- An Investigation of the Basic Assumptions behind Knowledge Management by Comparing Two Perspectives of Knowledge Creation -

Abstract

In the thesis two different views of knowledge creation are presented and discussed; the 'mainstream' view and the 'complex responsive process' view. The 'mainstream' view focuses on how storing, transmitting and sharing of mental contents takes place, while the latter view claims that reality is perpetually constructed in a responsive process between individuals. One of the main conclusions is that certain, important, types of knowledge cannot be held; these types of knowledge emerge as a consequence of the interaction between individuals in responsive processes. I argue that there is no real consensus of what assumptions to include when discussing knowledge and knowledge creation. The aim with the thesis is first to compare the two theories by discussing the assumptions they rely on, secondly the aim is to discuss which theory is most applicable by interpreting observations from a practical case in light from the two different theories.

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Introduction and Background

It has become clear that 'knowledge' is one of the most important assets for an organization. The concepts of 'Knowledge Management', 'Knowledge Creation' and the 'Learning Organization' get more and more attention. Central questions for the organization should then be: what is 'knowledge'? How is 'knowledge' created? How should it be managed? I will discuss these questions, and the assumptions behind them, in this thesis.

"Yet, in spite of all the talk about 'knowledge-based management' and in spite of the recognition of the need for a new knowledge-based theory that differs 'in some fundamental way' from the existing economics and organizational theory, there is very little understanding of how organisations actually create and manage knowledge."

(Nonaka, Toyama & Konno, 2000 p.6)

The organization has to adapt to changes in the environment, and in order to do this the organization has to understand the environmental changes and transform accordingly, i.e. the organization has to learn from its environment. One fundamental work on the issue of the 'learning organization' is *The fifth discipline* by Senge (1990). His view represented what was to be seen as an important shift from earlier forms of organizations; in which the organizational structure was imposed on people, forcing them to fit and adapt to the organizational structure, rather than letting the organization learn from the people. Another fundamental work is *The Knowledge creating company* by Nonaka & Takeuchi (1995). They introduced, a today often used, model known as the 'knowledge spiral', and described and discussed the importance of dynamics between 'tacit' and 'explicit' knowledge. This split between tacit and explicit, and the definition of what 'tacit' and 'explicit' knowledge is, is still under a lot of discussion and academic dispute. I will later address some of these issues.

Another central article in this field is "Organizational Learning: The Contributing Processes and the Literatures" by Huber (1991). Huber makes a critical reading of the literature in the field and suggests four constructs of organizational learning. His article is

an attempt to take a systematic view of what had been written at the time about knowledge creation. Huber states in his article that the research field concerning organizational learning lacks coordination and guide-lines: "With very few exceptions […] work on organizational learning has not led to research-based guidelines for increasing the effectiveness of organizational learning." (Huber, 1991 p. 108) Huber underscores the importance of correctly understanding the concept of knowledge creation, and the assumptions underlying this concept. This thesis aims at discussing these assumptions, explicit and/or implicit, in the constant emerging flora of literature treating knowledge creation.

Both the work of Nonaka & Takeuchi (1995), and Senge (1990) will have a central position in the thesis because it is my impression that these books have been heavily influential in the debate about how knowledge is created and about how knowledge should be managed in organizations, (Nonaka & Takeuchi (1995) were cited 3031 times and Senge (1990) was cited 3272 times according to Google Scholar (2005-10-07)). These two books will also represent what in this thesis is called the 'mainstream view'. It should be emphasized that this thesis discusses the assumptions behind the theory of knowledge creation; in this way these texts represents a cluster of thoughts with a common mental model of how knowledge is created. The mental model which these assumptions create is essentially about how storing, transmitting and sharing of mental content takes place (Stacey, 2001). I will later contrast their work with the texts of Stacey (1993, 2001), which can be seen as a critique of the 'mainstream view'. The discussion provided by Stacey (2001) has been a great source of inspiration and thus has a central position in the thesis.

Purpose of the study
The purpose of the thesis is to compare two theories of knowledge management, and to discuss which of the two is most applicable through interpreting observations in a practical case.

Questions

The later view presented in this paper, the 'complex responsive view', raises some questions as a critique to the first view, e.g.: What is 'knowledge'? How is 'knowledge' created? How should it be managed? Which assumptions about human behavior and interaction are adequate when investigating knowledge creation? What implications might this have for the way knowledge is managed and, can it at all be managed? These questions are the common theme behind the reasoning of this thesis.

Putting the discussion in a context

In a meta-perspective it seems like the Western, linear, rational, non-system thinking opened up for influences as the Japanese business models were superior. Nonaka & Takeuchi (1995) explain why Japanese companies were such a success during a large part of the late 20th century. Part of the explanation is that the Japanese organizations focused on the process, in contrast to the goal-oriented focus in the West. This is what came to be known in the West as JIT and TQM. These influences can also be seen in the Western theoretical literature as it became more interested in the Eastern way of conducting business. Senge (1990) is referring to Eastern philosophers at several places in his book, and in Nonaka & Takeuchi (1995) the whole idea of the book is to compare the Eastern and the Western approaches to business. This openness is a consequence of the success that Japanese business had during some decades of the last century, and this success is in turn a consequence of the influences that the West had to the East. This is an example how dynamics and contradicting principles forces the organization to constant change. Contradicting views turning into creative dynamics is the melody for modern business, and the symphony goes on.

The focus is shifted from the static to the ever-changing; from thinking about equilibriums to thinking about processes (Brown & Eisenhardt, 1997). The modern organization transforms faster and faster to keep ahead of its competitors. At the same time stability and/or identity is one of the key elements of success. There will always be contradictions in organizations; stability versus change, centralization versus decentralization, separation versus integration, adaptation versus isolation, the individual

versus the collective, the local versus the global, etc. It seems like paradoxes, or at least contradictions, are a natural part of organizational life as they give rise to tension, and tension gives rise to dynamics which in turn enables transformation. Thus, learning to understand these contradictions and managing them in a constructive way; creating dynamics instead of letting the different views turn into conflicting views, is one of the fundamental challenges of organizational life.

Culture is part of what constitutes the environment where the organizational evolution takes place. The concept of 'Culture' is hard to understand and even more to translate and compare. Our mental models and concepts have to be interpreted in the context of the culture, and concepts as 'knowledge', 'group process' etc can have different meanings as the cultural context differs. As an example Stacey (2001) delivers a critique of the perspective Nonaka & Takeuchi (1995) have of the split between the individual and the social. One has to ask if this critique is relevant. The Japanese idea of the individual is not the same as the Western idea, and therefore when Nonaka & Takeuchi (1995) discuss the split between the individual and the social it could be interpreted in a way that is much more in line with the view Stacey (2001) presents. The focus in this paper is, however, not on the cultural differences; it is just worth mentioning that I have considered issues like these when reading the literature.

Mixing the contexts of the concepts

There are a number of concepts in this thesis that themselves could be the topic for a thesis. There is confusion in the field of knowledge creation within organizations because the field stems from many different disciplines. Sociology and Psychology have heavily influenced the way thinking about organizations has evolved, and these disciplines have in turn been influenced by different philosophical schools of thought. Natural science and the evolution of complexity theory have also lent concepts to the theory of the organization, which further complicates this discourse. Complexity theory stems from natural science and the concepts today within the field of complexity theory have traveled through different disciplines before ending up in the hands of the theorists of organizational science. Even if the concepts have the same names in the different fields

the assumptions and methodologies are different. A study of light, or speed would result in different findings depending on the assumptions of the theory used. The same is true for human sciences; what basic assumptions are used make up the context in which the phenomena observed are viewed, i.e. there is no theory-independent observations. That means that the meaning of central concepts is at a sliding scale. The context determines in what direction the meaning is leaning.

467. I am sitting with a philosopher in the garden; he says again and again "I know that that's a tree", pointing to a tree that is near us. Someone else arrives and hears this, and I tell him: "This fellow isn't insane. We are only doing philosophy."

