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A Study on Mongolia's National Innovation System: ICT as a Pilot Sector for the Innovation System Development

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Abstract

Innovation system is a framework concept that can be classified in many ways, namely-national, regional, sectoral and technological. Regardless of classification, all these systems have some common features and characteristics as a system. Before the innovation system concept, Mongolia developed and implemented a system to maintain nation's capacity to acquire, absorb and disseminate technologies like other countries. There were two important practices in the system development. Firstly, Mongolia modified and implemented a system "ShBOS" (meant "Invention and Innovative Idea System") that met its unique features to create innovative culture in the nation. Secondly, newly emerged ICT sector was quickly scaled up to be able to export technological products. The main objective of this article is to study modern experience of developing the national innovation system in Mongolia, assess current state of the system, innovation awareness and readiness, and carry out recommendations on its improvement with particular focus on the capacity of ICT sector as a pilot sector. The paper suggests that the above mentioned two achievements can be applied for developing the national innovation system through technological innovation system approach.

Keywords

Innovation system, Innovation ecosystem, Information technology

1. INTRODUCTION

Innovation has been widely recognized as a foundation for the competitiveness of nations, regions, and industrial sectors. The experience of the developed countries has proven that the most effective way to foster innovation is building a strong linkage between innovation actors. In another word, the experience proves that successful economic and industrial development is intimately linked to a nation's capacity to acquire, absorb and disseminate modern technologies through a functional innovation system.

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The National Innovation System (NIS) concept first appeared in the mid-1980s in the context of debates over industrial policy in Europe. Since then, an international body of literature documents the growing influence of the NIS approach (Sharif 2006). The NIS framework suggests that the research system's ultimate goal is innovation, and that the system is part of a larger system composed of sectors such as government, university, and industry and their environment. The framework also emphasized the relationships between the components or sectors (Godin 2009). Although the innovation system approach originated from research on national innovation systems (Freeman 1987), researchers soon began conceptualizing innovation systems at the regional (Cooke et al. 1997), sectorial (Malerba 2002), and technological levels (Carlsson 1995) as subsystems of a NIS.

Even though innovation systems can be defined in a variety of ways, they have certain common characteristics as a system. They all involve the creation, diffusion, and use of knowledge.

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Systems consist of components, relationships among these, and their characteristics or attributes (Carlsson et al. 2002). Therefore, environment, interaction, relationship, and collaboration among components, elements, and subsystems are essential to the innovation system development. Thus, innovation ecosystem approach has emerged in science and technology study recently. Some researchers (Oh et al. 2014) suggest innovation ecosystem approach as a new model and independent approach, while some others (Jucevicius and Grumadaite 2014) suggest it as a complementary to the innovation system approach. Recently, scholars and practitioners increasingly identify the usefulness of the innovation ecosystem concept. To make innovation happen a suitable innovation ecosystem must meet different conditions. These conditions may address natural, structural, organizational and cultural factors (Durst and Poutanen 2013).

Whereas a developed country's goal of having an innovation system is for maintaining or improving an already established level of competitiveness and growth, a developing country's ultimate goal is to develop fast to "catch-up" other economies as soon as possible. In order to accomplish the goal of "catching-up", developing countries face common challenges, particularly in the post-communist countries. When it concerns post-communist economies (former socialist countries before the 1990s), Mongolia in particular, the term of innovation is new, introduced in the mid-2000s, and the understanding of the innovation processes is somewhat limited.

There was a practice to develop a system "ShBOS" (meant "Invention and Innovative Idea System") to acquire, absorb and disseminate new technical solutions and technologies before the 1990s democracy in Mongolia. The ShBOS system played crucial role to create innovative culture in the country. After the innovative culture set, ICT sector was selected as a leading sector to create critical mass and to develop the system similar to the technological innovation system. Over the last two decades, Mongolia has been trying to transfer to a free market economy. And, in the last decade, Mongolia tries to adopt and implement the new concept of the innovation system and faces with challenges.

