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Brief Introduction to National Open Innovation System (NOIS) Paradigm: Integrating Online Social Networks and the Triple Helix Model

Teemu SANTONEN*
Laurea University of Applied Sciences
Vanha maantie 9, FI-02650 Espoo, Finland
teemu.santonen@laurea.fi

Jari KAIVO-OJA
Finland Futures Research Centre, Turku School of Economics
Rehtorinpellonkatu 3, FI-20500 Turku, Finland
jari.kaivo-oja@tse.fi

Jyrki SUOMALA
Laurea University of Applied Sciences
Vanha maantie 9, FI-02650 Espoo, Finland
jyrki.suomala@laurea.fi

*** Corresponding author**

Abstract
On the basis of beliefs on open innovation, online social networks and Web 2.0, we propose a new type of approach based on people-to-people interaction to support national innovation activities. With the aim of generating new ideas, our National Open Innovation System (NOIS) combines two rival innovation sources: (1) technology and social foresight research, and (2) customer needs and experiences (i.e. customer orientation strategy), while following the principles of Triple Helix. The resulting NOIS is an effective and comprehensive open innovation structure where university students and senior citizens are engaged as a significant resource for the business community, in order to fulfil the national innovation strategy as defined by the government.

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

1. INTRODUCTION

Innovations are important building blocks of today's economies. Organisational and individual knowledge and creativity are used for creating novel processes, products and services [1, 2, 3]. Innovations have a major impact on national economies, and are a big factor in creating competitive advantages for nations [4]. Thus the most competitive countries in the world typically have extensive and sophisticated national innovation systems (later NISs), whose theoretical foundations were built in the late 1980s [5, 6]. Recently, there has been increasing attention on the concept of "open innovation", both in academia and in practice. In his book Open Innovation: The New Imperative for Creating and Profiting from Technology, Henry Chesbrough [7], who coined the term "open innovation" describes the shift of organisations so-called closed innovation processes to a more open way of innovating. Open innovation can thus be described as combining internal and external ideas and internal and external paths to market, in order to advance the development of new technologies [7].

Since the 1990s, the commercialisation and rapid growth of the Internet and World Wide Web (later the web) has created the most promising platform for connecting people and communication. As a result of this technological transformation, we predict that innovation environments in general will change radically in coming years. One of the main change drivers of the moment seems to be online social networks (later OSNs) based on Web 2.0, which are generally communities and hosted services facilitating collaboration and sharing between users [8]. In principle, OSNs facilitate interaction among members by providing a dynamic/multimodal platform which enables versatile services such as discussions, sharing of multimedia content, organisation of social events and information-sharing, among others. The OSNs people use in their free time have gained unprecedented popularity in recent years and we have witnessed the birth of significant commercial success stories such as Facebook in a short period of time. In addition to leisure, we believe that OSNs can be utilised as a critical part of NISs. Therefore, in this article we make a brief proposal regarding a new National Open Innovation System (NOIS) paradigm, while following the principles of Triple Helix and supporting Finland's national system of innovation.

The paper is structured as follows: in the next section, we briefly present the existing body of knowledge on the Triple Helix Model. We then present and discuss our NOIS concept. Finally, we draw conclusions

