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INTRODUCTION TO NATIONAL OPEN INNOVATION SYSTEM (NOIS) PARADIGM

A Preliminary Concept for Interchange

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ABSTRACT

Grounded on the beliefs of the open innovation, online social networks and web 2.0 we are suggesting a new people-to-people interaction based approach to support the national innovation activities. In order to generate new ideas our National Open Innovation System (NOIS) is combining two rival innovation sources (1) the technology and social foresight research and (2) the customer needs and experiences (i.e. customer orientation strategy) while following the principals of Triple Helix. As a result NOIS is an effective and comprehensive open innovation structure where university students and senior citizens are engaged as a significant resource for business community in order to fulfil the national innovation strategy as defined by governmental body.

Keywords:
Open innovation, National Innovation System, Triple Helix, Foresight, Customer orientation

1. INTRODUCTION

Innovations are an important building stones of today's economies. Organizational and individual knowledge and creativity are used for creating novel processes, products and services (Huiban and Boushina, 1998, Kenney, 2001, Taatila, et. al. 2006). The innovations have major impact on the national economies, and they are a major factor in creating competitive advantage between different nations (Tuomi, 2002). Because of this the most competitive countries in the world typically have extensive and sophisticated national innovation systems (later NIS) which theoretical foundations were seed in late 1980s (Freeman, 1987, Lundvall, 2007). Johnston and Bate (2003) describes the importance of innovation in following way: But what's more fundamentally true is that we now have an economy powered by human creativity. Creativity – the ability to create meaningful new forms, as Webster's dictionary puts it – is now the decisive source of competitive advantage. Virtually in every industry, from automobiles to fashion, food products and information technology itself, the winners in the long run are those who can create and keep creating.

Recently growing attention has also been devoted to the concept of "Open Innovation," both in academia and in practice. Chesbrough, who coined the term "Open Innovation" describes in his book Open Innovation: The New Imperative for Creating and Profiting from Technology (2003) how organizations have shifted from so-called closed innovation processes towards a more open way of innovating. Open Innovation can thus be described as: combining internal and external ideas as well as internal and external paths to market to advance the development of new technologies (Chesbrough, 2003).

Since the 1990s the commercialization and rapid growth of the Internet and World Wide Web (later Web) has created the most promising platform for connecting people and communication. As a result of this technological transformation we expect that innovation environments in general will change radically in the coming years. Moreover, this technological change is driven not only by new waves of information technology such as the Web but as well as other technologies like nanotechnology. Some calls this technological change process to be ubiquitous revolution, where all technologies will be integrated to other technologies and technology is a seamless part of everyday life of ordinary people.

One of the hottest change driver at the moment seems to be the Web 2.0 based Online Social Networks (later OSNs) movement which generally refers to communities and hosted services facilitating collaboration and sharing between users (Cachia, Compañó and Da Costa, 2007). In principal the OSNs facilitate the interaction among members by providing a dynamic/multimodal platform which enables versatile services such as discussions, sharing of multimedia content, organization of social events and information sharing to name a few. These networks comprise millions of active members from all continents and from all age groups.

The OSNs used in people's free time have gained unprecedented popularity in recent years and we have wideness a significant commercial success stories such as Facebook.com in a short period of time. Besides the user and the business community, the OSNs are also a increasingly hot topic among academics. Recently for example Cachia et. al. (2007) have evaluated the field of OSNs and noted that in 1st strand of OSNs are Google Trends, Zeitgeist and Yahoo!Answers kind of services, while in the 2nd strand there are e.g. Wikipedia, YouTube, delicio.us and digg. In the very progressive 3rd strand are MySpace, Orkut, Flickr and Linkedin. Finally, according to their evaluation, 4th strand will be Second Life, which is a 3-D virtual world entirely created by its residents.

In addition to leisure, we expect that OSNs can be regarded as tool to enhance creativity through the unprecedented modalities of communication and interaction they offer. It is also obvious that the more modules for innovation cooperation there are, the more interactive the OSN is. As a result of this new interaction we can expect that virtual and real worlds will integrate. In the future people are going to have both "First Life" and "Second Life" while the barrier between these two is coming blurry.

1.1 Objectives of this paper

We believe that the OSNs can be utilized as a critical part of NIS. Therefore in this article we are proposing a new National Open Innovation Systems (NOIS) for supporting the Finnish national system of innovation. Ahlbäck (2005) has suggested on the basis of WEF The Global Competitiveness Report 2004-2005 that Finland is the most innovative and competitive country in the world. As result, according to Yin (1990) sample selection criterions for cases, Finland and our concept suggestion can be regarded as an extreme sample and as a dynamic information society laboratory (Ala-Yrkkö and Hermans, 2002). Most importantly in this article we are not only going to propose the abstract concept, but also describing how this kind of model can be implemented as a concrete online web service. Thus, this article should give a good guidance were the leading national innovation system in the world is heading next and how the other nations can follow it.

The paper is structured as follows: in the following section, we briefly present the body of knowledge regarding the theoretical basis of creating innovations. We, then, present and discuss our NOIS concept in detail. Finally, we draw conclusions.

2. THE THEORETICAL APPROACHES IN INNOVATION RESEARCH RELEVANT TO INNOVATION SYSTEMS

2.1 What is the difference between idea and innovation?

Two forms of thinking – adaptive and creative – are typical for humans. In adaptive thinking an individual acquire important skills and knowledge, which are already present in the culture and are important in order to fit in the culture. On the contrary creative thinking means, that an individual creates novel things for the culture, which others acquire. Throughout this process the novel idea eventually becomes a small part of the culture. As a result the following idea definition is suggested: "Idea is a novel representation in individual's mind relating to conception or notion of something to be done or carried out. At the first stage, novel think is an intention or plan in individual's mind, which arises from individual's creative thinking process. In the second stage after individual's thinking process individual share his/hers idea with other people by verbal or written communication ".

According to Taatila et. al. (2006) economic innovation refers to novel ideas that have been implemented, producing more financial value than has been invested in creating them (Stevens and Burley, 1997), i.e. financially and commercially successful innovations. Taatila et. al. continue by arguing that from the business point of view the innovation is primarily interesting due to its positive financial effects: either it increases the cash flow – for instance as a new product or a new successful strategy, or as a capability to penetrate into new markets (Dougherty, 1996) – or decreases the costs, for example, as a more efficient production process. As a result an economic innovation is something genuinely new that brings added value to a company (Haho, 2002; Ståhle et al., 2004; Urabe, 1988).

Besides economical point of view series of other innovation definitions and classifications have been presented. Sometimes the term innovation is used as a synonym for invention or novelty. This typical concept of innovation refers to immanent qualities of products, technologies or ideas. Other way to define innovation is see innovation as changeability. Further notions of innovation do not focus the results of value creation processes, but rather the structure of value creation itself. So, innovation means change or with special regard to "organizational innovation " (Kirner 2006, 16). Changeability (see Moldaschl 2006), this is, a dynamic capability, or in brief: an organizational competence. One can define innovation also with the help of diffusion process (Rogers 2003). In this respect, this concept of innovation does not address inventions, but rather spread of ideas and inventions. Nor does it address intra-organizational change processes, but rather their impact on markets and societies. Interestingly Drejer

(2004) and Coombs and Miles (2000) suggested following three alternative approaches to understand service innovation and service innovation policies, such as our National Open Innovation System (NOIS). *First*, an assimilation approach suggests service innovation primarily may be described applying existing product innovation principles. An assimilation approach suggests product innovation methodologies may be adapted to service innovations. *Second*, a demarcation approach on the other hand suggests that service innovation is unique and new principles must be developed for the sole purpose of describing and explaining service innovations. Demarcation approach suggests all service innovation methodologies must be developed from ground up. *Third*, a synthesis approach suggests a combination of the two previous approaches is best suited for understanding both service and product innovation. A synthesis approach suggests both types of innovations may benefit from a combination of the two previously applied approaches. Moreover, in current Nordic empirical studies Leiponen and Drejer (2005, 2007) identified five types of innovation in the Nordic (Danish and Finnish companies) firms: (1) science-based innovation, (2) supplier dominated innovation, (3) production intensive innovation, (4) market driven innovation and (5) passive innovation. Finally, in the table 1 we have presented a practical classification of innovation (Hauknes, 2003).