(Wittgenstein 1972)

As a simplified and brief example of the above discussion one could argue that there are some analogies with what happened in Physics during the last century: The Newtonian reality and view of the world had been the 'Truth' for quite some time, when suddenly the theories of relativity and the paradox of uncertainty were introduced by Einstein and Heisenberg respectively. The assumptions about what 'reality' is were different from before, and the Newtonian way of looking at the world becomes a special case of the relative universe. In linear thinking the idea is to avoid paradoxes. It is part of the whole positivist paradigm that logical contradictions should be avoided. However, in Complexity Theory paradoxes are sustained because they create the dynamics which in turn forces the system to evolve. If the organization is seen as a process, the contradiction would just be an illusion created by the idea that the organization is static. As the heading of this section states it is a question of mixing contexts. Again, there is an analogy to Physics: When the apple fell to the earth the measurement frame was clear, while in the relative universe the two bodies fell towards each other. The mental model had to be changed, or in other words, the contexts where different. An important point to bear in mind is that Newtonian Physics are valid under certain circumstances, i.e. in certain contexts. Newtonian Physics is a *special case* in the 'relative universe'.

A lot of phenomena that had earlier been interpreted as strange and perhaps even as errors on measurement were now fitting the extended theory. The linear, or Newtonian, model had dealt with isolated simple systems like a pendulum or an electric circuit. These simple models could be controlled, but as soon as the principle of the simple systems was about to be tested in a bigger system the principle fell. The bigger system needed another set of rules. The scientists "could not respond in the traditional way to the presence of unexpected fluctuations or oscillations – that is, by ignoring them." (Gleick, 1988 p. 304)

The field of Physics went trough a shift of paradigms. A lot of new concepts were introduced. There are important differences in the basic assumptions behind the different paradigms. My point here is that there is often unnecessary confusion due to the fact that the concepts used have certain underlying assumptions that do not apply to the field currently discussed, or, as in this case, that the assumptions for what is discussed are not clearly enough defined. That was what happened in Physics at this point, when the two paradigms collided, and that is what often causes the scientific disputes today. Scientists and authors took concepts from one discipline and put them into another context. The result was confusion and misunderstandings of meanings. This happened once again in Physics when the theories of complexity and chaos emerged. However, I am not arguing that it is impossible to lend and use concepts and ideas from different fields; (which I will do in this thesis) it is just a matter of the degree of awareness of the relations between the basic assumptions in the fields. The theory determines what we see.

Lack of consensus

I will give an example of the lack of consensus of what is measured: "we found that [the parameter] years of education was positively related to knowledge creation capability […] and experience was unrelated." (Smith, Collins & Clark, 2005 p.353). Compared with: "General performance was predicted by experience with the organization, indicating that experience in complex knowledge environments is critical for meeting job expectations. In addition we found that education had a significant, negative relationship with general performance." (Teigland & Wasko, 2000).

The opposite results can of course have many different causes, one being the abrupt detachment of the claims from their contexts, but the business area in which the studies are conducted are related (high-tech knowledge based business), the methods similar (interviews and questionnaires), the hypotheses investigated are similar, and the academic references almost identical; (e.g. Nonaka & Takeuchi, 1995; Huber, 1991; Kogut & Zander, 1992). Two of the authors are also at the same University. The problem I think is that knowledge is somewhat 'invisible', i.e. it cannot be measured directly; a parallel to Physics: what is measured is often not the force in itself, e.g. gravity. What can be measured is some output as a proxy for the knowledge creation capability; and the best output to measure in this context would be new innovations as a proxy for knowledge creation, either as a new service process or as a new product, but does this really capture the essence of what knowledge and learning is?

Structure of the thesis

The paper is structured in the following way: The mainstream perspective of knowledge management and its basic assumptions are presented. The complex responsive view uses concepts from Theory of Complexity and therefore there is a section to explain some of the key concepts of Complexity Theory. There are several organizational theorists that use concepts from Chaos Theory (Brown & Eisenhardt, 1997; Liang, 2004; Stacey, 2001) The presented concepts can be seen as illustrations of principles that have provided fruitful insights into science in general, and which now are about to be interpreted in the context of Social sciences. The following section is a presentation of the contrasting, or extended, view; knowledge creation as complex responsive processes (Stacey, 2001). The perspective presented by Stacey (2001) is a critique of the first view, but in my interpretation it should not be seen as a critique of the overall conclusions; it is a critique of some of the assumptions underlying knowledge creation. I will try to provide a simple and illustrative example of why it can be interesting to challenge the mainstream view. The case observations will be interpreted from the two different perspectives. Interpretation A represents the 'Mainstream view', and interpretation B represents the 'complex responsive view'.

The Mainstream View

"An entity learns if, through its processing of information, the range of potential behaviors is changed."

Huber (1991) p. 89

Some heavily influential writers

One of the fundamental assumptions about the individual in the mainstream way of thinking about knowledge creation is that the individual is the center of what is done in the organization. The individual comes first. "… new knowledge always starts with an individual …" (Nonaka & Takeuchi, 1995 p.13). The idea is that the individual *owns* or *contains* the knowledge; this idea that the individual comes first as well as the split between tacit and explicit knowledge is in turn based on ideas by Polanyi (1958).

Polanyi mainly investigates individual knowledge and then transfers his conclusions to the organization. Hedlund & Zander (1993) are critical about the way Polanyi transfers conclusions about individual knowledge and applies them to the organization. I here have yet another of the implicit assumptions which represent the split between the individual and the social.

'Knowledge' in an organization is often about how to do 'stuff', either it is a product or the ability to provide a service. Let us assume we have one machine and two people in an organization. The simplest suggestion is to divide knowledge within the organization into a 'soft' and a 'hard' dimension (Hedlund & Zander, 1993). The hard part consists of the technology and the machines, while the soft part would be the know-how to use the machinery. And if we think about it, it is quite logic that we need to combine them to actually do anything. Technology is in this sense equivalent with people – or even shorter – technology is people.

In our assumed organization, the machine would be the hard part, and the people knowing how to use the machine would be the soft part. Organizational knowledge is

then defined by the sum of tacit knowledge that individuals hold about products, systems and processes and explicit knowledge codified in manuals, databases and information systems (Kogut & Zander, 1992; Nonaka & Takeuchi, 1995).

Tacit and explicit knowledge

The knowledge creation of the firm is then often stated to be a process of two different kinds of knowledge, in the words of Nonaka & Takeuchi (1995): a tacit and an explicit form. 'Tacit knowledge' then needs to be translated or converted into 'explicit knowledge' of some form. 'Explicit knowledge' is seen as systematic knowledge, transmitted from one person to another in the form of a formal language (Nonaka & Takeuchi, 1995). The often used 'spiral model' introduced by Nonaka & Takeuchi (1995) represents knowledge as a spiral process going from 'tacit' to 'explicit' and back to 'tacit' again. It is this dynamic spiral movement that enables knowledge to be created. 'Tacit knowledge' is in turn seen in two dimensions. One is the technological know-how that comes after years of experience. The other is a collection of experiences, values and beliefs that constitutes the framework for perceiving the world in a certain way. 'Tacit knowledge' is also seen as the source of insights and intuition, and may be viewed as our mind in its unconscious and self-conscious functions. The process of this translation is said to be done through analogies and figurative language. The translation can also be made through identification. The task involved is performed by a master and the student learns by 'mimicry'.

Going back to the imaginary organization - 'explicit knowledge' could be compared to a manual of how to run a particular machine and then what to do with the product when it is eventually produced. The tacit knowledge is the knowledge workers have about a particular machine and about the product they produce which cannot be put in a work description nor hardly even explained in words. Suppose one of the workers has worked there for several years and the other is new. The older person will show the new worker how to do, and the newer worker will learn by taking after the master, i.e. through mimicry. When the new workers try to do the same as his master, he will be corrected, in this way the master has to make explicit what he knows implicit and the newer worker

will have to take it in and make it tacit knowledge. In this way the knowledge spiral starts to spin.

