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Microinnovations among the paradigms of innovation research -what are the common ground issues

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Received: 22 April 2011 Accepted: 13 May 2011 Published: 24 May 2011

Abstract

If we consider innovations as human action, this research has been dominated on one hand by social and policy making processes and, on the other, by organizational management thinking. In this study, we shall introduce a third perspective to innovation as action, namely, innovation as a human way of thinking. We claim that innovations are always made by thinking people, and therefore we should also look innovations in concepts of scientific research to human thought processes. Since societal and organizational paradigms concern innovations as relatively large wholes, we term the research on these paradigms as macroinnovation research.Here, we study the relations of microinnovations research to major paradigms of innovation research and in this way define its role within the field. We shall define the common ground points between microinnovation research and such established paradigms as organizational innovation research, innovation processes, systems and especially ecosystems of innovations research, flow of information, diffusion of innovations and finally the research on innovation policies.

Index terms— microinnovation, paradigms, ecosystems, dominated

1 Introduction

he word innovation can be found in the 13th century French and three decades later in English. It thus has Latin roots (Innovare). In both cases, innovation refers to renewal (Zingerle 1976). Although this etymology is not significant for our arguments -the use of the word and the contents of the concept having recently become much more specified -it still expresses something essential about the nature of innovation. This is that innovation leads to something new which has not existed earlier (Damanpour & Wishnevsky 2006, Freeman & Perez 1988 **??** Schumpeter 1939, p. 85). In human terms, the new in life is always created by human thinking, and our species has earned its position among all other species by its capacity to think (Johnson-Laird 2008, Newell and Simon 1972). This is why it is natural to consider innovation as renewal and thinking as the human ability to create new thoughts and, consequently, new objects or social systems.

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The central social role of innovations is an undeniable fact today, and there has been a lot of effort to investigate them. If one looks at the Fortune 500 list, it is possible to see that from 1970 to 1995 around 60% of the companies disappeared from the list (Tidd et al. 1997). This means that even the most prosperous and best companies can lose their position in the markets if they do not take care of their innovation processes. Companies which

have been able to carry out successfully their technical innovation processes have prospered and gained markets (Adams, Bessant and Phelps 2006, Chesbrough 2003 **??** Nonaka and Takeuchi 1995, Tidd, 2001, Tidd et al. 1997). The Japanese car industry is a good example. Another good example is Apple, which has recently very successfully marketed its products all over the world and created a networked system. During technological revolutions, such as the recent emergence of mobile ICT, companies which have been able to manage effectively their product innovation management have survived and taken the main part of the markets, while the less successful competitors have abandoned the business.

Competition makes it understandable why innovation and taking care of innovation processes is not a free choice for a company but a simple necessity. If a company or a society is lazy in this point, others will take it over. However, before it is possible to get working innovation systems within countries and companies, we must have a clear understanding of this elusive and versatile phenomenon. This means that research in innovations is just as necessary as development of innovation systems.

Finally, the question is not only that of technological development and business processes but innovations are also important in the way communities, societies, organizations and collaborative networks organize their activities **??**oete 1997, Hautamäki 2010). Innovations may also concern systems such as national education, research organization and industrial networks. The new ways of organizing and acting may be important preconditions for the actual innovation processes in industries and in societies.

Innovations are studied using many different conceptual systems from political and organization sciences to economics **??**elson 2005, Tidd et al. 1997). This is not odd or exceptional in science. The phenomena of evolution, for example, are studied simultaneously with the help of molecular, cell biological and zoological concepts (Mayr 2001). It simply makes good sense to ask questions about innovation using concepts, methods and theories from many different fields of research, as in this way it is possible to get a comprehensive picture of this lifeline of modern society.

One can classify innovation research into many types, one major line of demarcation being between different types of innovation as human action, on one hand, and innovation as social transformation, on the other. The former type of innovation research uses some concepts of human action. This means normally either policy making or organizational management **??**Brown and Eisenhart 1995). Good examples of the latter are innovation systems, diffusion of innovations and financing.