Table 1 Five layers or fields of innovation (source: Hauknes, 2003)

Innovation field	Innovation locus
Product characteristics (product innovation)	Capabilities and competences involved in the design and production of products
Production and distribution process capability (process innovation)	Capabilities and competences involved in the design and operation of production and distribution process
Administration process capability (organisational innovation)	Capabilities and competences involved in the design and operation of information and coordinating processes
Innovative business capabilities (structural innovation)	Capabilities and competences involved in strategic and knowledge management and competitive transformation of firms
Relations management (market innovation)	Business intelligence and market research

Following summarization is made in order to identify the difference between idea and innovation. Idea is always the starting point, plan or intention for innovation. Idea changes to innovation during the execution/implementation process. Without the successful applying process, the idea will not change to innovation. That is why it is important to build consciously management systems that support innovations to emerge.

2.2 How does an individual create an innovation?

The headline question relates to human creative cognitive processes in science, technology, business and other domains. The possibility to create a novelty is one of the most essential cognitive skills of the human mind (Klahr, 2000, Thagard and Croft, 1999).

Creativity is a process whereby an individual exceeds a conventional habit (Suomala, Taatila, Siltala and Keskinen, 2006). A conventional habit includes typical practical and theoretical actions and goals in a domain. Professional experts in a particular domain have learned essential skills and knowledge of this domain. Science and technology represent creative domains, as most of the work scientists and engineers carry out is a conventional habit. Thus, experts do what coheres with existing knowledge and beliefs in their domain; their work involves filling in the details on matters that are basically already understood or applying standard techniques to new specific cases (Alvarez, 1998). However, occasionally there are puzzling situations that offer an opportunity for ampliative thinking and a really major discovery or invention.

A capability to create innovation is one type of creativity. Innovation process is goal-directed, complicated and thinking capacity demanding process. The prerequisite of invention is reasoning and problem solving skills and creativity. In this reasoning process individual uses inner and outer resources (Shirouzu, Miyake and Masukawa, 2002). Inner resources refer to individual's cognitive capacities. These inner resources have formed for individual during his/her personal life history in interaction with his/her environment. Inner resources are mental representations, which includes facts, pictures, concepts, beliefs, rules, theories, laws, hypotheses, metaphysical assumptions, values and examples of cases (Dasgupta 1996, Thagard, 2000). Outer resources can be divided to physical and social resources.

Thus, innovation creation is the combination of psychological, material and social issues. Our thinking habit is born in culture, where we have lived. However, from innovation point of view, the individual's thinking is essential. Although social network is essential for a creation of innovations, without human skill to create new representations, it is not any innovation anymore. Thus, it is interesting question, how does an individual change conventional habits for a novel route?

A creative process begins when an individual encounters a puzzling phenomenon. A phenomenon can be puzzling in two ways. First, in case of expected finding, the phenomenon fits with human expectations relating the future. Second, in case of unexpected finding, phenomenon is not coherent with the individuals cognitive and belief system and it breaks the conventional habit of a people. Thagard (2002) argues that puzzling phenomena produce emotions and in this way emotions play a large role in creativity in science, technology and other domain. In addition, practical need and frustration produce emotional curiosity and can break a conventional habit.

2.3 Expectations as source of innovation

When innovators are trying to create something novel, they are usually keeping track of what is going on in their potential innovation domain. This process does not involve a search through predefined representations, but rather the identification of a goal for a action by virtue of new representations forged from many resources. The construction of their potential chance is sensitive to the domain facing the innovators. Innovators build multimodal representations based on active goals. In this case, goals are

representational structures that guide the innovators in their pursuit of a reference state (Markman and Brendl, 2000). During the idea generation process, situations are evaluated relative to active goals.

Expected finding is typical source of novel idea generation in business context (Suomala etc., 2006). Because the goal to found a business can be long-standing, sometimes for many years, this goal is chronically active (Markman and Brendl, 2000). Founding new innovative company is very general goal and the creativity arrives, when individual found good idea for business (Suomala etc., 2006). This does not mean that an individual is aware of the goal all of the time, but it is likely that chronic goals affect the individual's perception and evaluation of different events. Goals have an important effect on how an individual organizes and categorizes the world, and help to organize the long-term representation of our knowledge (Dunbar, 2002).

How can an individual build goal-based multimodal representations from future events? Geary's (2005) description of a human autonoetic mental model fits well for goal-directed invention search. This concept is a fusion of Tulving's (2002) autonoetic awareness and Johnson-Laird's (1983) mental models. In essence, an individual can create a self-centered mental simulation of the "perfect world" in the future using an autonoetic mental model. A perfect world is one in which the individual is able to organize and control his own life in ways that will enhance his expected standard of living. According to Geary (2005), autonoetic awareness can be integrated with the motivation to control. The motivation to control is facilitated by the ability to mentally simulate potential future scenarios and changes in situations. Autonoetic awareness is not simply self-awareness, but also involves the ability to mentally relive past experiences and to project oneself into the future (Geary, 2005).

When innovators pursue a goal to found their own innovation, they build an autonoetic mental representation relating to future situations. In the idea generation moment, the innovators evaluated a chance based on this future scenario. The idea of innovation becomes a target for implementation when it is sufficiently interesting and baffling. The innovators believed that they had enough cognitive, social and material resources to implement their ideas for products or services.

2.4 Unexpected finding as a source of innovation

Surpirse, practical need, curiosity and serendipity can effect to the birth of new invention (Dasgupta, 1996, Thagard, 1999). The innovation process can start immediately after idea generation or the time gap between idea generation and idea application can be very long. Thus inventor can keep in his/her mind the idea long time, but the environment (resources, social support etc) is not ready to innovation process. On the other hand, innovation process could start quickly for example in company, in which new innovation is necessary to do.

Practical need is often the starting point for invention. The need can be social (everybody understand the need) or individual. For example, many invention in information and communication technology

(ICT) have born, when a ICT expert feels some IT application very irritating. In business context, business interest form needs to create innovations. Sometimes it is simple compulsion to create something new, in order that business operations can proceed with. The old wisdom - 'Necessity is the mother of invention "(Dasgupta 1996, 20) – describes the aspect of this idea.