The dark side of the split

The idea of 'tacit knowledge' has gained a lot of positive attention as well as some critique. Hedlund and Zander (1993) argue that the attention the concept gets signifies stands for something important, but at the same time the concept of tacitness is "a deceptive snare that obscures as much as it enlightens." (p. 12) and they list six conceptual problems with the concept. Stacey (2001) also delivers some critique of the concept of tacit knowledge; He argues that the focus usually is concentrated on how already existing tacit knowledge is translated and transmitted. The question then becomes: How did the tacit knowledge arise in the first place? Stacey is also doubtful about the idea that tacit knowledge rests in some hidden world that we cannot access. This idea he thinks stem from the analogy with the psychoanalytical interpretation of the organization. It is not clear, however, if Nonaka & Takeuchi (1995) really meant to create such a split between tacit and the explicit knowledge: Rather it appears that they see the tacit and the explicit as parts of an inseparable whole.

Categories of knowledge

According to Stacey (2001) knowledge is categorized within the framework of the 'mainstream view' into: 'data', 'information', 'knowledge', 'insight' and 'action'. The definitions of these concepts are as follows: Data is a set of discrete objective facts about events. Information is data that makes a difference. Information has in this sense a meaning, as it changes the mind of the receiver. The information can therefore be said to be formed in a certain way to have an impact. Knowledge is seen as a framework formed by experience and current values and beliefs. Insight is close to knowledge. It emerges from intuition. Action is a choice. The choice is based on believed knowledge about the consequences of the decision made. I will later in the thesis go through some the assumptions these categorizations give rise to.

The importance of language

An important issue to address in relation to the categories of knowledge is what kind of language is used in the transmission of the above mentioned categories? How do the code and the code-protocols look like? How does the team use language to transmit the different categories of knowledge? Team learning is essential for the learning organization, and team learning requires a team language that can deal with complex systems. Senge's (1990) argue that a lot of the mistakes done in the management of an organization is because the language used is either focused on short-term find and fix mentality, or it is focused on a short-term cause-and-effect chains. The level of the language of economics and business is still at an obsolete linear level, while the organizational reality is at a complex systems level. Still many managers concentrate on meeting next quarters profit or sales goals. The message conveyed to the organizational members will be to focus on short-term goals. Visions will be forgotten, and problems will arise. As the problems arise, the organization has even greater pressure to do something quickly. The find and fix mentality is back, and the bump under the carpet will soon rise just beside where it was just a minute ago (Senge, 1990).

Does thought precede action?

We tend to think, in our daily lives that the thought comes first and then the rational action second. We think through our alternatives and the consequences are surmised. Based upon what we then evaluate is the best alternative, we make a choice. In organizations there is an analogous idea, or mental model, of how decisions are made: Thought precedes action. We tend to think, as about ourselves, that the organization is a rational agent and that the actions of the organization are founded on rational reasoning: An assumption that could be questioned at several levels. First, there is a problem with the time perspective. Something that is considered 'rational' in the short-term could be regarded as highly irrational in the long-term. Secondly, even if we knew the time perspective to consider, we can question how the expected outcomes of our choices are formed, and we could also question the way we evaluate the choices and the expected outcomes. Along which scale do we measure the outcomes? Thirdly, the thought-precedes-action model implicitly holds that the relation between cause and effect is clear,

which perhaps is not the case. It may be that 'cause' and 'effect' are not adequate concepts to describe the world we act within (Hume, 1739).

The split between the individual and the social

The individual holds knowledge that the organization wants. So, in 'mainstream' perspective knowledge management is about how to spread the individual knowledge to the rest of the organization. With this focus, there is a lot of database type systems built to achieve 'knowledge'. The organization imposes rules on how the knowledge should be spread. The organization is then believed to have a structure that enables knowledge to emerge. This reasoning is also connected with the preceding paragraph – the idea that thought precedes action, at the individual level as well as at the organizational level. The idea is that information enables the individual, and thus the organization, to make 'rational' choices.

Summing up the basic assumptions of the 'mainstream view'

To conclude I will summarize the assumptions about how humans as individuals gain knowledge and how this knowledge is transferred to, or are gained by, the group.

- The individual comes first.
- Thought precedes action.
- The individual *contains* tacit knowledge.
- Tacit knowledge can be converted into explicit knowledge.
- The explicit knowledge can be transferred to other individuals, and in this way the tacit knowledge of the individual can be used by the whole organization.
- The means of transmitting the knowledge is through a language. Either through symbols as our written language or digits, through our spoken language as metaphors and analogies. The tacit knowledge can also be transmitted through identification and mimicry.
- There is separation between the individual and the social.

Theory of Complexity

I will briefly go through some of the main themes of the theory of complexity and, how this theory can be used in human/social contexts. As mentioned in the introduction this section seeks to ease the reading of the section treating the 'complex responsive view'.

Theory of complexity can be said to be dealing with systems. (The terms 'Complexity theory', 'Theory of Complexity', 'Chaos Theory' and 'Theory of Chaos', will all refer to the same field of science in this thesis.) Systems are a collection of entities. The entities can be atoms, ants or human; and they interact with some sort of mechanism. For Atoms it is electrostatic forces, for ants its pheromones and for humans it is some sort of language (Mahon, 1999).

Today the organization is often seen as a complex system that has to evolve with the changes in the environment in order to survive (Brown & Eisenhardt, 1997). How this process of learning, or transformation, functions is complicated and not well understood. One of the reasons for this is that the dynamics created by the ever-present contradicting views can be hard to overview and understand (Huber, 1991). With the assumption that human organizations show some similarities with any complex system, we first have to understand what a complex system is and how it behaves. Then some of the principles for the understanding of a complex system can make up the foundation for an understanding of human organizations. "Like organizations, complex systems have large numbers of independent yet interacting agents." (Brown & Eisenhardt, 1997 p. 29)

Background on the systems view and complex systems

I will present the view that the organization could be interpreted as a system. Systems thinking has a rich history: among the first to explore the field was Bertalanffy (1969) with his book: *General System Theory*, also Ackoff & Emery (1972) have made an impact in the field. The work of Senge (1990) heavily builds on the foundation of Systems thinking. Very brief a system can be described as something that has an input, process and an output. The process can be seen as a rule of how to transform the input to

output. What characterizes a *complex* system is a collection of individual agents interacting with a set of local rules (systems), i.e. there is no global rule that every individual has to follow. Each agent follows their own rule in relation to the agent with whom it interacts. The identity of the individual agents or elements will only be constituted in relation to the other agent. It is the relative relation that decides the outcome of the interaction, and the outcome of the interaction in turn decides the structure and the process in the system.

Stacey (2001) describes how the systems thinking has evolved in the area of organization management. Stacey argues that the first step was from just controlling the detailed task the employee did, "controlling the performance of tasks […] the particular action members of an organization were required to undertake in order to produce its goods or services" (Stacey, 2001 p.3), to manage the inter-related system of tasks. This inter-related system was managing people's relationships, and the different roles people had in the organization. This later even led to include people's values and beliefs. The manager controlled, or was thought to control, the system of inter-related tasks as well as the system of values and beliefs - the organizational culture. It was at this point management theory started to be interested in the learning process. If values and beliefs in such a high degree were essential to how the organization was formed, and transformed, it became important to understand how values and beliefs were created. The discussion is very simplified something like this: constant organizational change became a prerequisite for success and therefore the people in it had to change. The new task for managers included managing peoples learning processes. Management went from control of detailed tasks, to control of mental processes during the last decade. The idea of knowledge management was born (Stacey, 2001).

Definitions of 'Dynamics', 'Feed-back loops' and 'Networks'
Stacey (1993) has defined complexity theory as *"the dynamics of non-linear feed-back networks"*. I will in further detail go through each of the terms in this statement:

'Dynamics' is the concept of energy or power that emerges when two different, or opposite, forces meet. In Physics it would be a billiard ball hitting the others, creating the whole system to change. In human science it would be the intrinsic paradoxes of e.g. stability/identity and change, local vs. global, etc. As mentioned in the beginning of this paper to learn to deal with these forces is one of the fundamental challenges to organizations. Complexity simply means the impossibility of prediction. Details can not be understood, but patterns observed. What can be predicted is very constraint (Liang, 2004).