Innovation research has so far considered innovation as human actions from two different perspectives. These two research paradigms are innovation policies and organizational innovation processes (Brown and Eisenhardt 1995). The policyrelated research opens up questions on how the USA, European union or Japan should organize their actions to effectively foster innovations in their particular areas of competence (Diederen, Stoneman, Toivanen and Wolters 1999, Beise and Stahl 1999, Etzkowitz and Leydesdorff 2000, Freeman and Soete 1999). The organizational type research concentrates on organizational and management innovation processes (Birkinshaw, Hamel, and Mol, 2008, Dodgson 2000, Drucker 2006). However, these two broad categories do not give us all the information that we need about innovation as human action.

Here, we suggest one new perspective to innovation as human action, i.e. innovation as human thinking (Saariluoma, Kannisto 2008, Saariluoma, Kannisto and Kujala 2008). In our work, this means that we shall consider innovation processes in terms of the cognitive scientific research on human thinking. Since thinking is the only means to generate innovations, it is equally important to consider innovations as policy making or management. Without our human thinking ability we would have no more innovations than chimpanzees have. This is why it makes sense to ask what the innovative thought processes are when studied in terms of the research in human thinking (Simon 1969). Because national and organizational paradigms of innovation research analyze relatively large issues, we can term this third perspective as microinnovation research (Saariluoma, Kannisto 2008, Saariluoma, Kannisto and **??**ujala 2008).

In this paper, we are interested in defining the position of microinnovations research among the main paradigms of innovation research. A way of doing this is to look at how the questions of microinnovations, i.e. the research to innovative thinking, are related to the main paradigms of innovation research. This deals with what microinnovation research might add to the analysis of innovation policies and systems, organizational and innovation management, innovation processes and diffusion of innovations. We systematically ask what the function and role of human thinking in these major innovation discussions are, and in this way we can clarify the position of microinnovation issues among other paradigms of innovation research. Our discussion raises two basic questions. Firstly, is thinking really essential in analyzing some known aspect of innovation? Secondly, what kinds of research issues are opened up by concepts of human thinking? II.

2 Innovation processes

Innovation is a process in which innovators find new things (Christensen 2002). We do not know how we will do things until after the innovation process has reached its goal. The goal itself is either a small or a large change in technology, but it is also a change in the quality of human life (Saariluoma and Leikas 2010). Flash memories and memory sticks, for example, changed the way people store information in their computers and in many other devices. This innovation, originated by Sony in 1998, has spread very fast over the whole field of computing. Apple invented a number of devices, which eventually lead to a revolution in mobile services.

Design is the key in the innovation process and also forms the core of innovative thinking. However, not all

design processes lead to innovations. Thus not all that is required in innovation can be seen in terms of design, either. Fifth generation computers require a large-scale design process, but we still do not have computers which some suppose should think like human beings. Of course, this undertaking lead to many important improvements in our knowledge of 2011 computing, but still it never became an innovation as such, because human thinking is more complex than the information processing that can be realized by the computers of today.

Companies have to conduct a variety of activities to build up their production volume. Product design is the process of devising and laying down plans that are needed for the manufacture of a product (Pahl and Beitz 1988 From the microinnovation perspective, the main problem area in design is design thinking, which is assumed to signify a process of organized thoughts aiming to a clear goal. Design begins with concepts and broad solutions. A concept (or sometimes scheme) comprises a "broad" solution which is normally documented as diagrams or sketches **??**Roozenburg and Eekels1995). The term principal solution is quite near to the "broad" solution (Pahl and Beitz 1988, Roozenburg and Eekels1995). Ulrich and Eppinger (2004) describe the field of concept selection as an iterative process of generation, screening, scoring and testing of concepts.

Besides satisfying the functional and working interrelationships of a product, a solution must also satisfy certain general or task-specific constraints. Hubka and Eder (1996) separate the properties affected by the constraints into categories based variously on industrial, ergonomic, aesthetic, distribution, delivery, planning, design, production and economic factors. Today we have to add factors such as safety, environmental and legal considerations, transport, maintenance, recycling and disposal (Pahl et al. 2007).