This paper consists of four sub-sections. In the first parts, we discuss about the emergence and development of the Innovation Systems and Ecosystems concepts. In the second part, the article goes back in history to trace the emergence of a systems approach in Mongolia before the 1990s democracy. Then we looks at how the NIS approach entered into Mongolia, and the initiatives to develop the National Innovation System and its ecosystem since the 1990s. In the third part, we introduce the result of our recent survey on innovation awareness and readiness focused on innovation systems elements in Mongolia. In the following part, we assess current state of ICT sector in Mongolia. Based on the research result, we propose suggestions to develop NIS through technological innovation system focused on the ICT sector's achievements and conclude our remarks.

2. NATIONAL INNOVATION SYSTEM AND INNOVATION ECOSYSTEM

2.1. National Innovation System

Used by several international organizations, most notably the Organization for Economic Cooperation and Development (OECD), the national innovation system approach enjoys wide currency in Scandinavia and Western Europe, in both academic and policymaking contexts[1]. Countries have been developing their national innovation systems. Similar to the term innovation's definitions, there are several definitions for national innovation system. According to OECD's manual, one account of NIS is the set of institutions that (jointly and individually) contribute to the development and diffusion of new technologies. These institutions provide the framework within which governments form and implement policies to influence the innovation process. As such, it is a system of interconnected institutions to create, store, and transfer the knowledge, skills, and artifacts which define new technologies (Metcalfe 1995; OECD 1997).

The NIS definitions can be classified into broad and narrow definitions depending on to what extent we look at institutuinal settings. On one hand, the broad definition of NIS is "a set of all interrelated institutional actors of government, public and private institutions, which take responsibilities by contributing to create, diffuse, and exploit new, economically valuable knowledge in the collaboration of innovation agenda" (Oyuntsetseg 2009). On the other hand, the narrow definition includes organizations and institutions directly related to searching and exploring technological innovations, such as R&D departments, universities, and public institutes (Lundvall

[1] In 1992, Finland was the first country to adopt the concept of an NIS as a basic category of its science and technology policy (Sharif 2006).

1988). Experts in this area emphasize that effective institutional setting and interactive learning between major actors within the setting are very important for generating innovations and strengthening and maintaining national competitiveness (Chung 2002).

Since there are no blueprints, standards, or theories for developing an innovation system (Sharif 2006), each country has a different experience with the development history of NIS. From their experiences, those countries, who have implemented the concept based on their country's unique environment, are the most successful. For developing countries, there is an opportunity to fill the gap of development in a short period of time by introducing a pragmatic innovation system concept based on country's profile (The World Bank 2010). However, a lack of national innovation policy, shortage of knowledge production, lack of skilled labor and the inexistence of financial support systems for innovation are some of the key constraints in promoting innovation in developing countries. Thus, UNESCO advises that these countries promote inclusive innovation for sustainable development by facilitating the development of innovation ecosystems promoting a culture of innovation (Schlegel 2014). In this paper, we aim to use the narrow definition of innovation system for the case of Mongolian technological innovation system.

2.2. Innovation Ecosystem

Studying innovation systems from the ecosystem perspective has emerged in science and technology (S&T) study recently. Some researchers (Oh et al. 2014) suggest the innovation ecosystem approach as a new model and independent approach, while some others (Jucevicius and Grumadaite 2014) suggest it as complementary to the innovation system approach. The fundamental hope behind ecosystems thinking is to expand the capabilities of one actor beyond its own boundaries and transfer knowledge into innovation in collaboration with others (Adner 2006).

An innovation system is "the complex relationships that are formed between actors or entities whose functional goal is to enable technology development and innovation. The actors include the material resources (funds, equipment, facilities, etc.) and the human capital (students, faculty, staff, industry researchers, industry representatives, etc.) that make up the institutional entities participating in the ecosystem (e.g. universities, colleges of engineering, business schools, business firms, venture capitalists, industry-university research institutes, federal or industrial supported centers of excellence, and state and/or local economic development and business assistance organizations, funding agencies, policy makers, etc.) (Jackson 2011). The innovation ecosystem only partly depends on presence of elements (i.e. talent, firms, institutions, capital), but even more so on their identities, meaning, networking capabilities, culture of trust and pragmatic cooperation (Jucevicius and Grumadaite 2014).