'Feed-back loops' could either be positive, negative or linear. The negative feed-back loop moves the system towards stability as it decrease the effect of the initial stimuli. The linear feed-back loop is when the output is in relation to the input. This was thought to be the main case, but is now seen as a special case of the feed-back loops. The positive feed-back loop increases the stimuli, so the response in itself is an even greater stimulus. This enables the force of non-linearity. In normal language this means that small actions can have very big effects, and that the system becomes unpredictable. This phenomenon was named 'The Butterfly Effect'. The Butterfly effect was named after a discussion of if a wing stroke from a butterfly in Japan could be the cause of a storm months later in the US.

'Networks' in this definition would be the same as the system approach, i.e. that there are a lot of interacting agents in the system, and the agents can be seen as subsystems. So, to sum up, complexity theory is: a lot of agents, interacting through some sort of language who creates non-linear feed-back loops, which in turn creates the dynamic to change the system.

Again – mixing the contexts
Originally the research on 'chaos 'and the 'complexity theory' was a part of the natural sciences. The Chaos property was first used when explaining thermodynamics (cf.: "The relationship between heat, work, temperature, and energy, now encompassing the general behavior of physical systems…" Encyclopædia Britannica). The 'entropy' (measure of

disorder) property is central to the thinking of thermodynamics, and was then spread to other parts of Physics and Mathematics, e.g. the fast growing field often referred to as AI. There has been a rapid growth and use of the property of chaos and it seems like the field where the theories are useful for understanding the world, do not stop at the natural sciences. The theory of organizations and especially management theories have made progress with the help of the concept of chaos. There are some who argue that the concepts of complexity, non-linearity and self-organization are among the most important concepts that were discovered during the last century, and that there is a scientific revolution; a whole new way of seeing the world, attached to the insights that these concepts provide (Gleick, 1988).

"Now that science is looking, chaos seems to be everywhere"

James Gleick (1988)

Some authors argue that organizational theory has made a shift, or could be said to be in the shift, in paradigms from the machine-based into an information-based approach (Liang, 2004; Gleick, 1988). The shift is similar to the step science took with the shift from a Newtonian view of the world to the Relativity view of the world. The view of humans and human organizations changing from mechanistic into complex and non-linear may today seem natural, as the discourse has been around for some years now, and the old structures and mindsets surviving from the industrial era are becoming more and more obsolete (cf. Liang, 2004, Kauffman, 1993).

Chaos and self-organizing

One thing that most scientists have in common is the principle that the universe is made up by chaos and order at the same time, and that the two are inseparable. Order and chaos create dynamics. The universe is constantly drifting apart and thus creating more and more disorder or entropy. But at the same time there exist spaces and areas of order in the chaos (Georgescu-Roegen, 1971; Stacey, 2001). The spaces of order have a common characteristic; they organize without a blueprint, i.e. they self-organize (Kauffman, 1993).

Darwin's self-selection is a special case of self-organizing

Systems that show signs of self-organizing often adapt to the environment in which they exist. In this sense the self-organizing principle can be seen as a widening of the concept of the evolution, although one has to keep in mind that the driving force behind Darwin's evolutionary principle is natural selection, whereas the idea of self-organizing stresses the fact that systems, simple and complex, spontaneous organize themselves (Kauffman, 1993). This spontaneous order occurs in many places in nature, and can have several causes of underlying forces. *Darwin's natural selection may be a special case of the self-organizing system, as the Newtonian universe is a special case of the relative universe.*

Kauffman (1993) argues that it is not the fact that systems show the intrinsic principle of self-organizing that is mysterious; it is the fact that the extent to which this is happening is so overwhelming. "… natural selection is important, but is has not labored alone to craft the fine architectures of the biosphere, from cell to organism, to ecosystem. Another source – self-organization – is the root source of order." (Kauffman, 1995 vii)

One of the most important concepts for this paper stemming from complexity theory is self-organizing. Self-organizing is the spontaneous process among agents in a complex adaptive system that interact without a blueprint. The phenomenon is observed in Physics, Chemistry, biological, ecological, social and cultural structures. The idea of self-organizing is that there is no need for agency, inside or outside the system. There is no need for someone or something to plan or control the process of organization for the agents in the system: They self-organize (Liang, 2004; Mahon, 1999; Kauffman, 1993). The interaction of the agents only follows local rules, i.e. there is no global, or overall, rule. This finding could be important for describing how human interaction takes place, and for a description of the nature of the organization.

Do we have proof?

The phenomenon has been tested in computer simulations several times. Stacey (2001) describes a computer simulation as follows: Each agent is a program. The program can be seen as a set of rules how to act and respond. Each agent consists of a sequence of

symbols. The programmer specifies the initial conditions, and the program is run. The programs interact in relation to each other, i.e. when an agent meets another it is their relative individual rules that decides the outcome of the interaction. The interesting thing is that this local interaction creates global patterns. So patterns, that can not be predicted, emerge without any global rules. The system is said to self-organize.

The focus points in these patterns are called attractors. Attractors were first discovered and examined by M. J. Feigenbaum. He examined simple equations, and calibrated these by changing the input. There was only one output for each input. This way of calculating can for example be used when examining populations. One year's population is the input, and next year's population is the output. Feigenbaum started looking at non-linear equations and saw that there were patterns attached to the way these equations converged i.e. iterated equations came closer and closer to a certain point in the system. These points are called attractors (Gleick, 1988).

Kauffman (1995) also makes a simulation of a complex system. He suggests that there are analogies to be made from the simulation. As an example there is the phenomenon called 'patching' which could explain the emergence of clusters. Kauffman finds that when the number of interacting agents is small there is higher level of stability in the system – i.e. there is a higher level of repetitive behavior. When the number of interacting agents is very high, the system tends to be highly instable and destructive. At a mid-range between the two extremes, the dynamic at the edge of chaos emerge (Kauffman, 1995). Systems evolve into this state where they are changeable without being destructive. One way for the system to evolve into this state is 'patching'. Patching is the emergence of enclaves, or clusters, within the system. Within the cluster there is a high level of interacting agents, while this clustering dampens the interaction enough for the system as a whole to avoid the destructive pattern (Kauffman, 1995).

Self-Similarity
Within the theory of complexity there is also the concept referred to as 'self-similarity'. This idea was investigated by Mandelbrot (1977) (also cf. von Krogh & Roos, 1996 pp.

209-210), who later named the certain equations, which was used to describe the idea, to 'fractals'. The interesting features of the fractals has since then been a source of new ideas and new scientific approaches. Mandelbrot put the question: How long is the coast of England? Any answer will be indefinite - it depends on the scale used. The interesting thing is that the pattern shown on a map of the coast will be repeated, using different scales. It will be impossible to say, just from looking at a picture of the coast, which scale is used. This is called 'self-similarity' or 'jaggedness' and that led Mandelbrot to look for regularities and patterns which later build the foundation for the fractals (Mahon, 1999). Why is this interesting in this context? It is interesting to use this concept in human interaction as the same patterns often reoccur in human interaction. Often this is seen as different levels, but can in this perspective be seen as the same phenomenon observed through different methods or with different focal points.

The self-similarity as a concept is similar to the holistic approach, described by the screenwriter and thinker Koestler (1979) in his book: *Janus - a summing up*. Very briefly the idea is that the individual entity is it self and part of the social at the same time, they are inter-related, therefore the analogy to Janus. But the individual entity is nothing in itself. Its identity is defined by the social (cf. Kogut & Zander, 1996), and vice versa. There is an intrinsic paradox in the concept of the individual as the social constructs the individual and individuals construct the social, if they are not seen as the same thing, only with different focus (also cf. Kauffman, 1995 pp. 274-275). Individuals, organizations, clusters, regions, nations etc. show the same patterns; in their interaction and in the way they evolve (c.f. the discussion in the introduction about hoe the Eastern and Western culture 'communicated' and transformed). The idea to introduce the concept of self-similarity is just to make it easier to make a mental picture of the phenomena we see in an organizational context; to be able to let go of the hierarchy of levels. The assumed split between the individual and the social can instead be interpreted as different level of focus (von Krogh & Roos, 1996 p. 209).