Nowadays, product design is embedded in a more comprehensive process, which is called product development, and further, e.g., according to Roozenburg and Eekels (1995), product development is part of industrial innovation process. The above mentioned problems become concrete tasks after the problems that designers have to solve to create new technical products (artifacts) are clarified and defined (Pahl et al. 2007). This happens in individual work as well as in teams in order to realize interdisciplinary product development (Ulrich and Eppinger 2004).

In addition to emphasizing systematic procedures, Pahl et al. (2007) mention clearly the importance of experience, intuition, and creativity as far as an effective design methodology as a "practical tool" is concerned. It is a concrete course of actions that derives its knowledge from design science (Pahl et al. 2007, Hevner et al. 2004, Järvinen 2004) and cognitive psychology (Pahl et al. 2007). The aim of design science, in brief, is to develop rules for development (Pahl et al. 2007) or to build innovations and evaluate them (Hevner et al. 2004, Järvinen 2004).

The process of growing something to a commercial product does not form a straight line from invention to innovation but presupposes a huge number of small and larger inventions. The construction of DX-200 was not a simple elegant process as it entailed a large number of great inventions. It presupposed, like most modern commercialized ICT-innovations, a long development work (Bruun and Wallen 1999). One of the best inventions was the way this development process was kept alive so that it had a theoretical possibility to become the basic innovation for mobile ICT.

This means that innovations in general do not result from one single invention, but, rather, they are processes that are often also goal directed. Thus we might talk about a mass of new ideas organized in a clever manner for a single problem solving process. A logical question now to ask is: what kinds of thought processes could there be and how are they organized to get a real innovation?

In a study by Saariluoma, Nevala and Karvinen (2006) a long-range development process is analyzed. The target was an extended nip in a paper machine, which was developed during 1986-2000 and which made the Metso corporation the world technology leader in paper machines. At the same time Belotti, the best known company in the industry, ended its activities. Therefore, this very difficult engineering process can be thought of as a genuine industrial innovation process.

We found four different modes of engineering design thinking. Firstly, when people came across a problem, they made a coherent mental representation of possible solutions. Secondly, they tested it and restructured the representation when the outcome of testing was not satisfactory. Thirdly, there where thought processes in which people tried to solve which one of a number of plausible solutions would be optimal. Finally, they integrated the accepted solution to the whole. Respectively, we discuss here apperceptive, restructuring, reflecting and constructive modes. This empirical investigation illustrates that innovation entails different types of thought processes.

Invention and innovation have thus specific relations. Innovation process organizes numerous invention processes into one whole. These processes have specific contents. A part of the contents may be technical, some of it has to do with human actions, some is process information and, finally, much of it belongs to marketing. The differences in this background information show already how innovation arises from numerous inventions, and thus it is through a business process.

In each state of innovation, problems emerge and must be solved. If a group or network of innovators fails, innovation cannot become true. Failures in apparently small problem solving processes may have fatal consequences. Many supertankers blew up in the Sixties as a consequence of one design error in their tanks (Perrow 1999). One failed problem-solving and design process thus destroyed the ships which were otherwise well designed. This example illustrates how important it is to study the flow of thoughts and problem-solving processes in innovation research -and not only problem-solving processes but also the preconditions for problem solving.

3 III.

4 What IS INNOVATIVE THINKING?

We all know what is thinking. It is something we do to get new ideas and new ways to look at our life and work. Thinking is thus intuitively very essential for renewal, which is typical to innovation. For this reason, it makes sense to study what kinds of questions can be asked and answered by using concepts and theories of human thinking. Though this is very clear, our intuition does not yet give us much, because scientific theories of human thinking are as far from everyday intuitions as the concept of mass in mechanics compared to the everyday concept of mass **??**Holyoak and Morrison 2005). This is why we first have to consider, from the viewpoint of science, what we mean by thinking.

Thinking has interested philosophers and psychologists for thousands of years, but it has also been topical in modern psychology (Evans and Over 2004, Holyoak and Morrison 2005, Manktelow and Over 1990, Sonnentag, Niessen and Volmer 2006). The difference between these two disciplines in looking at the issue is roughly the following: philosophers are interested in what is the objectively right way of thinking, while psychologists work with problems of how people really think. Therefore, it is good to combine the two perspectives when working within the frame of cognitive science.