These above mentioned elements introduced by the innovation system environment, create the ecosystem environment and are influential on the ecosystem itself. Based on Jackson's and others suggestions, an innovation ecosystem's elements can be classified into groups as follows: 1) Innovation culture elements, 2) Regulatory environment elements, 3) Talent elements, 4) Capital elements, 5) Density elements (Oh et al. 2014). In another words, a country should develop its NIS by having policies that educate human resources in innovation culture, lead to a friendly regulatory environment, and support critical mass building through investment concentration.

3. ORIGIN AND DEVELOPMENT OF AN INNOVATION SYSTEM (AND ECOSYSTEM) CONCEPT IN MONGOLIA

In this section, we discuss about the Mongolian experience in the development of a system, National Innovation System, from two different perspectives. First, "ShBOS" system, and secondly, National Innovation System of Mongolia.

3.1 First attempt to develop a framework: Development of "ShBOS" system

Researchers all agree that before the terms "innovation" and "innovation systems" definitions showed up in S&T studies, they existed in human history. There were experiences that lead to the development of similar systems in Mongolia during the socialist era.

In Mongolia, for the first time, on May 19th, 1944 by the Ministers' committee's 63rd resolution, guidance to reward those who bring new product invention including innovative ideas was approved; and ordered appropriate ministries' to register the idea and new inventions, provide certificates, diffuse, and use them in the industrial sectors manufacturing. The resolution also made the National planning office responsible for bookkeeping of the certificates issued by those ministries (Demberel

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et al. 2000). It was the first system of knowledge creation, diffusion and exploitation of new technologies.

The first system to invent, register, exploit knowledge into industry and diffuse the "Invention, and innovative idea system" was developed and improved in 1960, 1970 and used until 1992. <Fig.1>

Additionally, at the Mongolian Youth Federation's Bureau of the Central committee's meeting on April 4th, 1977's they passed a 36th resolution, leading to approval of the structure of "ZTB" (Youth technological invention) system to develop children, and youth's science and technological inventions (Mongolian Youth Federation 1981). <Fig.2>