Why all the talk about theory of complexity?

The idea of this section was to present some core concepts of the theory of complexity. Complexity, dynamics, non-linearity, self-organization and self-similarity have been put in a brief context to make it easier to follow the analogies between complexity in natural science and complexity in human systems. As mentioned in the beginning of the paper there are some dangers attached to switch contexts with these kinds of concepts, but there are also new ideas emerging from the dynamics this creates. Some of the taken-for-granted mental models can be challenged with the insights from theory of complexity.

The Complex Responsive Process

"Biological organisms in communication interact with each other. They are not putting anything into each other nor are they transmitting anything to each other." (Stacey, 2001 p. 195)

Language again

Everything starts with language. Our language is both the bearer and the creator of meaning, and in this perspective the reality is also socially constructed through the language; thus, even our thoughts emerge from our language. It is not the language in itself that is studied. The language is the tool we use to relate. It is what enables the responsive processes. It does not necessarily have to be our verbal or written language. It can be the ways people communicate through relating in other ways, e.g. through action and gestures. Stacey (2001) discusses how the symbols; spoken, written, gestures etc, make it possible to communicate. He makes a distinction between three different types of symbols. The proto, the reified and the significant:

The proto-symbols are the basic human body rhythms as heartbeat, brain activity etc. These activities are monitored and they give rise to gestures that can be seen by others. One important point in the reasoning is that there is no difference in level of the three different types of symbols, and that the presence of a body is a necessary condition for communication to take place. The gesture together with the response from the other body, are together seen as a symbol, which is language, which in turn is meaning.

Reified symbols are the tools used to discuss abstract things, e.g. Physics, or this paper. When a human uses the word 'relativity', the meaning does not lie within the word; it lies in the response the symbol provokes. The word is a symbol as it refers to something. This something, or referent, can only be understood if the context is understood. The theoretical/abstract discussions that takes place, requires knowledge about the framework in which the symbols refers to phenomena. The proto-symbol communication scheme is direct in the sense that there is no need of something other than the two present bodies.

The same goes for the communication with the significant symbols, where meaning is created directly between the bodies. The reified symbol needs the reference to the framework in which the phenomena referred to are taking place. As an example the language, as we refer to it in a daily sense, have these characteristics (syntax and grammar). Mathematics and logic are also systematic frameworks with their own set of rules which have to be understood to be able to be in a meaningful discussion about the subject.

Significant symbols are thought to emerge from the way our body is designed to respond to the art of mimicry. The first step humans took towards some kind of communication must have been a way to gesture that provoked a gesture in another body. This gesture was, apart from other gestures, filled with meaning as the other changed behavior. This change in behavior could in turn be used as a reference when the other wants to use the gesture and change the behavior of the first. In this way, I think, symbols with meanings were shared by the group and the first language was created. The language, in this sense, is very pragmatic. The language can not exist without a body, and not without a specified context (Wittgenstein, 1972; Merleau-Ponty, 1962). Merleau-Ponty (1962) even argues that there can not be any *knowledge* if there is not an individual and a context, (which would be the same as arguing that there has to be two entities for the feed-back loop to be created. The feed-back loop creates transformation, i.e. the range of possible outcomes is greater and therefore by definition knowledge is created.)

The human nerve system and entire body system evolved a function of responding, and can provoke a feeling that another body experiences, i.e. the act of relating. The significant symbol is therefore a gesture that is used in the interaction between people. The interaction is circular and reminiscent of the circular feed-back loops. The body is just as important as the brain in understanding how this process works, and as mentioned before, this process is not located in the individual; it is the dynamic between individuals that constitutes what they know.

The brain therefore works as monitor of the body's different systems (Mead, 1934). These systems relate to experiences when encountered with new situations, and humans are therefore able to imagine the future. The future is perpetually constructed in social processes as humans relate (Stacey, 2001). The language is the tool that humans use to communicate their intended actions, and the response is what these indicated actions causes the other body to imagine and then response – complex responsive process. In this circular way people construct the reality and the future. Therefore, the consciousness and the social are reflections of each other, and the individual is at the same time private and social. The reflections made by a body to a certain stimuli can be seen as a private role play, provoking different feelings within the body which is the imagined responses from the other (Mead, 1934). Mead also gave the explanation why vocal expression developed as fast. That is because that is the expression our body can register in the most similar way that others will hear the message. We cannot in the same way monitor our face expressions.

This way of identifying how human interaction takes place has some implications of how knowledge is created. Accordingly to Stacey (2001) there is a taken-for-granted view that knowledge can be created, measured and managed. This way of treating knowledge as it would be a 'thing', he argues is fundamentally wrong. As described above the language as different types of symbols are the fundamental building bricks when creating meaning and knowledge. But the symbols are not in themselves bearer of the meaning, it is just in the relation to the other the symbols provoke a response, and it is in this action of gesture and response that knowledge is created.

Successful organizations operate in some sort of non-equilibrium state. "That state is one of contradiction and continuing paradox which produces dynamics of irregular changes in behavior that are difficult to predict." (Stacey, 1993)

The conventional thinking around markets in specific and economics in general, is that there is some sort of equilibrium that the systems tends to be attracted to. An example is

the market equilibrium in neoclassic economics; the state of balance between supply and demand. We can think of this as the Newtonian Universe when there was no relativity, i.e. one could still measure what happened compared to a fixed measure. Complexity theory states that creativity and innovation which is natural in the intelligent adaptive organization, is far from an equilibrium state. It is near the edge of chaos, and thus just keeping the balance between order and disorder. As mentioned above the organization uses the dynamics which are embedded in the confrontation between order and disorder to extract value (Brown & Eisenhardt, 1997; Kauffman, 1993; 1995).

The idea that human interaction and computer simulations of complex adaptive systems show similarities may seem wrong, and one has to be clear that there are differences, but the analogies may also suggest new approaches on how organizations behave. If it is true that human interaction show patterns that can be seen in the same way as self-organizing patterns among agents in the simulation, there can be a lot to learn from studies of complexity.

"The local buzz is certainly dependent on particular local institutional preconditions but the important point is that it largely takes care of itself. If a number of actors are placed within a region some sort of buzz will automatically result (even in prisons, where the inmates are kept apart from one another in order to limit information spillover, a lot of buzz occurs)."

(Bathelt, Malmberg & Maskell, 2004)

The term 'buzz' would refer to, in the language of Nonaka & Takeuchi (1995) 'the knowledge spiral', and in the words of Stacey 'the responsive process'. The idea is that knowledge is created when people interact and that this interaction cannot be managed too tightly. There has to be some slack or redundancy in the organization. In this sense, "more would be accomplished by doing less". (Stacey, 2001 p. 229) The idea is that the self-organizing feature is present in human interaction and that this feature enables knowledge creation. The focus should be on how people, and organizations, already interact if they are given time and how people naturally create positive feed-back loops. It

is in the semi-structured setting, between order and chaos that the organization can find the fuel for dynamic change (Brown & Eisenhardt, 1997).

Is the idea of mutual exclusiveness applicable?

Mead (1934) argues that the human is a biological organism that acts both towards itself, the mind, and towards others (the social). Stacey (2001) sees this act of 'ongoing relating' as private and social at the same time. There is so to speak both a private and a public role play, and in this role play Stacey means that self-organizing patterns emerge. The gesture-response themes organize in a pattern and they repeat. This repetition is what is usually called institutionalized relations, and this is what is usually described as habits. Stacey also means that this takes away the split of the social and the individual. With this view the biological, the mind and the social, all are at the same ontological level. They construct each other as in the holistic approach described earlier. The repetitive themes organizing social experience, arises together in the interaction between people (Stacey, 2001). Knowledge can be said to be relationships, and it arises when relationship take place. We can see it as a position is in the relative universe; a position is not a fixed concept it is a relative, it can not be anything in itself.