Intuitively thinking is manipulation of ideas, images, memories, percepts or simply mental representations **??**Holyoak and Morrison 2005). In principle, we can simulate the manipulation of representations with computers (Anderson 1983, Dunbar and Fugelsang 2005, Newell and Simon 1972, Sun 2006). This kind of manipulation causes shifts in the contents of our thoughts. In one moment of time we might not be able to represent something, even though a little later this may be clear for us (Duncker 1945, Köhler 1925, Wertheimer 1945). Innovation researchers also speak about changes in perception (Drucker 1977).

Another character of human thinking is that it emerges when we have a goal but are not able to reach it by the means currently available for us. It is thinking that creates those means for us (Johnson-Laird 2008, Newell and Simon 1972). Of course, innovation processes are very goal-oriented. The goal is to create and market products that can provide new value to users and change the ways they live (Cockton 2006, Saariluoma and Leikas 2010). Thinking is the way that final goal can be reached.

Thinking presupposes motivation. People must set goals and pursue these goals. If people had no goals, they would have no problems either, nor any need for creative thinking. They must be motivated to have thoughts which are relevant in innovation processes. Motivation and goal-setting is one of the core characteristics of humans (Dwegg and Lewgget 1988). Therefore, it is essential in microinnovation research to work with the problem of motivated thinking. The importance of motivation has been known for quite a long time among traditional innovation researchers, though it has not been connected to the scientific study of human thinking.

We can see the influences of innovation by considering the effects of dismotivation on our daily work life. A study by Hidalgo and Albors (2008) demonstrates that such dismotivating phenomena as bureaucratic complexity, unwillingness to share knowledge, low awareness of innovation technology and difficulty to accept failure harm innovation activities (Hidalgo & Albors 2008). The literature on organizational motivation and creativity is in this work central (Amabile 1999).

When considering microinnovation problems, perhaps the main attention should be put on intrinsic motivation for which there is a wide and elaborated literature. Thinking has always an important intrinsic component (Ryan and **??**eci 2000, Oudeyer andKaplan 2008). People must have their own needs to pursue their goals. This is something that organizations all too often unintentionally miss. Closed minds, unnecessary and unskilled evaluations, and absence of real feedback are typical phenomena spoiling human motivation (Amabile 1999).

Negative organizational practices are in contradiction with one important principle of human motivation. This is the self-determination theory (Ryan and Deci 2000). In this theory, intrinsic motivation, selfregulation and well-being are central determinants of human action. In intrinsic motivation, the important things are interest, enjoyment and inherent satisfaction. This means that people must be genuinely committed to the ideas they foster in innovation processes. Of course, closed organizational practices are destructive for human self-determination. We can also see that factors in work atmosphere and in life outside work are essentially a process which organizes inventions into a whole. Therefore, it is too simplifying to consider innovation as inventions which have merely passed This introduction illustrates that we have important reasons for thinking that motivation is among the important factors in microinnovation research. Motivation explains a part of what happens when innovating people think about various issues. It is especially important when we consider the relations of organization, management and innovative thinking. This is why it is necessary to include problems of motivation and thinking to the spectrum of microinnovation processes.

Nevertheless, thinking does not only depend on the thinking person, but also on information and social contexts. Much of human thinking is social, i.e. it must be considered either in social, psychological, sociological or social scientific terms (Wegner 1998). This means that the final outcome of thinking is a product of several people and their collaboration. One invents something, and the next piece is invented by someone else. Finally, all knowledge is brought together into a complex idea. Much of design and innovation must be seen from this social perspective. This is why it is essential consider the role of social psychology, sociology and cultural research in thinking that takes place within microinnovation processes.

Language and dialogue are the most important tools of social thinking. In dialogue, people learn about content

and processes. They learn to know each other, they get new skills and finally, they can see much more than they would alone (Isaacs 1993). Thus dialogue enables people to share knowledge and become conscious of many tacit aspects in their thinking. It is also an essential tool in management and leadership , Isaacs 1993). In this way, the nature of dialogue is a vital problem in the research into microinnovation processes.