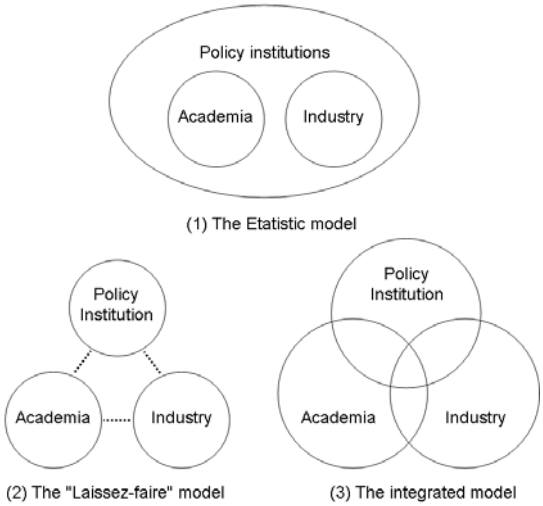
2. TRIPLE HELIX

The Triple Helix model is probably the best-known framework for describing the collaboration between universities and other operators that support innovation processes. It is a result of Henry Etzkowitz's analyses of the changes in scientific information production and universities' roles in the information society [9, 10]. In principle, 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 manufacture, and the government secures a level of stability for maintaining exchanges 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 partners engage in collaboration and competition 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 time, the following three alternative Triple Helix models have evolved (Figure 1): (1) the Etatistic model, (2) the "laissez-faire" model and (3) the integrated model [11].

Figure 1: Three alternative Triple Helix models



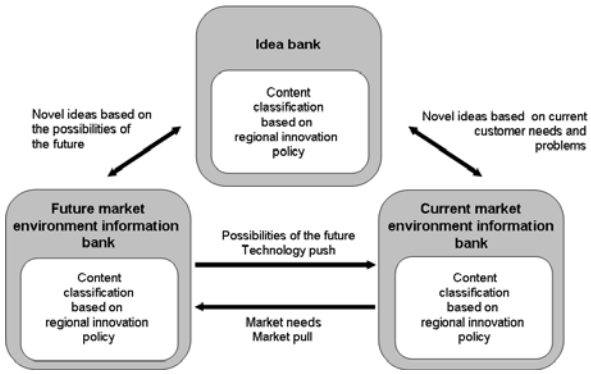
According to Etzkowitz, information production has moved from universities to university-government-industry interaction, or towards Mode 2 [9]. As a result only the integrated model is argued to really support innovation in knowledge societies. The "Etatistic" and "laissez-faire" Triple Helix models are cooperation models, which have, in fact, often actively discouraged novel innovations. Would-be innovators have often been frustrated by bad management and conservative management processes that were built to ensure discipline, alignment and conformity rather than to provide support for creativity, innovation and experimentation.

3. DEFINING THE NATIONAL OPEN INNOVATION SYSTEM (NOIS)

Introducing the innovation triangle. Figure 2 presented the general Innovation Triangle framework, which consolidates our National Open Innovation System (NOIS).

Our framework includes two complementary innovation sources: *first*, future market environment information (i.e. the box on the left in the figure) and *second*, current market environment information (i.e. the box on the right). In order to create a solid interaction interface between the three banks, a common content classification scheme based on Finnish regional innovation policy was defined. Since our NOIS is an online social network (OSN) we also present the profile of the online community members. Together these individual functional components and the interaction interface between them form the overall functionality, which we named the National Open Innovation System (NOIS). Below we present in more detail our framework, the interfaces between the main functional components and the resources which will produce the content in our NOIS.

Figure 2: The Innovation Triangle



Innovation source 1: future market environment information bank.

The left-hand box in Figure 2 represents the future market data bank. The theoretical basis of this bank derives from futures research and foresight theories. The European Union's foresight best practice project FOR-LEARN [12] gives the following definition for 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 is interesting, because it combines foresight research with innovation policies such as NISs.

In foresight people typically follow: (1) trends and anti-trends, (2) expected future scenarios (either explorative forecasting or normative back-casting scenarios) or (3) emerging weak signals and seeds of change. Often analytical foresight analysis starts by analysing existing dependencies. This part of the study can be called (1) hindsight (focused on historical trends) pr (2) insight analyses (focused on current problematic situation). Typical parts of foresight exercises are: (1) designing an exercise, (2) running the exercise and (3) evaluative follow-up of the exercise. Strategically there are two basic alternatives for foresight research in relation to an innovation: (1) before the actual innovation is identified and (2) after the innovation is identified. Typically the innovation process is seen as linear, with 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 [12, 13, 14]

According to Kaivo-oja [15], we can connect foresight systems and innovation systems in the following seven alternative ways, which are non-linear rather than the conventional linear ([13], see details in Appendix 1). We present seven theoretical alternative interaction models, which all are possible in modern firms and corporations. We consider that foresight systems can play and actually often do play an important part in relation to innovation systems.