A somewhat distant but interesting example of how this works I have borrowed from Hofstadter (1979):

The following sentence is false.
The preceding sentence is true.

It can be hard to say *where* the paradox is. The sentences in themselves are not paradoxes. They are simple, useful, sentences, but put together they make up a paradox, also called in this form: a strange loop (Hofstadter, 1979). The strange loop corresponds to what logicians call anomaly or tautology.

The problem seems to be that the two sentences refer to each other. The problem is *between* the sentences not *within* them. This is also an illustration of how difficult it can

be to locate agency. One of the fundamental thoughts of the 'mainstream view' presented in this thesis is that the agency is located in the individual, and that there is a clear split between the individual and the social. The analogy is far stretched, but can give an illustration of the idea how it is the dynamic between the two agents that make up the system.

Mead (1934) describes the body rhythm as what constitutes feelings and emotions, which in turn are essential for the act of relating. Stacey (2001) argues further that body rhythm, thought and action are inseparable. They are all part of the same process. Individuals do not think and then act. Humans are not computers that process information and then make active choices. There is an ongoing flow of gesturing and private and social role play. The individual, so to speak, tries in a private role play, what gestures/actions may cause as gesture from the other, in a process of potential future, i.e. thinking.

The brain has no memory
The brain has no memory, i.e. we do not have any capacity to contain. It is in the interaction between body and the nerve system that the memory emerges. As Stacey (2001) points out; modern neuroscience suggests that the brain does not represent stimuli. The brain reacts differently to the same stimuli in different contexts, and there also seems to be a relative experience to different stimuli. History becomes different in this sense in relation to the context where it is reproduced. It think it seems plausible to argue that the memory is constructed when it is provoked by stimuli; the stimuli provokes a neural pattern that in turn provokes certain body functions to either increase or decrease activity. The brain scans the body and there is a feed-back loop created, constructing the reality.

Stacey also delivers critique to the way Senge (1990) makes the art of the dialogue to something romantic. According to Senge the art of dialogue is different from discussions. Discussion is the competitive form of communication and dialogue is the collaborative form of communicating. Through the dialogue Senge means that we can find the key to create the dynamics that change the world, while Stacey argues that that dynamic is already occurring in normal ways of relating, and that communication is so much more

occurring today and that is why the society and the business environment is changing faster than ever. There is no safe way of communicating and there should not be. The act of relating is always a risk. The feed-back loop which emerges between two people in a dialogue can also be negative. The reinforcing negative feed-back loops create a bad relation. According to Stacey it is misunderstandings that create the dynamic in the human system, and that is why it is so hard to find a way to manage, or control, these systems.

The Case of PharmaCorp – A Brief Illustrative Example

In the following section I will present a case to give a concrete example of what I have aimed discussed in the preceding sections. The example is from one of the major companies in the pharmaceutical industry – referred to as PharmaCorp. The case is described in detail in a dissertation by Roth (2002); the following section is based on that study.

Describing the study

The pharmaceutical industry provides an interesting environment for studying knowledge creation and knowledge transference because the industry to such a large extent depends on research. The research is team-based, and the teams meet very tough time constraints for conducting the research process. The process as a whole takes from five to fifteen years and is expensive, especially as the rate of success, i.e. the percentage of projects which result in a marketable product, is low. As a consequence every cost-diminishing action, as well as measures which can positively influence the rate of success, are of great importance. What makes the industry unique is the knowledge-intense, team-based research – which has to be transformed into patents and later into marketable products. There is a direct relation between how well the knowledge is managed and the success of the company.

The research by Roth (2002) focuses on how knowledge is constructed and formulated in clinical research and development projects at one of the largest pharmaceutical companies in the world. PharmaCorp's three main focuses are cancer, cardiovascular and gastrointestinal medicine. The company has 10,000 R&D employees and a R&D budget of USD 2 billion (1999) (Roth, 2002). The high development costs put high pressure on management to early in the process decide which projects to put effort and money in, to identify the valuable projects – to the market and scientifically.

The main stages in developing a drug are toxicological testing, clinical testing and regulatory approval. The long development time as well as the different stages makes it

natural that the same people are not involved in the whole process. This interchange of people in the projects makes up for another interesting feature: it becomes necessary to create routines for passing on knowledge achieved in an earlier stage to people who will become active in latter stages of production – i.e. it becomes necessary with knowledge management to be a competitive player, as it is of great importance not to repeat what has already been done.

An interesting part of the study by Roth (2002) is his conclusion about the inconsistencies in learning and knowledge creation at PharmaCorp. The attitude both among management and team members were positive to learning and to knowledge creation, however little was done in practice or in terms of creating incentive-systems aimed at creating a learning organization.

The basis for Roth's case-study was interviews with participants of two research teams at PharmaCorp. Both teams were involved in promising cardiovascular drugs development projects. The research teams consisted of Clinical Research Leaders, Clinical Research Assistants, Medical Advisers, Data Coordinators, and Study Administrators. All categories of team members were interviewed. The interviews followed a semi-structured interview guide. The median duration for an interview was 90 minutes, and more than 30 hours of interview material were recorded. All the interviews were then transcribed and the interviews were analyzed by three different researchers independently.

Three Observations
From the material described above three observations were made:

1. *The importance of open communication.* Communication was found by Roth (2002) to be essential to the research teams: it turned out to be not only a question of communicating information within the group, but just as much a question a creating a mutual understanding mutual understanding of what problem was to be solved and what the others were doing. Most of the problems encountered by the teams were of a complex nature, and in order to solve them several members of

the groups stressed the importance of communication skills, the ability to listen turned out to be as important as talking. In these discussions the ability to pinpoint the formulation of a problem often led to new processes of thought among the participants, sometimes also on the part of the speaker. The listening could open up new perspectives and suggest new solutions through analogies to other problems. There were also examples of situations when one member experienced a lack of communication: most team members regarded it as very important to belong to a group where asking stupid questions was acceptable. This created an atmosphere where people were able to question any assumption, also those of a general but perhaps non-explicit nature. A problem which all the interviewees mentioned was the general lack of time for communication. Even if they had discovered that it was more efficient to talk through and communicate about such problems as they occurred – whether research related or social – the time allotted to such talk was always insufficient. As the pressure was heavy, the day-to-day business was given low-priority to discuss these kinds of problems. The long-term goals had a tendency to become invisible as the work progressed. The employees focused on their day-to-day tasks and a lot of unnecessary work was thus performed due to a lack of communication. There was too little time for reflection. In some cases managers and researchers might have been able to focus properly earlier on in the process if communication had worked better.

2. *Cooperative and socially acceptable behavior within research groups*. Personal relationships and team culture turned out to be important for overall team performance (Roth, 2002). 'Team culture' is one of those fuzzy concepts that may appear natural in this kind of context. On the other hand it turns out to be a concept notoriously difficult to quantify. In the interviews, team members often expressed that the culture, or the ambience of the group, was of critical importance for creative and efficient work. The openness and relaxed atmosphere in the group stimulated new thinking as the interaction increased. 'Social competence' was defined as being flexible and cooperative, with a feeling for the

other departments' needs. The process of clinical research is a joint procedure involving several teams. A large part of the work consists in coordinating the great amount of information about how the substance being tested affects the patient. In this work there is a need to communicate essential information to all parts of the company, but the marketing department won't ask the same questions as the clinical test team. The ability to cooperate with ease and grace were of big importance. Attention to what other departments saw as important became a necessary feature. Other things that were included in this category were the ability to cooperate with people from different cultures, to be able to have a dinner conversation, and to put away prestige. In general the idea was to contribute to a comfortable working environment.