Intellectual curiosity could start idea generation that leads to new discovery. Curiosity has been regarded as starting point in science and in art. Intellectual curiosity may be important background for innovation process, because this process is often uncertain and personal motivation and emotional long-term commitment is presupposition for the process. Often the goal of innovation is not direct practical profit, but human's basic need to know more and more about world and its actions. The FogScreen innovation is a good example relating intellectual curiosity as the starting point for innovation. Senior researcher Ismo Rakkolainen at University of Tampere, In Finland, begin thinking on the summer 2000 the possibility to reflect pictures and movies to the fogscreen. He went to discuss about idea to his friend, professor Karri Palovuori and during this discussion the more clear idea of fogscreen arrived. The idea arrived based on intellectual curiosity and the basic goal was not to found company based on idea. However, the inventors founded the company FogScreen, Inc. Tuomi (2002) describe the history of Linux innovation. The idea arrived when hacker community was interested in developing open source code better. Originally, the question was not the profitability in commercial point of view, although Linux has the commercial role nowadays. In long term many scientific and technological discovery has strong commercial meaning although the starting point has been only intellectual curiosity.

Surprise may start the idea generation process, too. Individual may recognize things, which are not compatible with his/her previous knowledge/ or belief base in his/her mind. A surprise perception starts cognitive process, in which individual likes to explain a novelty, unexpected finding or some other peculiarity. The surprise perception starts often abductive reasoning process, in which individual try to find explanation for surprising perception. When an individual notices something puzzling about a phenomenon, he tries to understand it. Surprise is very subjective experience and it is typical for creative individuals that they can interpret ordinary situation (for other people) as surprise (Suomala et al., 2006).

Serendipity – lucky insight – may start creation process or it may lead to direct to invention idea. Serendipity is thus the process by which one accidentally discovers something fortunate, especially while looking for something else entirely (Thagard and Croft, 1999). George de Maestral invented the hook-loop fastener (brand Velcro) after observing how tenaciously cockleburs stuck to his wool pants. He had not any intention to invent this kind of material, but he discovered it accidentally, when he did perception of that.

Practical need, intellectual curiosity, surprise and serendipity are not contrast, but the creative process can start the combination of all these. Many individuals made practical innovations by intellectual curiosity. Masaru Ibuka, one founder of Sony-Corporation and inventor of many products of Sony has said, that he create because novelty things produce him great pleasure and by invention he can fulfil curiosity (See Dasgupta, 1996, 26).

2.5 Summary

An innovation is a psychological process that fits something to be created into pattern established by mental representations (Thagard, 2003). In conclusion, idea generation process contains recognition of puzzling phenomena and that a creative process is dependent not only on unexpected findings, but also on the expectations we have regarding our future. Thus, creativity is not only matter of logic, but requires mental representations such as concepts, images, and pattern matching that go beyond the types of structures and inferences allowed in the logical framework .

Even, the novel idea is born often in individual mind, the new ideas can not born without social practices and norms concerning such as work/study environment, funding, R&D policy, universities, research institutes and laboratories, libraries and journals, a reward system, authority, methodology and ethics. Many cultural archetypes effects innovators thinking processes. Societies share many archetypes, such as "hero", "villain", "sage" and "pauper", although the specific stories featuring these archetypes may vary. (Zaltman, 2003). Thus the creative process is co-evolution of an individual mind and cultural environment. When an individual learn – adaptively or creatively – he/she uses outer and inner resources for learning (Shirouzu, Miyake and Masukawa, 2002). Inner resources refer to the individuals 'memory and intentions and outer resources refer to the social and material resources. Thus, the use of knowledge and social resources for innovation process has been motivated, organized and gets meaning in social environment. The source of new ideas and innovations is co-evolution process between individual and social environment.

3. DEFINING THE NATIONAL OPEN INNOVATION SYSTEM (NOIS)

3.1 Defining the general framework of National Open Innovation System (NOIS)

Balzat and Hanusch (2004) has defined an national innovation systems (NIS) as a historically grown subsystem of the national economy in which various organizations and institutions interact with and influence one another in the carrying out of innovative activity. By imitating Simon (1962) the designs of most products and in our case the services are system designs that have general properties of decomposability into functional elements and interactions among those elements. An architecture is on the other hand a system design for which designers have specified (1) the way the overall functionalities of the product or process design are decomposed into individual functional components (Baldwin and Clark, 1997; Clark, 1985) and (2) the ways in which the individual functional components interact to provide the overall functionalities of the system design (Sanchez, 1999). Alexander (1964) suggested that good architectural designs are made of subsystems that can be adjusted independently to changes in the environment. By following these guidelines of modular system design and architecture in the Figure 1 we have presented the general Innovation Triangle framework which consolidates our National Open Innovation System (NOIS) for supporting the Finnish national system of innovation.

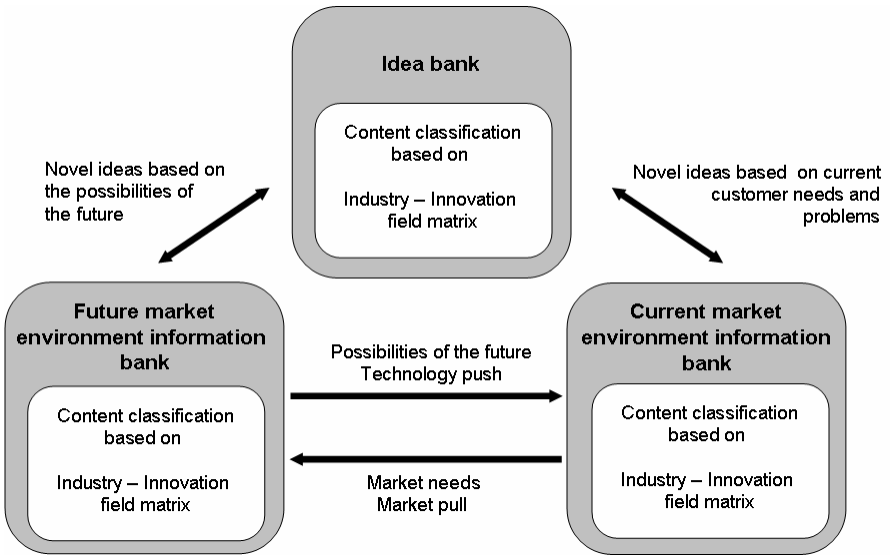

Figure 1 The Innovation Triangle

According to our literature review on innovation creation in order to generate novel ideas (i.e. the top box in the figure 1) one should define a framework which will support both user's expectations regarding the future and unexpected findings. Because of this our framework includes two complementary innovation sources. *First*, the future market environment information (i.e. the left box in the figure) and *second*, the current market environment information (i.e. the right box in the Figure 1). In order to create solid interaction interface between the three banks, the common content classification schema based on industry – innovation field matrix is defined. Since our NOIS is a Online Social Network (OSN) we will also present the profile of the online community members and the key functional principals relating the graphical user interface (GUI). Together these individual functional components and the interaction interface between them are forming the overall functionalities, which we named as National Open Innovation System (NOIS). In the following we will present in more detailed our framework, the interfaces between main functional components and the resources which will produce the content in our NOIS.

3.2 Innovation source 1: The future market environment information bank

The left box in the in Figure 1 represents the future market information bank. The theoretical basis of this bank is derived from the futures research and foresight theories. In European FOREN project the framework of fully-fledged foresight was presented. The key elements of fully-fledged foresight are: (1) the use of futures/foresight methods, (2) interactive dynamic networks of stakeholders and shareholders and (3) strategic and other decision processes and needs in these processes. These kinds of three critical foresight elements (foresight methods, networks and actual decision needs) are always relevant in the context of strategic innovation management. (see Keenan, Loveridge, Miles and Kaivo-oja, 2003, Gavigan et al., 2003).

