, for instance, would be instances of highly detailed, highly abstract, but weakly coded knowledge; one would find this knowledge near the front on the right of the Knowledge Space.

In reality tacit, coded and theoretical knowledge are not in a clear-cut way divided over actors executing tasks. It is the distribution of the types within and over actors and the dominance of one type in a task or a collection of tasks that matters. As indicated, theoretical knowledge builds upon coded knowledge which in turn builds upon tacit knowledge. This means that even if the dominant type is theoretical, tacit knowledge is always present. I repeat that fundamental in our approach is that humans as information processing systems possessing knowledge and cognition execute tasks, and that, irrespective of the content of the knowledge used in executing the task, the type of knowledge can be characterized. The K-space is a vehicle to assess types of knowledge. An individual executing a task with the aid of knowledge can move through the K-space over time if his/her knowledge type changes. The same holds for an organization as a multi-actor system.

KNOWLEDGE TYPES AND ORGANIZATIONAL FORMS

The discussion about organizational forms refers to coordination, cooperation and the design of organizations. It is not primarily about the primary process within the organization. Primary processes are about what an organization produces, yields or brings forth, such as hospitals, which through treating and curing patients, produce health. The way these primary processes are structured concerns the organizational processes, also called the secondary processes (Porter, 1985).

The organizational processes can be implemented in the organization in three different ways. First, they can be mixed up with the primary processes. Secondly, they can be lifted out and separated from the primary processes in independent units. Thirdly, the organizational processes can completely be cut off from the original organization and put into a new organization, whose primary process is then the execution of the organizational processes. For reasons of clarity I will treat the variations as similar: the organizational process.

Organizational processes can be described in terms of their constituting tasks: control, planning, administration, monitoring, communication, maintenance and contracting (Daft, 2000). Control concerns the task in which the right and power to command, decide, rule and judge is executed. Planning is the task in which the courses of actions for staff, products, machines, vehicles and activities at a strategic, tactical or operational level are determined. Administration is here meant to concern the task(s) by which all kinds of information regarding the primary (and organizational) processes is set down and established. Monitoring means the task to follow and assess the progress of the various products, services or primary processes in the organization. Communication is the task to remain in contact, orally or in written form, with the other members inside as well as outside the organization. Maintenance concerns the support and up keeping of the means of production and services.

Contracting is the task to manage and arrange the promises and appointments within and outside the organization in a formal (legal) manner.

As indicated in section 3, the types of knowledge are tacit, coded and theoretical. Although in practice all types of knowledge exist for every individual, this does not mean that uniform distributions exist. It is to be expected that with regard to various tasks one type is dominant. The determination of the dominance of a knowledge type can be accomplished for one individual, for all individuals and for the separate tasks out of which the organizational process exists. Theoretically, eight possible combinations of dominance () and subordination () can be determined. However, the absence of any or the presence of all dominant type(s) are equivalent. Seven combinations remain: from tacit: , coded: and theoretical: , to tacit: , coded: and theoretical: knowledge.

Now we will turn away from the knowledge types and organizational processes and direct our attention to the other end of the spectrum where the organizational forms are labeled. Many labels can be found (Sorge, 2001), but the most prominent ones are from Thompson, Mintzberg and Boisot. With regard to forms of organizations, Thompson (1967) describes coordination within an organization in terms of (task or process) interdependence, such as pooled interdependence, sequential interdependence and reciprocal interdependence. Pooled interdependence concerns independent departments, that is to say a divisional structure. Sequential interdependence relates to the situation where the output of A is the input for B. In reciprocal interdependence the output of A is the input for B and the output for B is the input for A. In describing the development of organizational forms, Mintzberg (1983) enumerates five forms: a simple structure, a machine bureaucracy, a professional bureaucracy, a divisionalized form and an adhocracy. Boisot (1995), who in a similar way as Mintzberg deals with the evolution of organizations, makes a distinction in fief, clan, market and bureaucracy. Boisot distinguishes organizations in terms of the codification, the concreteness and the diffusion of information. The organizational forms discussed by Thompson, Mintzberg and Boisot are based on decomposition structures, ways of coordination and the characterization of information. Other divisions take into account the authority relation - for example, the subdivision into monarchy, bureaucracy, aristocracy, meritocracy, democracy or technocracy (see also Sorge & Warner, 2001) -, institutional factors (Williamson, 1975) or organizational strategies (prospector, defender, analyzer, reactor; Miles & Snow, 1978).

The question is how organizational forms fit into the distributions and dominance of types of knowledge. I will briefly characterize the various organizational forms by referring to them in terms of knowledge types. The combinations are not the result of empirical research. They are the result of analytical thinking and could be reformulated as hypotheses.