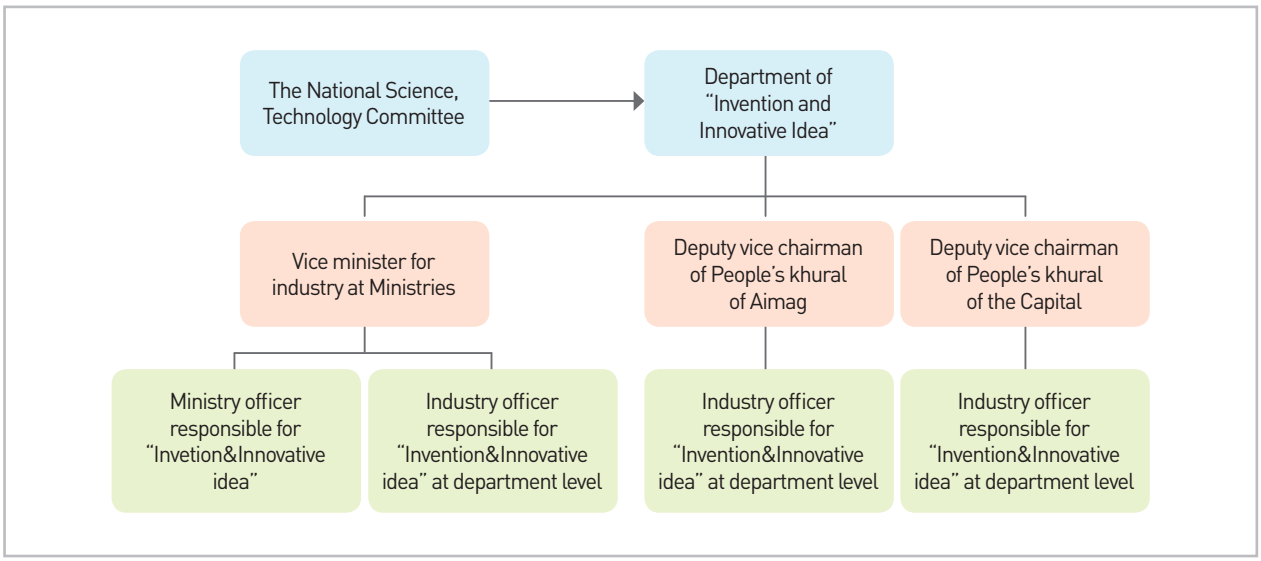

Fig. 1. "ShBOS" framework for creation, registration and diffusion of inventions

Source: Government of Mongolian People's Republic 1987

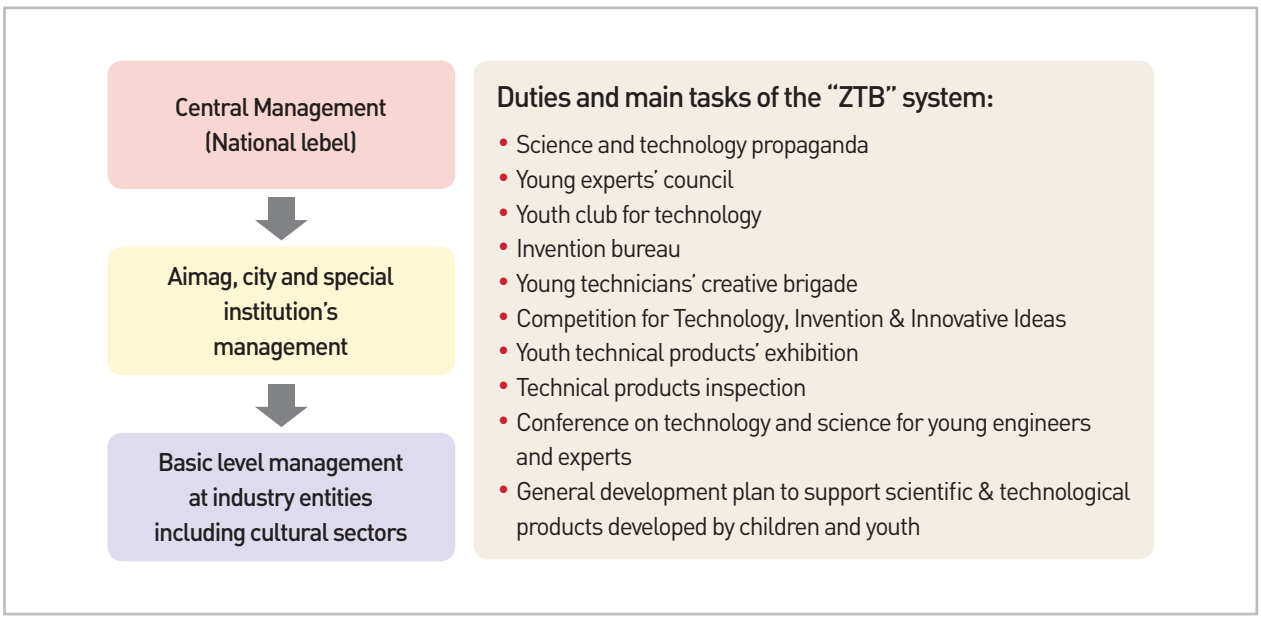

Fig. 2. Organizational structure of "ZTB" system

Source: Mongolian Youth Federation 1981

3.2 Second attempt to develop a National Innovation System in Mongolia

In its Millennium development goals-based comprehensive national development strategy, the country of Mongolia, which has chosen democracy to develop, has strengthened the science and technology capacity by developing and creating an innovation beneficial system; stated to implement economical frontier industries' technology and invention by adapting foreign advanced technological inventions and by local research and development result; stated to achieve the 7 sub goals from 2007 to 2021 (The Secretariat of the State Great Hural 2008).

According to the policies, in its master plan to develop Mongolian science and technology from 2007 to 2020, the government initiated a goal to reform the economy based on technological innovation, and approved, in 2007, "The program to develop National innovation system in Mongolia" (The Secretariat of the State Great Hural 2008), in 2010, "State policy on high technology industry," in 2011, "The program to develop high technology industry," in 2012, "Law of Innovation," and in 2013, "Investment law" and started to implement new National Innovation System.