3. *The sense of belonging* was put forward as the pride people put in their work and that was shared by the group. A common opinion was that it was necessary to share a feeling of being a part of a group in which all members shared pride of their work in order to enjoy the work and to put that extra energy in. In order to create this feeling several stated the importance of rituals and other forms of identity-defining routines.

Two models of interpretations: A and B

From this brief illustration of what was observed at PharmaCorp, I have tried to put the observations in relation to the perspectives presented earlier on: The 'mainstream' perspective will be represented by interpretation A, and the 'complex responsive' perspective will be represented by interpretation B. First I will restate important assumptions underlying the two views. Under A I will go through, and deliver some critique of, the various assumptions underlying the 'mainstream view' (cf. p. 13).

A – the 'mainstream' interpretation

The 'mainstream view' was categorized by the following assumptions: 1. Knowledge arises within an individual – the individual contains knowledge. 2. Thought precedes

action. 3. Tacit knowledge can be converted into explicit knowledge. 4. The explicit knowledge can be transferred to other individuals, and in this way the tacit knowledge of the individual can be used by the whole organization. 5. The means of transmitting knowledge is through a language - either through symbols as our written language or digits, through our spoken language as metaphors and analogies. 6. There is separation between the individual and the social.

The first observation about open communication would, in the 'mainstream perspective', be represented by an expert sharing his/her knowledge with other employees, or in the words of Nonaka & Takeuchi: externalize tacit knowledge through socialization. The individual who has come across the same problem before uses his knowledge and teaches the others how they should look at the problem and how they should solve it. This goes back to the assumption about the individual as the locus of knowledge creation, which was the first assumption.

The idea of the primacy of the individual is very old. In the different schools of thought from Plato to Descartes to Hume, knowledge is inseparably connected to an individual (Hedlund & Zander, 1993). The starting point for any class in Epistemology starts with Teatetus' claim that knowledge is 'justified true belief'. This notion has been under discussion since it was first introduced, and there have been a lot of suggestions to improve on the formula; but the claim is still more or less intact. It is interesting how a statement like 'knowledge is justified true belief', which was made over 2,400 years ago can still evoke such dramatic critique: "this is an absolute, static, and nonhuman view of knowledge and fails to address the relative, dynamic, and humanistic dimensions of knowledge." (Nonaka & Nishiguchi, 2001 p. 14) But it also reveals the fact that this issue is still worth debating. Nonaka & Nishiguchi allude to what I have tried to describe; namely that the assumptions in the first perspective may not be consistent with an adequate way of describing reality. These assumptions are often implicitly made. The individual perceives the world and the data is structured with the help of mental forms. Connected to this assumption there is also the belief that it is possible to make accurate

models about the world, translate them into some artifact or symbols (as our language) and then communicate this knowledge. With this view of the world the perceived world is automatically the same as the objective and transmittable knowledge.

The first observation in the case by Roth (2002) makes it clear that it is the mutual communication which is important. Members of the research teams are not taught things by their peers, they solve problems together through creative processes. These processes involve behavior that could be described by feed-back loops – initiated by people directing attention towards the problem about to be solved as well as towards the peers. The knowledge arises, so to speak, *between* the individuals, not within them; something which the 'mainstream view' does not describe in a satisfactory way.

The second assumption that thought precedes action was questioned from several perspectives. First, I argue that there is a blurred relationship between cause and effect. Second, that there is difference in the use of language and reality, i.e. the language still works at a linear level (which is a mirror of centuries of 'rational' thinking), while the reality is complex. Thirdly, I questioned the rationality assumption behind this thinking. We cannot evaluate the different lines of imagined consequences that an action might have: Something which, of course, is connected to various other problematic questions, not least in Ethics.

The third assumption in the mainstream view was that the individual is the carrier of knowledge. In the later perspective it was argued that the brain can not contain, it reacts to stimuli, i.e. it responds. This can be illustrated by the image of a book in a library, the content of which does not make any difference until it is read. Knowledge therefore cannot be cumulative in the sense that it can be gathered and stored. We have to *use* knowledge, if not apprehended by an individual and applied in practice – the knowledge, simply, is not there.

The fourth, fifth assumptions were about language and the split between tacit and explicit knowledge. The notion of knowledge as tacit and explicit is however problematic, and are perhaps unnecessary – at least when describing the situation at PharmaCorp.

The last assumption treats the separation of the individual and the social. This assumed split comes from the mental image of hierarchies. Instead if think the concept of self-similarity lent from theory of complexity very well can replace the mental picture of hierarchy we normally have. The individual and the social are the same thing, only with different focus. This reasoning corresponds to the observation about belonging to a group. The 'mainstream view' would see the individual as attached to the group if the individual share the code-protocol with the other members of the team uses. It seems quite clear that this view leaves quite a bit of human motivation unexplained.

B – the 'complex responsive' interpretation

The line of thinking here is that members in teams or organizations collectively create *sense* in relational processes. The central feature of this sense-making process is that individuals relate to each other in order to share values, norms and worldviews. The ability to relate is a basic *necessary condition* for knowledge creation. Knowledge is the *sense* that comes out of the relating processes, earlier referred to as positive feedback loops.

In the observations and in the discussion how to improve the sharing of information and experiences, there is a common principle that seems to stimulate good work. Openness and creativity stem from members of the project directing their attention: Both towards the professional problems and towards their colleagues. The first observation about open communication corresponds satisfactory to the way Stacey (2001) describes the 'responsive processes'. The idea of the feed-back loops is applicable to the observation of how open communication, talking as well as listening, is important for the creativity in the teams. This common principle is in the dissertation by Roth (2002) named 'care'. Care is a central concept of the dissertation and I think it is directly applicable to the discussion I have tried to sketch. Care is defined in the work by Roth (2002) and also by

von Krogh (1996) as the basic human property of being able to continuously direct attention towards other human beings. In this sense care is to be understood as a relation, either between two human beings or between a human being and an object.

The notion of 'care' has a long history – from the ancient Greeks to the more modern philosophers as Heidegger. But for my purposes it is enough to understand the definition above – and we could therefore also refer to it as 'attention'. The notion of 'attention' also has a small advantage in that it does not direct our thoughts directly to something warm or positive, like 'care' does. Therefore 'attention' might be better in this presentation, as it gives us the possibility to understand attention as the fundament for creating a feedback loop, without stating whether it is positive or negative. It should be pointed out that the notion of 'care' is not necessarily used as in the everyday sense, cf. Roth, 2002 p. 59: "…care is not aimed at producing an unrealistic comfortable, cosy and sheltered work life situation; care is a theoretical concept and is primarily aimed at providing the foundation for good communication effective team-work and sustainable organizational capabilities."

Summing up the case

I think the observations at PharmaCorp can be more easily understood with the 'complex responsive view' than with the 'mainstream view' – and that the 'complex responsive view' provides some of the keys needed to better understand how knowledge is created; in teams, in relational processes.

The case shows that the rather theoretical discussion about knowledge management and its foundations have direct impact on the way people think in organizations, and in turn how the work is organized – which has measurable effects. The complex functions underneath knowledge creation are something that directly affects a company's ability to succeed. The case also shows that even if the processes are not fully understood a lot could be learned just from thinking about some central features about knowledge. As discussed earlier in the paper concepts of knowledge are so central that the thinking about them is rarely challenged, but when they are, there is a lot to be revealed. It is my strong

belief that we are just beginning to learn what learning is – even though the discussion has been continuously alive for over two millennia.

	Mainstream view A	**Complex responsive view B**
1. Open communication	The expert shares the knowledge with other employees, i.e. externalizes tacit knowledge through socialization. Knowledge is a scarce resource.	Positive feed-back loops created in attentive interaction is a necessary condition for knowledge creation. The more shared the higher the value.
2. Social Competence	The code-protocol in which tacit and explicit knowledge are transmitted.	Makes interaction smoother and more predictable – more probability for positive feed-back loops.
3. Belongingness	To share a code-protocol.	Security creates openness to make mistakes which in turn creates creative environments.

Table 1. The observation in relation to the different perspectives of knowledge creation.