A clan consists of a limited group of actors that cooperate on the basis of trust, sometimes justified by family or very close friendship relations. Boisot (1995, p. 259) says that the term clan refers to a non-hierarchical group of limited size transacting on the basis of shared intangible knowledge and values. These values are implicit and well-known by the members of the clan, but they are very difficult to formulate. Clans are small and local. Different clans have different interpretations of what trust, loyalty, responsibility and obedience mean. Because of the condition of physical proximity a large clan splits into sub-clans. The organizational process within a clan, rooted in trust and loyalty, does not work in impersonal relations. Clans do use coded knowledge, but the interpretation of the codes is guided by knowledge of the tacit type. Theoretical knowledge is largely absent. Questions about and explanations of why governance and coordination are what they are are neither posed nor given. The distribution of knowledge types in a clan is: ta: ; co: ; th: .

The divisionalized form is only one of the many structures where tacit and coded knowledge are dominant and theoretical knowledge is subordinate. In a divisionalized form the middle line (in Mintzberg's (1983) terms) is responsible for the development of new businesses and the control of operations. Often divisions are formed within the larger organization. These divisions operate independently, but also have to communicate with other divisions. The organizational process to coordinate, cooperate and communicate is by means of rules and procedures which are often available and used in coded form. The distribution of knowledge types is: ta: ; co: ; th: .

In a machine bureaucracy coded knowledge is dominant. These bureaucracies are famous for their self-willed search for procedures, guidelines and scripts. Everything within the organizational process has to be coded, otherwise it is not suitable and usable. Tacit knowledge is avoided and if it turns up it will be converted into coded knowledge. Theoretical knowledge is also absent because the rules are so called self-evident. Explanations in terms of theories, models or scientific regularities or laws are not used. Often these theories are considered as undermining the procedures and rules formulated in codes. The distribution of knowledge types is: ta: ; co: ; th: .

In a professional bureaucracy (Mintzberg, 1983) the operational core consists of highly trained and well-specialized professionals. Many of them may have an academic background. This means that the organizational processes of coordination, control and planning are executed in close relation to the domain structure of the professions. The knowledge the professionals use is coded in the sense that it is represented and documented in rules, procedures and scripts. The knowledge is also theoretical because in answer to questions why explanations, theories and logical necessities can be formulated. Very little knowledge is tacit, which can be

illustrated by the long explicitly structured training period the novices in this kind of organization have to undergo. Examples of these organizations are hospitals, universities and ministries in certain fields (agriculture, economics or justice). The distribution of knowledge types is: ta: ; co: ; th: .

In organizational studies (Sorge & Warner, 2001) no clear-cut organizational form matches the dominance of tacit and theoretical knowledge. In this situation coded knowledge is subordinate. If we search for organizational situations where the distribution: ta: ; co: ; th: , is applicable the most striking example is a research unit 7&D). The dominance of theoretical knowledge is clear in such units, because the development of theories is the reason for their existence. However, much of the knowledge that is developed is immature, provisional and tentative. This means that codification may be the result of the research, but it is not the knowledge type by which the organizational process works. The tacitness of knowledge is relevant because oral explanations, demonstrations, intuitive insights and sophisticated imitation are essential in hypotheses and educated guesses. Everyone working in university research is familiar with the tension between the real research attitude (tacit and theoretical knowledge) and the red tape (coded knowledge) of the university officials.

Concerning the dominance of just theoretical knowledge, that is: ta: ; co: ; th: , it is very difficult to match this with one organizational form in particular. It should be an organization where theories dominate the coordination, cooperation and communication of and within the organization. Tacit and coded knowledge are of course present but they are guided by the true theoretical insights. The only real organization that comes close to this division of knowledge types is, I guess, the Roman Catholic Church. It is relevant not to identify theoretical knowledge with scientific knowledge. Scientific knowledge is an example of theoretical knowledge, but not the other way around. Although the Bible as coded knowledge is very important for the Roman Church, the interpretation of this document is guided by theoretical knowledge. The Islam could also be an example, but in contrast to the Roman Catholic Church the Islam does not have a centralized authority with regard to the doctrine. This example also makes clear that other principles besides the division and dominance of knowledge types should not be neglected. The Roman Catholic Church has a hierarchical structure, whereas the Islam has a network structure (Beinin & Stork, 1997).

A market is characterized by many autonomous organizations. The coordination as an organizational process is brought about by means of an *Ainvisible hand*®, it is realized outside the organization itself. The interaction is based on rivalry and competition. In theory the organizations are said to be equivalent, but in practice they are very different. The organizations internally work on the basis of local information, whereas external comparison is achieved in terms of prices. Because in reality the organizations are so diversified, this implies that an organization with a great deal of tacit knowledge competes or negotiates with an organization with a lot of coded and theoretical knowledge. However, two organizations both possessing dominant coded knowledge may also negotiate with one another. The variety of organizations involved in the market, explains the dominance of all types of knowledge (ta: ; c: ; th:). It also explains the complexity of market situations.

The various organizational forms are interpreted in relation to the organizational process. The forms are idealized in relation to the division and dominance of the knowledge types. If one goes one level deeper into the tasks that are the building blocks of the organizational processes, it might be the case that for control coded knowledge is dominant in the organization, whereas for planning in the same organization tacit knowledge is dominant. In order to test the way in which organizational forms and knowledge types match, it is necessary to collect data at the level of tasks, task execution and individual actors. In table 1 the combinations of dominance of knowledge types and organizational forms are summarized. I repeat that the combinations have to be conceived as hypotheses; until now no empirical data is available that could corroborate this matching.