Decision-makers can use the expected futures developments as guiding principle of behaviour. Typically people follow: (1) trends and anti-trends, (2) expected futures scenarios (either explorative forecasting or normative back-casting scenarios) or (3) emerging weak signals and seeds of change. In some cases people can take observed weak signals seriously and make decisions on the basis of these observations. Typically real novelties and innovations are based on observed weak signals. Imitation is more based on business as usual (BAU), or so called railway thinking and observed strong trends. Innovations can be based on these kinds of future-oriented behaviour rules. Expectations concerning innovations are really important for emerging socio-cultural evolution. Human behaviour is always future-oriented, although it is also rooted to various path dependencies. Often analytical foresight analysis starts analysing the existing path dependencies. This part of study can be called (1) hindsight (focused on historical trends) and (2) insight analyses (focused on current problematic situation).

The European Union's foresight best practice project FOR-LEARN has a following definition to foresight: *'Foresight is a systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilizing joint actions. Research*

and innovation policies are based on (implicit or explicit) visions of the future of science, technology and society." This definition is interesting, because it combines foresight research to innovation policies. Typical parts of foresight exercise are: (1) Designing an exercise, (2) running an exercise and (3) evaluative follow-up of exercise. Strategically there are two basic alternatives to make foresight research in relation to an innovation: (1) Before actual innovation is identified or (2) after an innovation is identified. Typically innovation process is seen to be a linear process, where there are three phases: (1) R&D-phase, (2) production phase and (3) marketing phase. Innovations are typically expected to happen in the linear form of the conventional R&D-phase (Takeuchi and Nonaka, 1986, FOR LEARN 2007, Salmenkaita and Salo, 2002).

Innovations depend on organizational, social, economic, marketing and other knowledge like political, technological and environmental knowledge. Innovation activities require intellectual and artistic creativity. The role of foresight systems should be analyzed in relation to the innovation systems, production and marketing. There is a gap in culture between the scientific community and industry (Irvine and Martin, 1984, Stankiewicz, 1986). According to Kaivo-oja (2006), we can connect foresight systems and innovation systems in the following seven alternative ways, which are non-linear compared to conventional linear (Takeuchi and Nonaka, 1986, see details in Appendix 1).

In the first IFO-model innovation process is before foresight process and then other processes (production and marketing) are performed in a firm. In the IFO model the role of foresight is mainly innovation-based process, where agents of foresight system try to transfer innovation to production and marketing processes. The IFO model is mostly based on the technology push mechanism. In the second model FIO-model foresight system plays a catalytic role in relation to innovation process. Typically in FIO-model trend analyses, scenario processes and weak signal analyses are used to stimulate innovation process inside the company. The FIO model is mostly based on the technology push mechanism. Third (OFI-model) and fourth model (OIF-model) are based on other firm-level processes and foresight system and innovation processes are more or less secondary ones to firm's production and marketing systems. In the OFI-model production and marketing unit of a firm or organization give tasks to the agents of foresight system and after that foresight agents stimulate and catalyze innovation process of a firm. The OFI model is mostly based on the technology pull mechanism. In the OIF-model production and marketing units of a firm help innovation to arise and after that foresight unit makes other analyses relevant to new innovation. The OIF model is mostly based on the technology pull mechanism. In the FOI model foresight analysis is performed before production and marketing processes and these two phases lead to innovation process. The FOI model is mostly based on the technology pull mechanism. In the IOF model innovation process is performed before production and marketing process and these two phases lead to the need of foresight analyses. The IOF model is mostly based on technology push mechanism. In the ISP model all three processes are performed simultaneously together. This process is very interactive and all activities are complementary. The ISP model is based on both technology push and technology pull mechanisms. (Kaivo-oja, 2006).

Theoretically, we have presented seven alternative interaction models, which all are possible in modern firms and corporations. We see that foresight system can play and actually often plays an important in

relation to innovation systems. Often foresight activities are performed by knowledge-intensive business companies and these kinds of companies are also co-producers of innovation (see e.g. den Hertog 2000). Theoretically these kinds of complex interactions can also explain also new empirical findings of Leiponen and Drejer (2005). We can expect that the five technological or innovative regimes (1) supplier dominated regime, (2) production intensive regime, (3) scale or science based regime, (4) market driven regime and (5) passive/weak innovators regime are based on different kind foresight system-innovation system interactions. In Table 2 technological and innovative regimes of Leiponen and Drejer (2005) are connected to different foresight-innovation interaction models presented above (Kaivo-oja, 2006).

Table 2 *Technological/innovative regimes and most possible interaction models between foresight system and innovation process (source: Kaivo-oja, 2006)*

Technological/innovative regime	Most possible interaction models
Supplier dominated regime	IFO (innovation concerning supply chains or sub-contractor relations lead to foresight process), IOF, (innovation concerning supply chains or sub-contractor relations lead changes in production) OFI (changes in supply chains or sub-contractor relations lead to foresight process), OIF (changes in supply chains or sub-contractor relations lead to innovation process), ISP (general model)
Production intensive regime	OFI or OIF (changes in production and marketing lead to foresight analysis or novel innovation process), ISP (general model)
Scale or science based regime	FIO (science based foresight leads to innovation), FOI (science based foresight leads to production changes), IFO (science produces innovation and need for foresight analysis), IOF (science produces innovation and fast changes in production), ISP (general model)
Market driven regime	OFI (production or market change leads to foresight and innovation), OIF (production or market change leads to innovation and innovation-related foresight), FIO (foresight done concerning production and market development leads to innovation and related changes in production and marketing), FOI (foresight done concerning production and market development leads to changes in production and this change creates innovation), ISP (general model)
Passive/weak innovation regime	No remarkable interaction, ISP (general model)

3.3 Innovation source 2: The current market environment information bank

In the in Figure 1 the right box represents the current market information bank. The theoretical basis of this bank is derived from the customer and market orientation strategy literature. A customer orientation strategy, which commonly is linked to the market orientation strategy (Kohli and Jaworski, 1990), can be defined as a strong desire to identify customer needs and the ability to answer these recognized needs. Others authors have presented similar definitions e.g. Narver and Slater (1990), the firm's sufficient understanding of its target buyers in order to be able to create superior value for them continuously, Deshpande et. al. (1993), the set of beliefs that puts the customer interest first, Gatignon et. al. (1997), a firm with the ability and the will to identify, analyze, understand, and answer user needs. In principal, in order to create business success there must be a clear need for the product/service. Like in the case of innovations the importance of the customer orientation strategies on business success have been emphasized (e.g. Narver and Slater, 1990). The presented theory is grounded on the basic belief that the company that better satisfies its customers 'individual wants and needs will eventually have greater sales (Pine, 1993).

In order to fully understand the customer behaviour, a company should systematically collect and analyse a significant amount of data related to their customer's behaviour and competitors actions. As a result of these in-depth analysis companies can use e.g. a customer segmentation strategy or so-called cradle-to-grave strategy which emphasize the lifetime value of a customer (Pitta et. al. 2006, Zeithaml et. al. 2001). From one organization point of view the extensive idea generation based on the customer data might be problematic since this process is typically very resource intensive. Even if the web has significantly helped companies to collect customer feedback (e.g. relating the problems or needs), for example the more in-depth interviews or large scale focus groups with customer are still often neglect as a result of high expenses. Although, since the data collection processes in general have become easier, companies are now producing more customer behaviour data, which can be used as foundation of idea generation. However, a great share of this data is often unused since companies are understaffed comparing the huge amount of customer data which is available for idea generation. Most interestingly with the help of extensive network of human resources such as NOIS this resource shortage might be overcome.