When developing the above mentioned strategic documents, foreign researchers' studies, foreign countries' experiences, and Mongolian researchers' work have been used by the policy makers. Among the studies, the research done by Dr. Oyuntsetseg (2009), who studied the National Innovation System's principles' model, prerequisite conditions and concepts to develop Mongolian National Innovation System, has had significant impact.

There are cases where the triple helix model (Ranga and Etzkowitz 2013) is used, which is one of the knowledge economy's well known concepts of government- academic institutions- industries which explain innovation systems (Leydesdorff and Zawdie 2010). In its extended version of the quadruple helix model, the "consumer" is added to define the interrelationships between the components (Carayannis and Campbell 2011).

The model proposed by Dr. Oyuntsetseg, suggests to add the fifth element of "innovation infrastructure" on the Quadruple Helix model to support innovative activities among the elements <Fig.3>.

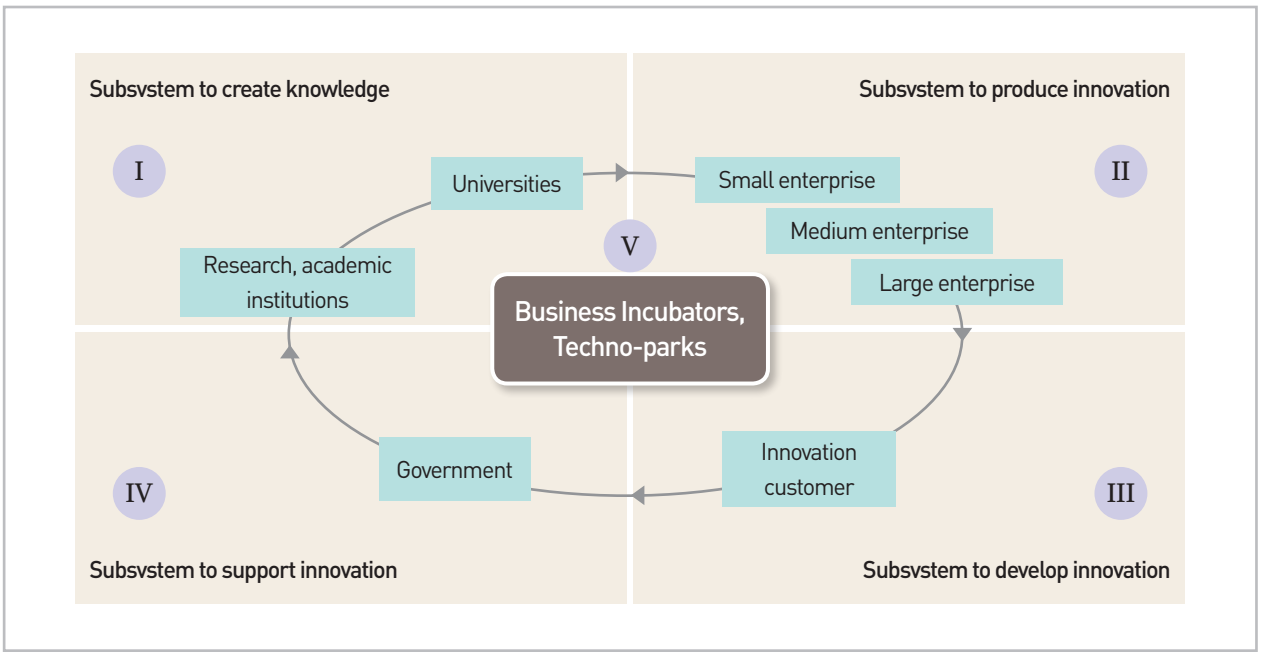

Fig. 3. "Base structure model" of a NIS

Source: Oyuntsetseg 2009
Note: I - Science-education block
II - Industrial block
III - Customer block
IV - Regulation block
V - Infrastructure block

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We studied the innovation system from the perspective of the "Base structure model" and intend to interpret the current state of Mongolia by considering five elements of 1) Innovation Culture, 2) Regulatory environment, 3) Talent, 4) Capital, and 5) Density.