Foresight activities are often performed by knowledge-intensive business companies and these kinds of companies are also coproducers of innovations. Theoretically these kinds of

complex interactions can explain the new empirical findings of Leiponen and Drejer [16]. We can expect that the five technological or innovative regimes – (1) the supplier-dominated regime, (2) the production-intensive regime, (3) the scale or science-based regime, (4) the market-driven regime and (5) the passive/weak innovation regime – are based on different kinds foresight system/innovation system interactions. Table 1 connects the technological and innovative regimes of Leiponen and Drejer [16] to the foresight/innovation interaction models presented above [15].

Table 1 Technological/innovative regimes and likely interaction models between foresight systems and innovation processes (source: Kaivo-oja, [15])

Technological/ innovative regime	*Most likely 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 needs 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 concerning production and market development leads to innovation and related changes in production and marketing), FOI (foresight 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)

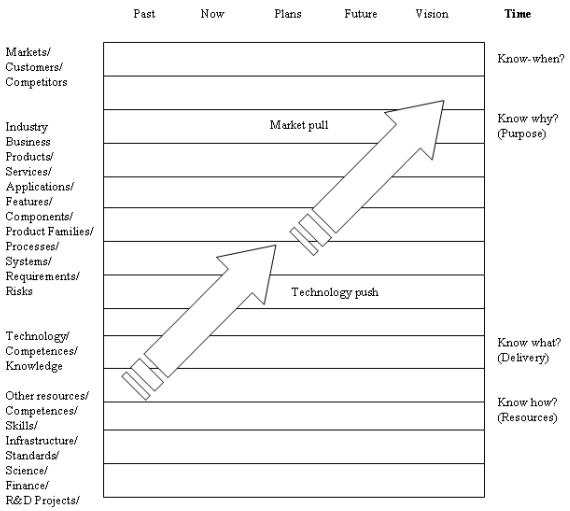
Innovation source 2: current market environment information bank. The right-hand box in Figure 2 represents the current market data bank. The theoretical basis of this bank derives from customer and market orientation strategy literature. A customer orientation strategy, which is commonly linked to market orientation strategy [17], can be defined as a strong desire to identify customer needs and the ability to answer recognised needs. Others authors have presented similar definitions (e.g. [18, 19, 20]. The theory is grounded in the basic belief that companies that satisfy their customers' individual wants and needs better will eventually have higher sales [21].

In order to fully understand customer behaviour, companies should systematically collect and analyse a significant amount of data on their customers' behaviour and their competitors' actions. With such in-depth analyses, companies can apply e.g. customer segmentation strategies or so-called cradle-to-grave strategies, which emphasise the lifetime value of a customer [22, 23]. From an organisation's point of view, extensive idea-generation based on customer data might be problematic, as this process is typically very resource-intensive. Even though the Internet has significantly helped companies collect customer feedback (on e.g. problems or needs), more in-depth interviews or large-scale focus groups with customers are still often avoided due to high expenses. As the data collection process in general has become easier, companies now produce more customer behaviour data, which can be used as a foundation for idea-generation. However, a large proportion of these huge amounts of available data is often unused due to understaffing problems. Interestingly, this resource shortage might be overcome with the help of an extensive human resource network such as NOIS. A good practice is to build consumer scenarios to identify key issues of consumer behaviour and consumer needs (cf. Alexander and Maiden, [24]). It is also possible to use Customer Experience Management (CEM) and Customer Relationship Management (CRM) tools (cf. e.g. Meyer and Schwager, [25]). In order to understand the current market environment the NOIS framework classifies the current market environment according to the following categories: 1) customer needs, 2) customer problems, 3) occurrence and 4) competitor action.

Technology push and market pull creating dynamic interaction between market data banks. It is important to recognise the technological push and pull factors in innovation processes. According to the "technology-push" theory, research leads to inventions, which then lead to the development, production, marketing, and introduction of innovations to the market. Radical 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 adaptation to the existing patterns of demand (see e.g. Dosi, [26]). As for the "demand-pull" theory, Schmookler [27] 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 economic troughs during 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. future market environment information) and 2 (current market environment information), a good policy support tool for integrating demand- and supply-side analyses would be *a generalised technology roadmap*. It is obvious that a NOIS that includes a significant amount of data needs some kind of integration tool for innovation management. As a result, a technology roadmap which nicely summarises the technology push and market pull approaches would be a very good tool for these kinds of practical integration needs (see Figure 3).