The same dialogue can have a number of discourses. It seems that a heterogeneous group needs a common ground discourse. The formation of common ground needs common patterns, mutually agreedformed rules, policies and practices. Argumentation and debate by an expert network to resolve problems, rather than being a direct source of information seem to orient expertise and experts in data exploration.

Thought progresses through a dialogue between people in the form of argumentation. Arguments are clauses with truth value (Hamblin1998, Parsons 1996, van Ermereen, Grootendorst & Snoeck Henkemans 1996). These clauses or propositions claim something about the world. Their role in dialogue is to show how things are and in this way to make a stand in relation to knowledge. In organizational discussions, arguments may be correct but they may also entail numerous fallacies. In any case, organizational thinking proceeds through argument.

It is crucial to ensure that argumentation works on solid grounds (van Ermereen, Grootendorst & Snoeck Henkemans 1996). This means that the discourse must remain justified. If we have a record of that, it will be possible to consider what the true grounds are, or whether the circumstances have changed so that something which was impossible earlier can now be done. The nature, truth and systems of argumentative discourse in innovation systems are important topics in microinnovation research.

There are also non-argumentative discourse practices in organizations. Typically, ideas may be met through irrelevant points of silence. These kinds of practices are destructive for organizational thinking. Therefore, it is essential that argumentations in organizations are considered from the microinnovation point of view. This addresses the questions of how thinking in argumentative discourses is organized, what we mean by strong practices and what kinds of practices are dysfunctional.

The points made here illustrate how microinnovations have their social and psychological aspects also. We need to investigate how thoughts get their forms in innovative discourses. The question then is not how the discourse proceeds but how thoughts get their forms. Discourses are important only because they can lead to incomplete or incorrect final solutions while preventing the best ideas from coming to the fore.

5 IV.

6 Societal innovations and innovation policies

Governments have a number of important tools for fostering innovations in their regions when creating good preconditions for innovative processes. The size of a region or district is not central when we think about fostering innovations.

Regional, national and international administrative organizations, from local communities to the European Union, can find and create instruments to improve the conditions for innovative organizations and innovative people. These instruments we call innovation policies.

Regulations, directing flows of resources such as money and knowledge, as well as creating advantageous organizational structures are typical policy means to create innovations (Tidd et al. 1997). Since the governmental resources are often quite large, the issues of innovation policies and societal innovations are vital. One cannot think about innovations without having a clear idea of what governments have done, how these operations have succeeded and what they could and should do.

Of the many governmental instruments to create innovations, the closest to the present topic is knowledge flow. Of course, there can be policy mistakes which may be costly to the societal innovation important governmental tool for improving microinnovation processes. Science and R&Dprocesses can be supported by many different means. It is possible to create physical infrastructures, such as fast communication lines, for people who are innovative and creative so that they can transfer knowledge to right places at right times.

Another large-scale view to innovation processes is the study of the development of systemic innovations and innovation ecosystems (Geels 2004, Geels, Boelie and Green 2004, Hautamäki 2010). Systemic innovations are related to transitions of sociotechnical systems. We have systemic innovations incorporated in many of the challenges that a modern society faces: in energy issues, transportation systems, health care systems, reforms in agriculture, waste systems etc. Systems could be developed by optimizing certain factors or by system innovations leading to new systems. As a result, systemic innovations are often described by jumps or transitions. Transitions could be large like a transition from a rural to an industrial society or more restricted like a transition from telegraph to telephone.

In our studies, our starting point is the thesis that innovation is thinking. So the issue is how the external and internal preconditions of innovation are related. One way to try to solve this problem is to make a distinction between invention and innovation. Thinking is, first of all, the creative base for inventions -that is to say, novelties. The framework of thinking is a niche or an innovation ecosystem. The pathway of novelties to markets is dependent on regime and landscape. They create the context of innovation (demand factor, users, norms, regulations). The context also has influence on this niche, creating pressures for an invention.