A good practice is to build consumer scenarios to identify key issues of consumer behavior and consumer needs (see Alexander and Maiden, 2004). It is also possible to use Customer Experience Management (CEM) and Customer Relationship Management (CRM) tools (see e.g. Meyer and Schwager, 2007). In demand side analyses companies typically follow: (1) systemic policies (cluster policies, supply chain policies), (2) procurement issues (R&D procurement, public procurement of innovative goods and services, support for private procurement) and (3) regulation issues (use of regulations to set innovation targets, commercial law, technology platforms to co-ordinate development of technology and standards). In order to understand the current market environment the NOIS frameworks classifies the current market environment in the following categories: 1) customer needs, 2) customer problems, 3) occurrence

and 4) competitor action. To sum up, it is possible to use many analysis tools to understand demand side issues.

3.4 Technology push and market pull is creating a dynamic interaction market information banks

It is important to recognize that there are technology push and pull factors in innovation processes. According to "technology-push" theory, research leads to inventions, which then leads to the development, production, marketing, and introduction of innovations to the market. Radically new inventions lead to the emergence of completely new industries and create renewed momentum for economic development. The supply of new technologies is, therefore, more important than the adaptation to the existing patterns of demand (see e.g. Dosi, 1982). In the case of the "demand-pull" theory, Schmookler (1962) found that the time series for investment and patents showed a high degree of synchronicity, with the investment series tending to lead the patent series more often than the reverse. He found that it was investment that usually led the upswing from the troughs of economic fluctuations. On the basis of this evidence, Schmookler argued that fluctuations in investment could be better explained by external events than by the course of invention and that, on the contrary, upswings in inventive activity responded to upswings in demand.

Concerning both innovation sources 1 (i.e. the future market environment information) and 2 (i.e. the current market environment information) a good policy support tool for integrating demand and supply side analyses would be *a generalized technology roadmap*. It is obvious fact that NOIS, which includes a significant amount of data, needs some kind of integration tool for innovation management. As a result it is suggested that technology roadmap which nicely summarizes the technology push and market pull approaches is a very good tool for that kind of practical integration needs (see Figure 2).

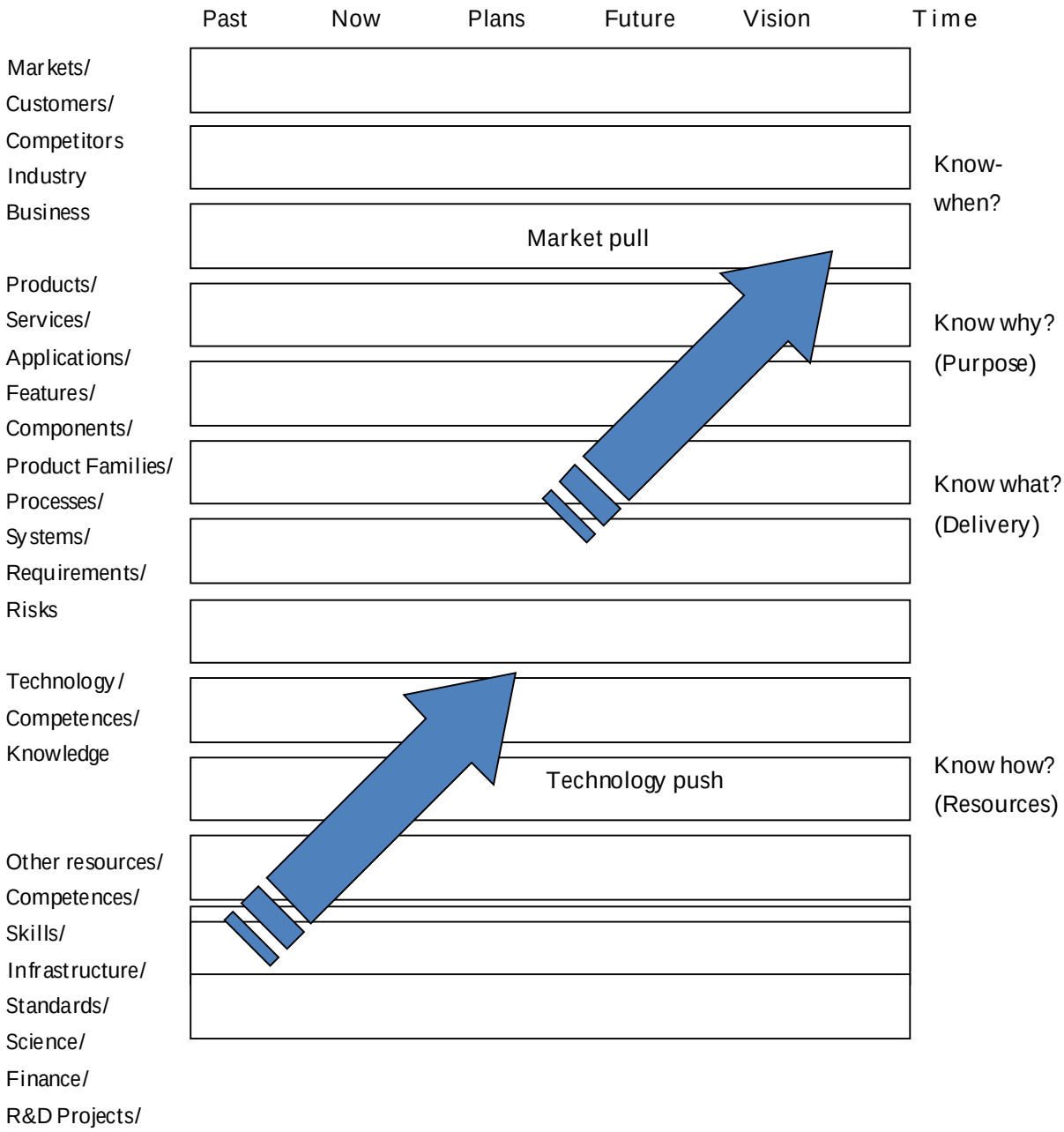

Figure 2 Generalized technology roadmap architecture (source: Phaal 2002)

3.5 The profile of the community members: Youth, aged and customers as content providers

At the starting phase the content including new ideas, foresight market information and customer problems/needs will be produced by two main opposite target groups: the youth and the aged. This polarized arrangement is expected to increase the dynamics resulting unforeseeable positive outcomes.

The youth. The Finnish higher education system (i.e. ISCED classification group 5) is based on so-called dual model (Ahola, 2006) consisting two complementary sectors: universities and universities of applied sciences. Universities are focusing on scientific research, whereas universities of applied sciences are working life oriented. In principal the universities of applied sciences are offering a more practical alternative where the theory and practice are in balance regarding the requirements set by working life. Over hundred thousand students performing their bachelor's degrees in the universities of applied sciences will be the main human resource to provide and share content in the defined Innovation Triangle concept. The supervision of the student work will be integrated as a part of everyday teaching tasks, while the overall resource allocation will be conducted with the help of university of applied science specific curriculum.

The aged. Especially in the western countries forecasts relating the amount of available workforce have been in unhealthy trend (Katajisto and Kimari, 2005). Mr Swanljung, chief executive of the Finnish Pension Alliance TELA has made a statement that there is already now labour shortage in many industries and areas in Finland (TELA, 2007). Moreover, according to him those already retired provide the most significant available labour reserve. On the other hand there is a growing need to activate aged and retired people (Katajisto and Kimari, 2005). In Europe, Finland is not alone with these concerns of problematic demographic change. Finland a country with a bit over 5 million inhabitants have over hundred thousand civic organizations and non-profit associations in which the Finnish welfare state has historically been leaned to. This voluntary workforce will be engaged as content providers alongside with more organized universities of applied science student resource. In principal the active members of ageing people will have an access to share and communicate their experiences with the youth. Marketing and resourcing this possibility will be conducted throughout the network of voluntary organizations.