Figure 3: Generalised technology roadmap architecture [28]



Community members' profile: young people, the aged and customers as content providers. Content, including new ideas, market forecast information and customer problems/needs will be produced by two main opposite target groups: young people and the aged. This polarised arrangement is expected to increase dynamics, resulting in unforeseeable positive outcomes.

Young people. The Finnish higher education system (ISCED classification group 5) is based on a dual model [29], consisting of two complementary sectors: universities and universities of applied sciences. Universities focus on scientific research, whereas universities of applied sciences are work-oriented. In principle, universities of applied sciences offer a more practical alternative, with theory and practice in balance and focused on the requirements set by the labour market. More than 100,000 students taking Bachelor's degrees in universities of applied sciences will be the main human resource for providing and sharing content in the defined Innovation Triangle concept. The supervision of student work will be integrated into everyday teaching tasks, while the overall resource allocation will be conducted with the help of the institutions' own curricula.

The aged. In Western countries especially, forecasts of the size of the available workforce have shown an unhealthy trend [30]. Esa Swanljung, chief executive of the Finnish Pension Alliance TELA has stated that in Finland there is already a labour shortage in many industries [31]. Moreover, those who are already retired provide the most significant available labour reserve. On the other hand, there is a growing need to activate the aged and retired [30]. Finland is not the only European country that has these concerns regarding problematic demographic changes. Finland, with its just over five million inhabitants, has more than a hundred thousand civic organisations and non-profit associations on which the Finnish welfare state has historically relied. This voluntary workforce will be engaged as content providers alongside the more organised resource of students from universities of applied sciences. In principle, the active members of the aging group will have access to sharing and communicating their experiences with young people. Marketing and resourcing this possibility will be conducted through the network of voluntary organisations.

The customers. Initially, businesses, local authorities and public administration are defined as the customers of our concept (i.e. players who do not actively participate in the content production, but use the content produced by others). Customers also have the possibility of participating in content production. *Firstly*, businesses can set up competitions in any of the three main content areas (i.e. forecasting, current market information needs, idea requests). By providing incentives for the top performers in a competition, companies can increase the chances of the community solving their particular task instead some other company's. *Secondly*, since our concept is based on the open innovation ideology, anybody, including the employees of customer organisations, can participate in the content production.

Allocating resources with the help of regional innovation policy. In the NOIS we have 100,000 students and senior citizens operating without a genuine centralised management system, which makes effective resource allocation very demanding. In a "fully" open innovation setup, there is a significant risk that a great majority of resources will devote their time to the exact same task (e.g. trying to generate ideas around the same narrow topic). From the point of view of coverage and effectiveness, this is a clear drawback and a waste of valuable resources. In our concept this problem is overcome by integrating the Finnish regional innovation policy and the specific curricula of universities of applied sciences. This interaction is logical and rational, as besides the requirement of training professionals in response to labour market needs, the network of universities of applied sciences in Finland has an obligation to promote regional development.

In Finland, government bodies including the Ministry of Trade and Industry, the Ministry of Education and the Ministry of the Interior have implemented a regional innovation policy through a specific Centre of Expertise Programme (later CEP). In principle, the CEP aims to improve the innovativeness and knowledge base of regions in accordance with national targets. Finland has widely adopted a so-called cluster approach to innovation science and education policies (cf. [32, 33, 34, 35]). The cluster approach has now also been adopted in European and OECD innovation policies [36]. An obvious conclusion is that open innovation banking systems can benefit from these kinds of cluster analyses. In Finland this approach has recently been adopted in the Finsight foresight and science policy project (cf. [37]), which was used in national technology and science policy strategy processes. Based on the CEP, a total of 13 national expertise clusters (i.e. content areas) have been defined, including ubiquitous computing, well-being and digital contents. In our concept this classification will be used as a main resource allocator among students. In practice, based on their individual competence and regional profiles, the universities of applied sciences participating in our social network will select the CEP clusters they find interesting. As the players' competence and regional profiles vary, it can be expected that the distribution of resources will be naturally balanced.