CONCLUSION: KNOWLEDGE MANAGEMENT, ORGANIZATIONS AND EMPIRICAL RESEARCH

The purpose of this article is to combine knowledge types with forms of organizations. Conceptually, a big distance had to be bridged. Knowledge is something individuals have within their cognitive system. Organizations are social units or collectives consisting of actors who cooperate and coordinate their divided and distributed tasks as part of primary (and organizational) processes.

I bridged this gap by first interpreting organizations as multi-actor systems. This paved the way for a semio-cognitive approach to actors. Second, I gave a behavioral and cognitive interpretation of the characteristics actors (might) have. Based on these features various kinds of actors could be discerned. Third, I argued that, besides the content of knowledge, also the type of knowledge is important. Three types of knowledge were distinguished: tacit, coded and theoretical. Finally, I analyzed the organizational process in terms of tasks, such as planning, control and administration, and I showed that various distributions (and dominance) of knowledge types match well-known organizational forms with labels such as machine bureaucracy, simple structure, clan or market.

Organizational form	Tacit	Coded	Theoretical
Simple Structure; Adhocracy: Clan; Fief; Family			
Divisionalized form			
Machine bureaucracy			
Professional bureaucracy			
R&D department; University research			
No application immediately recognizable			
Market, web, network (organizational processes are also external)			
No application immediately recognizable (or market, see text)			

Table 1: Organizational forms in terms of the dominance of knowledge types for organizational processes.

I argue that this gives an operationalization of knowledge management with respect to the tasks that constitute the organizational process. If knowledge is used in the organizational process, and no one would deny that, then in order to be managed that knowledge has to become observable and A measurable@. The point I also try to make here is that with regard to organizational forms there are, apart from random, also less random matches. I will formulate some conclusions in statements concerning knowledge management and organizations. I will end with briefly mentioning three kinds of empirical research that are now being conducted on the basis of the conceptual framework discussed in this article.

Knowledge management: Knowledge management is related to the management of the representations of actors. Management of knowledge means management of the content of knowledge as well as the type of knowledge. It is possible to discern various types of knowledge: tacit, coded and theoretical knowledge. The various types of knowledge are co-present. This holds for the primary processes as well as for the organizational processes. Tacit knowledge or coded knowledge, but also the combination of coded and theoretical knowledge may be dominant.

Organization: Organizations are multi-actor systems, consisting of actors and coordination mechanisms. With regard to human organizations, it can be bluntly stated that if there are no human information processing systems, there is no organization. The key terms for humans as information processing systems are cognition and representation. Humans have, develop, change and use representations: of their colleagues, their tasks, the rules, routines and procedures in the organizations, of information systems, and coordination mechanisms. Coordination mechanisms are incorporated in organizational forms. Organizational processes are also executed by human actors.

Empirical research: On the basis of the foregoing conceptual framework empirical research is now being conducted in the area of medical product innovation, the implementation of new standards for information provision and the implementation of planning supporting software.

With regard to knowledge management in medical product innovation, two innovation projects are followed over time and two already finished projects are analyzed in terms of the change of dominant type of knowledge. Concerning medical product innovation various contents of knowledge are determined, such as clinical expertise, mechanical engineering, electronics, animal experiments and patents. For each content domain the change, the interaction and the diffusion of knowledge types are investigated. The goal of this research is to add a knowledge management instrument to existing project management methods. Those methods generally lack a knowledge management component.

Regarding the information provision in the Royal Dutch Army empirical research is being conducted with the aid of questionnaires and observation schemes. For two large units, the so called AWhites@ (office people) and AGreens@ (battle people), the use and implementation of information provision methods (ITIL) is assessed and analyzed (van der Voort, 1999). The goal is to explain the different implementation rate and scope of ITIL in terms of the different distributions and dominance of knowledge types with regard to the various tasks for the various actors.

Concerning the implementation of planning software in a large hospital, we started a longitudinal empirical research (Sjarbaini, 2001) in which we follow the change in the distribution and dominance of knowledge types during the implementation and use of planning support software. From a knowledge management perspective questions are Awhy does part of the implementation possibly fail@ or Awhy does the implementation last

longer than expected? More than forty planners are questioned and observed in connection with their knowledge types for three sub-tasks of planning. Three what we call Knowledge snapshots are taken: a) before the implementation of the planning software, b) during the implementation of and training with the software and c) 6 months later. We expect that for certain sub-tasks the knowledge will change from tacit into coded, whereas for other sub-tasks tacit remains tacit. The last situation may hamper the successful use and acceptance of the software (Van Wezel & Jorna, 1998). The assessment of knowledge types gives an indication about the duration and speed of the implementation of innovation. Innovation as a radical change in ways of working or task execution is bounded by the types of knowledge that are present in an organizational structure. If the types of knowledge are Awrongly distributed or the Awrong= one is dominant, the innovation process may be seriously impaired.

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