The customers. First of all the companies, local authorities and public administration are defined as customers of our concept (i.e. customers are not actively participating the content production, but are using the content which others have produced). Nevertheless, customers have also the possibility to participate in the content production. *First*, a company can launch a competition in any of the three main content areas (i.e. foresight or current market information need or idea request). By paying extra rewards to the top performers in the competition, a company can increase the chances that the community will solve their particular task instead of some others. *Second*, since our concept is based on open innovation ideology, anybody including the employees of customer organizations can participate in the content production. However, it is important to take notice that all the content produced in our platform is following the principals of open innovation also in the case of the intellectual property rights (IPR).

3.6 The industry – innovation field matrix: Classifying the content and allocating the human resources

In the NOIS you have over hundred thousand workers operating without genuine centralized management system, thus the effective resource allocation becomes a demanding task. In the 'fully "open innovation setup there is a significant risk that the great majority of resources will devote their time in the exact same task (e.g. trying to generate ideas around the same narrow topic). From the comprehensiveness and effectiveness point of view this is a clear shortage and the waste of valuable resources. In our concept this identified problem is overcome with the help of industry –innovation field matrix. This matrix is integrating the Finnish regional innovation policy and different innovation fields to university of applied science specific curriculums. This interaction is logical and rational since besides the requirement to train professionals in response to labour market needs, the network of universities of applied science in Finland have an obligation to promote the regional development (ERRIN 2005).

The Finnish regional innovation policy. In Finland the governmental body including the Ministry of Trade and Industry, Ministry of Education and the Ministry of the Interior has implemented the regional innovation policy through the specific Centre of Expertise Programme (later CEP) (Kanninen et al, 2006). In principal the CEP aims to improve the innovativeness and knowledge base of regions in accordance with the national targets. In Finland so called cluster approach has widely been adopted in innovation science and education policies (see Porter 1985, 1990, Pentikäinen, 2000, Jääskeläinen, 2001). The cluster approach is now widely adopted also in European and OECD innovation policies (Roelandt and den Hertog, 1999, The High Level Advisory Group on Clusters, Chaired by Senator Pierre Laffitte 2007). An obvious conclusion is that Open Innovation Baking Systems can benefit a lot from these kinds of cluster analyses. In Finland, especially this approach was lately adopted in Finnsight foresight and science policy project (see Finnsight 2015), which was used in national technology and science policy strategy processes.

Based on CEP a total of 13 national expertise clusters (i.e. content areas) have been defied including for example ubiquitous computing, well-being and digital contents. In our concept this defined classification will operate as a main resources allocator among student resources. In practice based on the individual competence and regional profile the university of applied science participating in our social network will select the CEP clusters, which they found interesting. Since the competence and regional profiles are varying among actors, it is expected that the distribution of resources will be naturally balanced. From the pure technical and user interface point of view the constant CEP clusters keywords are attached in all user generated contents.

Innovation fields. Besides the CEP cluster based classifications in all three main databases – future and current market environment information and idea bank –one should be able to navigate the content also without industry specific mindset. In stead of CEP clusters the innovation classifications presented in *the theoretical basis of creating innovations* -chapter provide an industry free approach to classify the

produced content e.g. the five layers or fields innovation classification by Hauknes (2003). Once again from the pure technical point of view these different classifications are just simple constant keywords. However, with the help of series of innovation and CEP cluster classifications we can create interesting industry – innovation field matrix, which will deepen our understating on the produced content profile while allocating the human resources efficiently.

3.7 Increasing the likelihood of unexpected findings with content recommendation

When the amount of content increases in the web site such as ours, one must provide intelligent services to end-users in order to create a solid user experience. The web site specific search services have typically been the fastest and the easiest way to help users to find what they want. However, this approach is mainly supporting the expected finding event as a typical source of novel innovation (i.e. user has a need to find something specific and with the help of search service he/she can complete the task). On the top of user driven search services and intuitive site structure the most advantaged web sites such as Amazon.com and Youtube.com automatically recommend content to the users. These features can increase the likelihood of unexpected findings event and for example in the case of Amazon.com it increases the sales.

Content recommendation in a mass production magnitude is a form of mass customization management system which historically goes back over thirty years (Toffler, 1970, Davis 1987 and Pine, 1993). In the Internet environment the term personalization is often replacing the customization or more specific mass customization term, although the definitions of these terms in our opinion are very alike. Personalization term generally refers to making a web site more responsive to the unique and individual needs of each user (e.g. Cingil et al., 2000) while in the mass customization management system, the goal is to develop, produce, market, and deliver affordable goods and services with enough variety and customization that nearly everyone finds exactly what they want (Pine, 1993). In practice, mass customization means that customers can select, order, and receive a specially configured product - often choosing from among hundreds of product options - to meet their specific needs (Bourke and Kempfer, 1999).

Most importantly in many cases as a result of heterogeneous customer needs, the true desire and willingness to listen to the customer needs (i.e. customer orientation) should probably lead into mass customized products and services (Santonen, 2007). In principle at the extreme level of customization, a company can produce and market the unique products for all customers. Pepper and Rodgers (1996) determined this extreme customer orientation strategy approach as one-to-one marketing, while defining the differences between individual customers and customer segments, which more commonly are related to mass customization management system. Most interestingly, the authors of mass customization and one-to-one marketing (Pine et. al., 1995) joint the forces and argued that the company hoping to delivery customers exactly what they want (i.e. implement the extreme customer orientation strategy) must utilize both mass customization and one-to-one marketing management systems.

In the following we will describe our implementation strategy relating content recommendation, which is a typical approach for websites to provide the customized user experience. According to Santonen (2003) content recommendation in the web sites can be based on user preferences, content or user similarity to other users (i.e. collaboration). Manual decision rule-based systems allow web site administrators to specify rules based on end-user preferences, demographics or static profiles, which are collected through a registration process or session history (Mobasher et al., 2000). In a pure content-based recommendation system recommendations are made on the basis of a profile, which has been generated by analyzing the content, while a pure collaborative recommendation system does not analyze the content at all, but recommends items that other similar end-users have liked or used (Balabanovic and Shoham, 1997). In practice following recommendation approaches have been identified (Santonen, 2007): recommendation based on (1) usage or click-thorough history, (2) pre or user defined keywords (Mobasher et. al., 2000), (3) simultaneous versions (Lampel and Minzberg, 1996), (4) purchase history (e.g. www.amazon.com), and (5) user performed rating (Balabanovic and Shoham, 1997). In our NOIS concept the content recommendation for users will be based on the combination of presented recommendation alternatives.

These identified recommendation features will help us to increase the likelihood of unexpected findings e.g. by combining and linking different ideas and idea sources in a novel way that the user him/herself cannot manually or intuitively create. The automatically create novel combination can trigger surprise, serendipity or curiosity reaction in users brain, which will lead in to innovation creation process.

DISCUSSION

4.1 Creating the novel fourth generation Triple Helix Model based on online social networks

In the suggested National Open Innovation System (NOIS) we have created an online social network based model which integrates following three actors: (1) the university students and faculty members and senior citizens as content providers, (2) the Finnish regional innovation policy as stated by the governmental body and 3) the companies, local authorities and public administration as customers. Thus, it is argued that we have actually defined a novel fourth generation Triple Helix Model, which should deepen interaction and dynamics between university system, government and corporations.