Undoubtedly, one of the main issues here arises from related argumentation and decision-making theories (Hamblin1998, Hastie 2010, van Eemeren, Grootendorst & Snoeck Henkemans 1996, Tversky and Kahneman

1974). There are numerous decisions taken and discourses going on at different levels of governmental institutions, from parliaments to local governments. They follow rational procedures in the world where we know that irrational practices are common (Giegerenzer and Selten 2001). Obviously, we have to study these issues in detail when dealing with microinnovation research.

7 V.

8 Systems of innovations

It is well-known that experimental thinking, which underlies modern innovation systems, was developed by Galileo. He studied how the variation of the length of a pendulum changes its movements. He presented a procedure which has been used since in academic research as well as in industry. Much less well-known is the fact that he copied his procedure from the Pythagoreans, who hundreds of years before had manipulated the length of a string to study the changes in the height of a tone. Indeed, Galileo directly cites the Pythagoreans' experiment.

Why did the idea of Galileo lead to a dramatic change and to the birth of a new industrial and economical culture when the outcome of the Pythagoreans' experiment was very modest in its time **??**Galilei 1954, p.p. 95-103)? The natural answer is that Pythagoreans had no preconditions for an innovation system, which indeed was already present in late renaissance Italy. Similarly, Leonardo, despite his great ideas, did not yet have any innovation system, and thus his ideas were left unobserved.

The examples illustrate that thought without an innovation system does not flesh out to innovations. On the other hand, it is equally clear that without new thoughts and ideas, there will be no innovations. This is why it is essential to consider both innovation systems and innovative ideas. Without these systems innovation does not materialize, and without ideas systems are bound to remain empty. However, there are many different ways to conceptualize systems in innovations research. 10 On one hand, systemic innovation means a cluster of innovations where many innovations are related and dependent on each other. In this sense also a technical device like a mobile phone presupposes a cluster of technical innovations (signal processing, batteries, displays, antenna etc.). Sometimes the phrase "parallel innovations" is used in the same sense. On the other hand, systemic innovations refer to changes or transformation in large operating systems, such as an energy production system or a railway system (see Elzen, Geels & Green 2004). New technologies incorporate ideas, and the process of systemic innovation is a process of combining ideas. These naturally involve thought processes, and in this way microinnovations are connected to systemic innovations.

However, there is another conception of system in innovations research. This is the idea of innovation system or innovation network and, especially, innovation ecosystem (Hautamäki 2010, Tuomi 2002). Innovation ecosystem is a local environment for innovation processes. It consists of different actors working together and communicating with each other. It provides a flow of ideas between individuals and institutions like universities, service providers, financers and large and smaller companies collaborating in an ecosystem. For our purpose here, innovation ecosystem is the context and enabler of innovative thinking. A larger, regional or national, concept of innovation ecosystem is an innovation system. associated parts of the system of firms. Typically, these can be research organizations, legal bodies, local trade and business associations and government agencies. As a whole, such elements can form effective networks and ecosystems for innovations. However, they have only marginal relevance to the contents of innovative thoughts and for their creation. Therefore, we cannot assume that there would be much common ground between these concepts and microinnovations.

However, the concept of innovation system can also refer to a flow of ideas between institutions **??**Saariluoma, Kannisto and Kujala 2008). Especially the flow of knowledge and knowledge creation between actively collaborating organizations or collaborative networks and teams can open up many important common ground points between microinnovation research and systemic innovation studies. In such cases, the social construction of knowledge easily rises to the fore **??**Berger and Luckman 1966).

System innovations are defined as large-scale transformations in the way societal functions such as transportation, communication, housing and feeding, are carried out. A system innovation can be understood as a change from one socio-technical system to another (Geels 2004). One aspect of a system innovation is technological substitution, which comprises three sub-processes: a) emergence of new technologies, b) diffusion of new technologies, c) replacement of old by a new technology. The second aspect is coevolution: system innovations not only involve technological substitutions, but also changes in elements such as user practices, regulation, industrial networks, infrastructure, and cultural meaning (Chesbrough 2003 **??** v. Hippel 2005). The third aspect is the emergence of new functionalities: when radical innovations have particular technical properties, this may enable the articulation of new functional characteristics. (Geels 2004) A typical example could be the flow of ideas and knowledge in open innovation systems (Chesbrough 2003). Linux community created vast operating systems by means of collaborative cooperation with no direct financial goals. Later on, of course, numerous important business ideas grew from this ecosystem of ideas. From microinnovation points of view, it is essential to study how the idea grew and what are the motivating forces behind. In open innovation, the innovation process is decentralized and distributed (Chesbrough 2003, Hautamäki 2010). It is interesting to study how microinnovation process takes place in a distributed mode of innovation. At least, we have to understand the flow of knowledge between "thinkers". Thus, communication is a central mode in microinnovation.