DISCUSSION

In the proposed National Open Innovation System (NOIS), we have created a model based on online social networks that integrates the following three players: (1) higher education students and faculty members and senior citizens as content providers, (2) the Finnish regional innovation policy as stated by the government, and 3) businesses, local authorities and

public administration bodies as customers. Thus we argue that we have actually defined a novel fourth-generation Triple Helix Model, which should deepen interaction and dynamics between higher education, government and corporations. It can be assumed that the three previously defined Triple Helix models and our forth model, based on social networking, are hardly the end of this institutional evolution. The information revolution brought by computers and telecommunication technology has had and will surely continue to have a major impact. Moreover, new technologies enable new cooperation forms in data bank and innovation policies. Yet it is obvious that the Triple Helix framework in general requires a supportive and catalytic approach such as a NOIS to bring dynamic interaction to a whole new level. We argue that after implementation, the NOIS should produce significant competitive advantages for Finland and other European countries whose higher education is based on state-owned free education. In principle, the NOIS embodies a new and significant development resource for industry that has previously clearly been underutilised. Our argument is in line with other suggestions, which see the Triple Helix models as alternative future frameworks for European innovation policy [38].

CONCLUSION

In this study we have proposed a new approach based on people-to-people interaction, which we named the National Open Innovation System. We have integrated the Triple Helix model with social networking ideologies to form a new model, which we argue will change the current practices of interaction between higher education, industry, and government. By following our concept, young university students with their fresh ideas can effectively combine forces with senior citizens and their significant practical knowledge in an open innovation-based social networking community.

From a theoretical point of view, the presented NOIS is an open-source model for emerging online social networks (OSNs). OSNs have gained unprecedented popularity in recent years. We have pointed out that OSNs can also play a technologically and socially important role in the commercialisation process of novel ideas and inventions. OSNs can support the commercialisation of new ideas, inventions and innovations on a large scale. The new NOIS model has many interesting characteristics, both socially and technologically. We predict that with the support of OSNs we can expect improved success rates and wider involvement of social networks in commercialising novel ideas, inventions and innovations. The presented NOIS is one concrete and conceptual framework for implementing new kind of open innovation policy in Finland and in other countries.

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

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Appendix 1. The models of interaction between the foresight system and the innovation process

Figure 1 Model I: Innovation-Foresight-Other processes (IFO) model

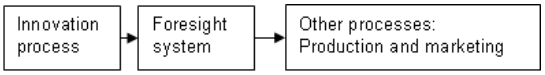

Figure 2 Model II: Foresight-Innovation-Other Processes (FIO) model

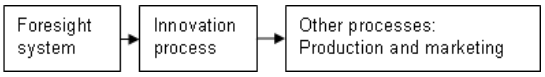

Figure 3 Model III: Other industrial processes-Foresight-Innovation (OFI) model

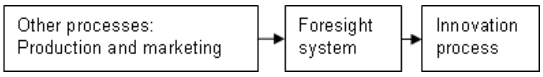

Figure 4 Model IV: Other industrial processes-Innovation-Foresight (OIF)

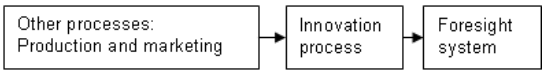

Figure 5 Model V: Foresight-Other industrial processes-Innovation (FOI)

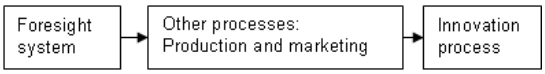

Figure 6 Model VI: Innovation-Other industrial processes-Foresight (IOF)

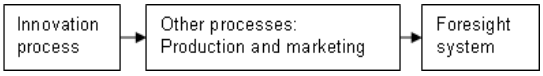

Figure 7 Model VII: Interactive simulative process model (ISP)