The Triple Helix model – probably the most well-know framework to describe the collaboration between Universities and other actors supporting innovation processes – is a result of Henry Etzkowitz 'analysis of the change in scientific information production and universities role in the information society (Etzkowitz and Laydesdorff, 1999, 2000). In principal the Triple Helix is a model for understanding and guiding interactions in university-industry-government relations and has become a popular concept in the field of higher education and innovation research. In the Triple Helix model each actor has its own task: Universities produce research, industries manufactures, and the government secures certain stability for maintaining exchange and interaction. The Triple Helix regime operates on these complex dynamics of innovation as a recursive overlay of interactions and negotiations among the three institutional spheres. The different partners engage in collaborations and competitions as they calibrate their strategic direction and niche positions. The "Triple Helix" denotes that this social world is more complex than the natural one.

Over the time the following three alternative Triple Helix models have been evolved (Appendix 2): (1) the Etatistic model, (2) the "Laissez-faire" model and (3) the integrated model (Gergils, 2005). According to Etzkowitz, information production has moved from universities to university-government-industry interaction, or towards Mode 2 (Etzkowitz and Leydesdorff, 2000). As a result only the integrated model is argued to really support the innovations in knowledge societies. The 'Etatistic" and 'Laizzez-faire" Triple Helix models have been co-operation models, which have actually often actively discouraged novel innovations. Would-be innovators have often been frustrated by bad management and conservative management processes that were build to ensure discipline, alignment and conformance rather than provide support for creativity, innovation and experimentation.

It is assumed that the three previously emerged models and our forth model grounded on social networking are hardly the end of this institutional evolution. The information revolution in computers and

telecommunications technology has had and will surely continue to have a major impact. Moreover, new technologies enable new co-operation forms in banking and innovation policies. Yet it is obvious that Triple Helix framework in general requires supportive and catalyst approach such as NOIS in order to increase the dynamic interaction in to whole new level. We argue that after implementation, the NOIS should produce a significant competitive advantage for Finland and other European countries which higher education is based on state-owned free university education. In principal the implemented NOIS is introducing a new and significant development resource for industry, which previously has clearly been under-utilised. Our argument is in the line with other suggestions which see the Triple Helix models as future option frameworks for the European innovation policy (Leydesdorff, Loet and Etzkowitz, Henry, 2001).

4.2 Transformation from closed innovation paradigm to open innovation paradigm will have crucial impact

Nowadays, several factors have led to the erosion of closed innovation model. First of all, the mobility and availability of highly educated people has increased over the years. As a result, large amounts of knowledge exist outside the research laboratories of large organizations. In addition to that, when employees change jobs, they take their knowledge with them, resulting in knowledge flows between firms and other organisations. Secondly, the availability of venture capital has recently increased significantly, which makes it possible for good and promising ideas and technologies to be further developed outside the organization and closed circles. Besides, the possibilities to further develop ideas and technologies outside the organization are growing, for instance, in the form of spin-offs or through licensing agreements. Finally, other organizations in the supply chain, e.g. suppliers, play an increasingly important role in the innovation process.

As a logical result, organizations have started to look for other ways to increase the efficiency and effectiveness of their innovation processes. For instance, through active search for new technologies and ideas outside of the firm, but also through cooperation with suppliers and competitors, in order to create customer value. Another important aspect is the further development or out-licensing of ideas and technologies that do not fit the strategy of the organization. Open innovation model can thus be described as: combining internal and external ideas as well as internal and external paths to market to advance the development of new technologies (see e.g. Chesbrough, 2003). In this article, our central assumption is that in the future evolution of NOIS, the idea of open innovations is going to be crucial. This does not mean that we expect that there are not going to be also closed innovation processes. However, because various reasons mentioned above the strategic role of open innovation processes is expected to grow. Till now only the few pioneering companies have follow the open innovation based development strategy. As a result of NOIS and other sustaining structures supporting the mass production of open innovation, we will most likely see open innovation utilization to expand the next level in few years.

How innovation bank systems in general could be developed on the basis of these research findings? Firstly, one important conclusion is that there are still many companies, which use a closed approach to innovation development. These companies are lacking management processes and supportive systems for open innovations. Concrete open innovation concepts and service are needed in order to activate these passive companies. Secondly, technology push factors are still relevant and novel technological ideas and inventions are underutilized. Moreover, market pull factors are also very important, especially in the emerging field of service innovations. Thus, the better identification of user needs yet the future possibilities based on the NOIS could provide a good platform for new innovations. As a result innovation bank system in general should be based on both pull and push factors. Finally, the different characters of innovations including service innovations or fact that an idea can emerge as novelty, by changeability of previous product and service systems and by gradual diffusion process should be taken also into consideration when innovation bank systems and especially open innovation systems are developed further.

4.3 Offering new possibilities to University faculty members and students

The previously introduced industry – innovation field matrix which was created to support the resource allocation and content recommendation can also be used as a research instrument to identify the most potential innovation sources. The innovation researchers participating in our network will have full access to the data export functionalities, which enables the empirical investigations of the produced content for example in the statistical software environments. Besides statistical analysis the innovation researches can also utilize other research methods. In principal the NOIS database with extensive classification schema derived from innovation literature are representations of structured text databases as if they were kind of equal to structured content analysis. This opens significant possibilities for e.g. product and/or service feature level investigations.

From the puritanism open innovation definition point of view our main resource – the university students – is not fully voluntarily participating in the content production (i.e. they are producing the content as a part of their studies). As a result one should have extra benefits for them such as money in order to increase the interest towards activity and better quality of content. So far the dominant evolution trend with the social networking communities has been following: *First*, create a concept which will attract a significant amount of users to your web site. Since the content production in the NOIS is integrated in the universities curriculums, the size of user community target should be covered. *Second*, after you have exceeded the critical mass of users, start thinking about how make money. As a result the main revenue source for social networking communities with high usage rate has been the capital investment and advertising. At the present moment majority of the social networking communities are not sharing the monetary rewards with the community member. In contrast to this practice the NOIS is including the following in-build business model: The provided information service and social network are valuable for companies. It would very hard for them to create the similar service by themselves. Thus, they are willing to pay a small fee for our service. By the end of the day the novel ideas are first created in

the individual's mind, that's why the NOIS should be a personal tool for developers in the companies. Therefore, the usage fee will be few euros per users per month. As a result also the SMEs will now have the same possibilities to benefit from the NOIS service as larger organizations. The generated revenues are mainly distributed to students and senior citizens who have created the original content.

CONCLUSION

In this study we have suggested a new people-to-people interaction based approach, which we named as National Open Innovation System. In principal we have integrated the Triple Helix and the social networking ideologies in to a new model which is argued to change the current practice of university, industry, and government interaction. As a result of our concept suggestion the young university students with fresh ideas and the senior citizens with significant practical knowledge can effectively combine their forces in a open innovation based social networking community.

The main aim in our NOIS concept is to develop new commercial success stories and uplift the currently under-utilised student and senior citizen creativity and communal interaction resource as a sustaining national competitive advantage for Finland. The main customers for our concept are companies, local authorities and public administration. These actors will have an access not only to the extensive idea bank but also to the future market environment and customer need/problem information, which are systematically updated. Since the quality and the comprehensiveness of the provided information are valuable for our customers, they are willing to pay for this service. By following the social networking suggestions the significant share of the generated revenues will be distributed to students and senior citizens who have created the original content. In the most optimistic scenario on the top of state study grants, which are generally available for University students in Finland, the students will be well paid when they perform their usual studies. On the other hand the senior citizens can uplift their financial status, which according to pension experts in general will fall into decline for the upcoming pensioners. Our aim is also the commercialization of the concept and technological solution by creating a new kind of educational format which can be exported.