The general conclusion concerning the relations of innovation systems and systemic innovations to microinnovations originates from the fact that systems are in a constant change information wise. This information entails thoughts which are combined with each other by active human thinking. This means that systems actually emerge from thinking, to support thinking in innovation processes. Therefore, we have to investigate the nature of discourse and thinking in relation to the flow of information between the systems.

9 VI.

10 Organizational innovation management

The importance of thinking in innovation management has indirectly been known for a long time. Nonaka and Takeuchi (1995) already argued that Japanese companies had got to their position because they were more able to create knowledge than their Western rivals. Here we must keep in mind that creating knowledge is nothing but thinking. Thinking is the psychological process which creates all new knowledge we have. This is why understanding thinking is so vital in managing innovations.

Another close idea is creativity. Von Stamm (2008), for example, writes: "Creativity is the beginning of innovation". She uses the word creative here in everyday sense, but equally well one could write: "Thinking is the enigma of innovation". This means that innovation essentially refers to creating new, often unexpected, mental representations and respectively turning these new thoughts, ideas or plans into real products. Even from this point of view, thinking is an important but barely researched ground for innovation research.

The relations of the two important psychological concepts "creativity" and "thinking" are problematic and there is a lot of confusion about how to use them intuitively. The main point of this difficulty is historical. Creativity is an external sign or measure for thinking, but it does not really refer to the mental process of thinking. The notion of creativity became important and popular in the Fifties, which was the period of behaviorism. In that period, psychologists did not pay much attention to internal, mental or cognitive processes.

Therefore, creativity was used synonymously with thinking, but this is fatal error, as it easily omits the internal research process. This means that we do not consider what happens in the minds of thinking people: what the preconditions for good thinking, such as skill and expertise, are, and what the laws of the contents of thoughts are.

The connection of new and thinking is evident and its relations to creating knowledge and creativity obvious, but still it is surprising how little work in Karvinen 2006), but one can hardly find research on innovation and thinking. This is why it is essential to call attention to the microinnovation processes.

In practice, microinnovation processes within an organization are vital as they enable innovation managers to reach more concrete ideas about how to direct the flow of innovative thought processes. Innovation management needs not only concern products; it can also work on organizational thought processes (Amabile, Hadley and Kramer 2003). Understanding microinnovation processes is one of the first steps towards a more comprehensive innovation management.

11 VII.

12 Microinnovations research -new ways of looking innovations

We have outlined here some of the main features of new ways to look at innovations. This is based on the idea that innovations always depend on how individuals think. Even the most complicated ideas are nothing but organized collections of ideas individuals have thought one at the time. Thought is thus the "atomic" or" molecular" structure of big innovations. For this reason alone, it is essential to consider innovations as human thinking and not only as social or organizational processes. Addressing only those higher levels simply ignores human thinking and its preconditions.

Innovations are systems of thoughts. This means that there are information contents, which have integrated into each other into sense making systems. We do not always fully understand why some ideas work and what we should do to get them to work. The task of microinnovation research is to consider how these ideas are integrated into wholes, what the preconditions of such processes are, and how we could improve the thinking conditions for innovating people.

Microinnovation research is not independent of the research on the higher societal and management levels. On the contrary, microinnovation research should be able to explain why some interventions on these higher levels make sense or why they are not rational. However, it would be a mistake to think that social or organizational innovation phenomena could exhaustively explain what happens in the minds of innovating people.