Conclusion

Knowledge is not cumulative in the sense that it can be gathered and stored like some sort of commodity. If it cannot be gathered and stored the idea of transmitting 'knowledge' is inadequate. In my opinion it seems clear that 'knowledge' is created through a responsive process. We have to *use* knowledge, if not used it doesn't exist!

The reasoning behind the 'complex responsive view' is superior to the 'mainstream view' in how it approaches the process of knowledge creation. The main difference between the two perspectives is that knowledge is said to exist as a commodity in the 'mainstream view', whereas there are no such assumption in the 'complex responsive view'. Stacey (2001) argues that knowledge emerges as the consequence of a responsive process. The organization is not a system that can be managed. The organization is positive and negative processes, feed-back loops, taking place between human beings. The focus is shifted from how to manage what has been thought to be a commodity, to focus on how one can participate in an ongoing process, and by participating provoke others to respond. In this way the 'learning organization' emerges.

Concluding Remarks

In our daily lives we have ideas of how perception and communication take place. These ideas rely on assumptions. Most of these assumptions are part of the cultural framework in which we live and are therefore both hard to observe and to question. I have tried to make analogies with what has happened in Physics during the last hundred years. Namely, that there has been a clear shift in the basic assumptions that constitutes the framework for perception and therefore also communication, and this process of shifting the framework for perception continues. Today it may seem natural to refer to one's subjective experience of a situation, to use the idea of relativity and the principle of uncertainty, or to focus on the processes instead of the equilibriums. Reality is in this sense something totally different from what it was a couple of centuries back. The shift in Physics was from the idea that the world is linear, and actions can be perceived in reference to an objective framework, to a non-linear, uncertain and relative universe. It takes some time for these shifts to be common knowledge, or even common sense. I argue that there are analogies between what happened (and happens in science in general) in Physics and what is now happening in the organizational science.

Towards the end of the book Nonaka & Takeuchi (1995) discusses some theoretical implications of their theory. One of the main points in this section is that a big difference between the East and the West is that the Westerners are used to divide the world into dichotomies, i.e. two opposite sides. That is how we are used to view the world, while the Easterners are used to see the dichotomies, not as opposites, but rather as complementary. The individual and the social is a good example. Stacey is critical about the split between these two, that he argues that Nonaka & Takeuchi are making. Nonaka & Takeuchi argue that there is no split; the two perspectives should rather be seen as complementary. This idea is very near the one Stacey (2001) argues for, i.e. the 'self-similarity' of individual/social behavior patterns (von Krogh & Roos, 1996).

Further Nonaka & Takeuchi (1995) are arguing that the same reasoning holds for the dichotomy tacit and explicit knowledge. They see it as complementary processes that

have to be present to create each other as it is the dynamic between the two that are interesting. These arguments bring the different views a step closer to each other.

During my presentation of the two different perspectives there has been a tendency towards the question: What is knowledge? However, this question tends perhaps to be somewhat philosophical, and may in some ways seem irrelevant to the context about knowledge in corporations. On the other hand – when discussing cases and more practically oriented literature on knowledge creation there seems to be an implicit assumption of what knowledge is: Something which I have showed is not always that clear. This unclearness of what knowledge really is, in turn, gives rise to the need of understanding and questioning these assumptions.

I have tried to argue that there are a number of pitfalls, and a lot to *keep in mind* when discussing knowledge creation, not least I have tried to put the focal point on the problems rising from our preconceived, many times implicit, assumptions about knowledge and learning. My discussion and critique of the different perspectives briefly hints at some considerations for any epistemology of the organization, and hopefully I have provided some useful remarks of what can be important when doing research in the area of knowledge creation.

References:

Ackoff, R. L. and Emery, F. E. (1972) *On Purposeful Systems*, London: Tanistock Publ.

Bathelt, H. Malmberg, A. and Maskell, P. (2004) "Clusters and Knowledge: Local Buzz, Global Pipelines and the Process of Knowledge Creation" *Progress in Human Geography* Vol. 28, Issue 1, 31–56.

von Bertalanffy, L. (1969) *General Systems Theory; Foundation, Development, Application*, New York: Braziller.

Brown, S.L. and Eisenhardt, K. M. (1997) "The Art of Continuous Change: Linking Complexity Theory and Time-paced Evolution in Relentlessly Shifting Organizations" Administrative Science Quarterly Vol. 42, Issue 1, 1-34.

Bryant, S. E. (2005) "The impact of Peer Mentoring on Organizational Knowledge creation and sharing: An Empirical Study in A Software Firm (Forthcoming in *Group & Organization Management*).

Georgescu-Roegen, N. (1971) *The Entropy Law and the Economic Process*, London: Harvard University Press.

Gleick, J. (1988) *Chaos,* London: Heinemann.

Hedlund G. (1994) "A Model of Knowledge Management and the N-form Corporation" *Strategic Management Journal* Vol. 15 Issue 5, 73-91.

_____ and Zander, U. (1993) "Architectonic and List-Like Structuring: A Critique of Modern Concepts of Knowledge Management" Working Paper 93/02, Institute of International Business, Stockholm School of Economics.

Hofstadter, D. R. (1979) *Gödel, Escher, Bach - an Eternal Golden Braid*, New York: Basic Books.

Huber, G. P. (1991) "Organizational Learning: The Contributing Processes and the Literatures" *Organization Science* Vol. 2, Issue 1, 88 – 115.

Hume, D. (1739/1978) *A Treatise on the human nature,* 2nd Edition Oxford University Press.

Kauffman, S. A. (1993) *The Origins of Order*, Oxford University Press.

_____ (1995) *At Home in the Universe*, Oxford University Press.

Koestler, A. (1979) *Janus, A Summing Up*, London: Picador Publications.

Kogut, B. and Zander, U. (1992) "Knowledge of the firm, Combinative Capabilities, and the Replication of Technology" *Organization Science* Vol. 3, 383-397.

____ (1996) "What firms do? Coordination, Identity and Learning" *Organization Science* Vol. 7, 502 – 518.

von Krogh, G. and Roos, J. (1996) *Managing Knowledge*, London: SAGE Publ.

Liang, T. Y. (2004) *Organizing Around Intelligence*, Singapore: World Scientific.

Mahon, C. J. (1999) *Charting Complexity*, Copenhagen: New Social Science Monograph.

Mead, G. H. (1934) *Mind, Self and Society*, Chicago: Chicago University Press.

Merleau-Ponty, M. (1962) *Phenomenology of perception* Trans. C. Smith, New York: Humanities.

Mandelbroot, B.B. (1977) *The fractal Geometry of Nature,* New York: W.H Freeman.

Nonaka, I., Toyama, R. and Konno, N. (2000)"SECI, Ba and Leadership: A Unified Model of Dynamic Knowledge Creation" *Long Range Planning* 33, 5-34.

Nonaka, I. and Nishiguchi, T. (2001) *Knowledge Emergence*, New York: Oxford University Press.

Nonaka, S. and Takeuchi, N. (1995) *The Knowledge-Creating Company*, Oxford: Oxford University Press.

Polanyi, K. (1958) *Personal Knowledge,* Chicago: Chicago University Press.

Roth, J. (2002) *Knowledge Unplugged*, Gothenburg: Dissertation at Chalmers.

Senge, P. M. (1990) *The Fifth Discipline*, London: Random House.

Smith, G. K., Collins, C. J. and Clark, K. D. (2005) "Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms" *Academy of Management Journal* Vol. 48, No. 2, 346-357.

Stacey, R. D. (1993) *Strategic Management and Organisational Dynamics*, London: Pitman Publishing.

Stacey, R. D. (2001) *Complex Responsive Processes in Organizations,* London: Routledge.

Teigland, R and Wasko, M. M. (2000) Creative Ties and Ties that Bind – Examining the Impact of Weak Ties on Individual Performance, Institute of International Business.

Wittgenstein, L. (1972) *On Certainty* ed. G.E.M.Anscombe and G.H.von Wright Transl. by Denis Paul and G.E.M.Anscombe, New York: Harper.