From the theoretical point of view the presented NOIS is an open source model for new emerging Online Social Networks (OSNs). OSNs have gained unprecedented popularity in recent years. Many applications of OSNs have been focused on people's free time, not so much on work and business life. With our concept we have pointed out that OSNs can also play technologically and socially important role in the commercialization process of novel ideas and inventions. OSNs can support commercialization of new ideas, inventions and innovations in large scale. The new NOIS model includes many interesting characters, both socially and technologically. In the future we expect that by the support of OSNs we can expect better success rates and wider involvement of social networks to commercialize novel ideas, inventions and innovations. The presented National Open Innovation System is one concrete and conceptual framework to implement new kind of open innovation policy in Finland as well as in other countries.

Due to the nature of our study – a concept definition – the validity of our arguments calls for future research. In order to prove our points regarding the utility value we should empirically verify our value promises.

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APPENDIX 1

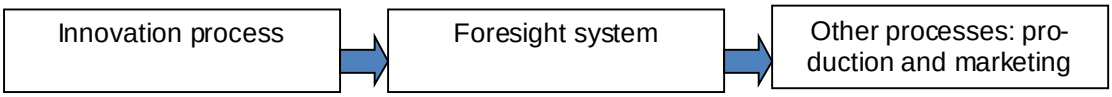

Figure 3 *The interaction models between foresight system and innovation process: Model I: Innovation-Foresight-Other processes (IFO) model*

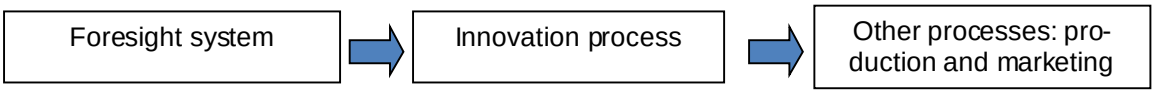

Figure 4 *Model II: Foresight-Innovation-Other Processes (FIO) model*

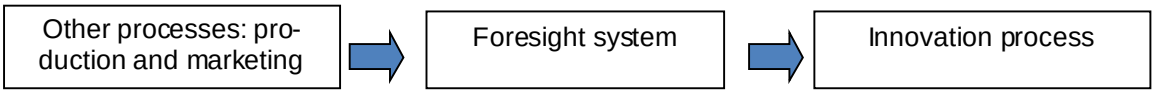

Figure 5 *Model III: Other industrial processes-Foresight-Innovation (OFI) model*

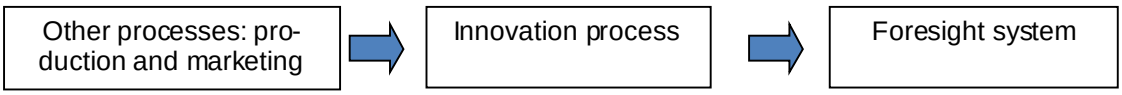

Figure 6 *Model IV: Other industrial processes-Innovation-Foresight (OIF)*

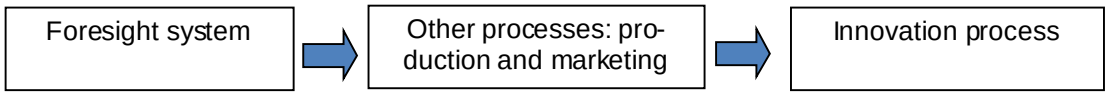

Figure 7 *Model V: Foresight-Other industrial processes-Innovation (FOI)*

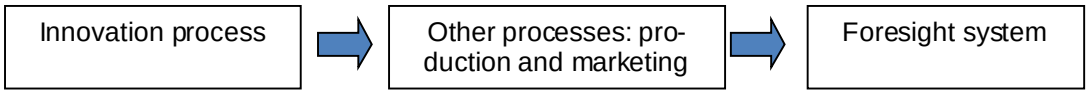

Figure 8 *Model VI: Innovation-Other industrial processes-Foresight (IOF)*

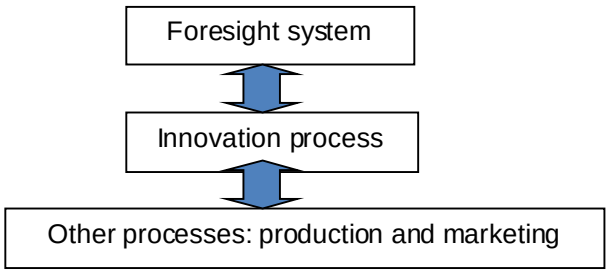

Figure 9 *Model VII: Interactive simulative process model (ISP)*

APPENDIX 2

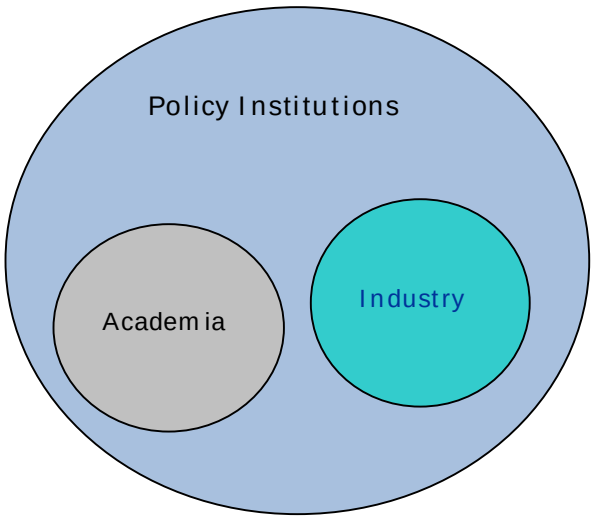

Figure 10 *An Etatistic Model of University-Industry-Government Relations*

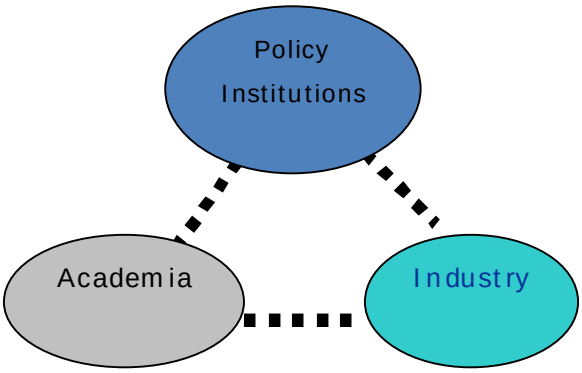

Figure 11 *A "laissez-faire" Model of University-Industry-Government Relations*

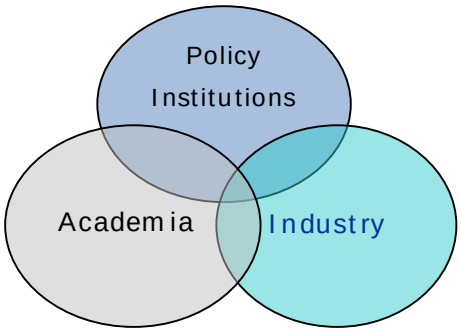

Figure 12 *The Triple Helix Model of University-Industry-Government relations*

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