Human thinking depends on many external factors such as obtaining knowledge or building social relations. These factors can be influenced by organizational means, but the external conditions do not explain all of human thinking. It is also essential to investigate internal conditions of human thinking. These concern such issues as emotional states, skills, motivation and exhaustion. These factors must be thought in their individual terms mostly, and this is why we have to consider innovations also from the microinnovation point of view.

When we look at innovation as thinking, we can also ask, in a meaningful manner, what its preconditions are. We know quite a lot about human thinking, and we can learn more about the nature of innovations. In particular,

we can learn about the internally significant preconditions, which is not open for externalist innovation research as it closes out innovation as a mental process and thinking.

To think, we first need information. Thinking is organizing innovation. It has, of course, its emotional and motivational aspects, but we leave them out here to concentrate on the main thing. Thinking creates new information. People get information and they process it in their thoughts to bring about new information. Before Pasteur, we had no idea about the connection between microbes and some illnesses, but after his work the situation changed. Nevertheless, it was possible for him to do his life work, Leeuwenhoek having done his so that Pasteur could get the information he needed.

Information is often important for innovations, but problems in getting information may have serious consequences. The problems with information in innovative thinking may be due to the absence of information, poor relations between people in the organization, poor communication, low competences or simply lack of information services in organization. 13

Innovations may be affected also by many dangerous and illusory ways of thinking. Illusions due to vividness or illusory thought models may act as an induction bias. Vivid information tends to look more probable than it actually is and act as an induction bias in generalizing from the past to the future **??**Tversky and Kahnemann 1974). From the fact that Napoleon so far had beaten all the enemy armies did not follow that he could also do the same with the Russian army. The circumstances can always change for some reason and then the old truths will be far from realistic.

The spread of innovative thinking may also be too hasty or follow too strict time tables, which leads to most routine thinking and errors (Saariluoma 2002). Haste may get people to forget something and apply a tunnel vision to the problems to solve. It may also lead to problems in checking all the necessary things. Innovative thinking may also be disturbed by poor social climate at work (Amabile 1999). It may be that people do not like to work together or they cannot find common important goals. The formation of inner and outer circles and other possible things which can lead to a bad work climate may be problematic for the innovation process. It has its consequences for the vital information flow as well as for emotional enthusiasm.

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[1]© 2011 Global Journals Inc. (US)

[2]© 2011 Global Journals Inc. (US) important for creativity in organization. They form the Microinnovations among the paradigms of innovation research -what are the common ground issues

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[5]Global Journal of Computer Science and TechnologyVolume XI Issue XII Version I July important for creativity in organization. They form the basis of motivation. They create the conditions for intrinsic motivation, which is a critical element in microinnovation processes.

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[7]Julyprocesses, and in the end of the day these mistakes are nothing but thought errors. The reasons for such thought errors are typical in microinnovation research.Nevertheless, flow of knowledge is the most

[8]Global Journal of Computer Science and TechnologyVolume XI Issue XII Version I July Innovation systems, when understood in a traditional manner as static institutions, are seldom relevant in microinnovations research. By system we refer here to a cluster of companies and to the

[9]Global Journal of Computer Science and TechnologyVolume XI Issue XII Version IJulyThere can be even much simpler reasons for failures. Lee Iacocca (198x) tells in his famous invention which did not work. The invention would not autobiography how a worker used a lot of time for an

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innovation management research has been done to investigate innovation as a thought process. There are important studies connecting thinking and design (Gero 2003, Saariluoma 2003, Saariluoma, Nevala and asked the mechanics whether it would be possible to realize this idea as departments did not really communicate with each other. Communication is the lifeline of innovation.

The examples show that there are numerous preconditions for innovative thinking. It would be unrealistic to think people as capable for successful innovative thinking unless they analyzed carefully the preconditions for it. The analysis of preconditions is one important issue in our research to innovations. This is why microinnovations are important (Saariluoma and Kannisto 2008).

To investigate closer the position of microinnovations in innovative processes, it is reasonable to consider in detail two important aspects of innovation processes and their connections to microinnovations. These two aspects are product development and systemic innovations. The first one represents the major management process and the latter the social dimension of innovations. The key problem to consider is how human thought processes are involved in these innovation processes.

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