4. STUDY OF INNOVATION READINESS AND AWARENESS

The study of innovation in Mongolia has been objectively evaluated by the readiness of the previously mentioned "Base structure model" and its ecosystem factors or elements. The study is based on both paper and electronic survey conducted in April 2015 to 300 innovation and technology professionals whose work definitions include R&D, innovation, and technology from the sectors of public and private organizations including academic institutions. The number of effective replies was 114 (38%). Questions in the survey consist of innovation system completeness, achievement for recent years, effect of Innovation programs, and so on.

Out of the total participants, 60% were male, 46 were up to 30 years old, 50 were 31 to 40 years old, 16 were 41-50 years old, and 2 were 51-60 years old. 48 hold bachelor's degrees, 43 are master's degrees holders, and the remaining 23 participants are Doctors of Philosophy.

The objective of the first part of the survey was to study the current phase of the Innovation system's completeness. Although, as a result of the test survey, 89% of the participants believe innovation is fundamental to the country's development and innovation can take the country to better development, 73%, or 83 participants, responded that the national innovation system in Mongolia is incomplete. The result regarding the innovation system completeness is summarized in <Fig.4>.

According to the result from the <Fig.4>, 17 participants believe that there is no innovation system in Mongolia and 7 participants "do not know". If the system is incomplete, the following three indicators have been chosen the most as what is missing in multiple choice questions.

- Collaboration, relationship -65.6%
- Infrastructure -50%
- Public regulation and regulatory environment -50%

The purpose of the second part of the survey was to observe how public regulations and the regulatory environment for building Mongolian National Innovation System is affecting the innovation initiatives. In order to measure performance, the focus was on number of patent applications filed considering quantity approach, but quality.

Looking at the Intellectual Property Office of Mongolia's (IPOM) statistics <Fig.5>, the number of patents and applications filed have been increasing continuously since 2009. This could indicate indirect impact of the national innovation system development program. However, this hypothesis needs to be studied in detail. In the initial survey, our aim is to demonstrate how well the intellectual property culture is set for those organizations with R&D, innovation and technology units. From the survey result, it indicates the tendency to file patent applications increased dramatically since 2012 <Fig.6>.

Another goal was to reveal intellectual property (IP) culture of

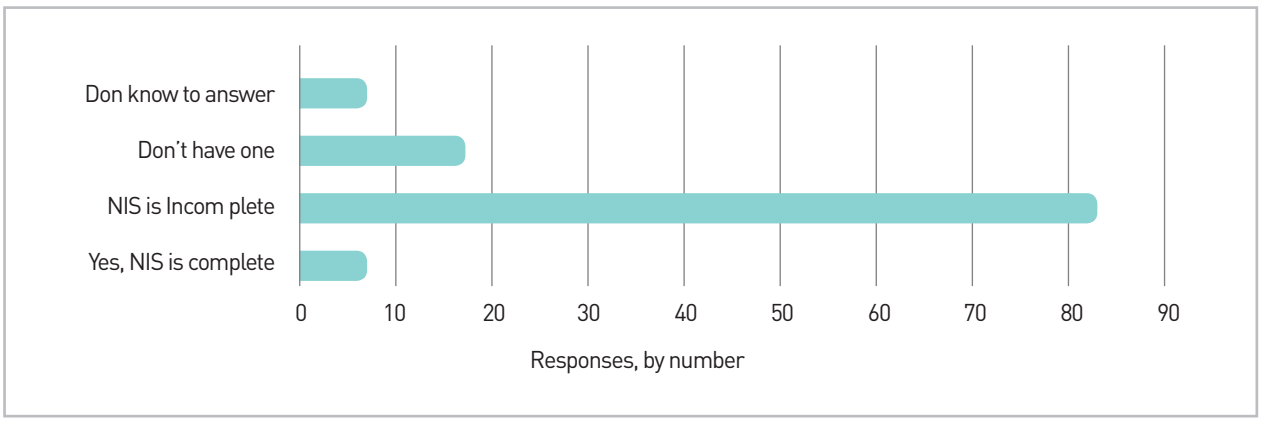

Fig. 4. Answers to the question of "Do you agree NIS of Mongolia is complete? If, you don't, select what is/are missing (multiple choice), please?"

Source: Dashdondov et al. 2014

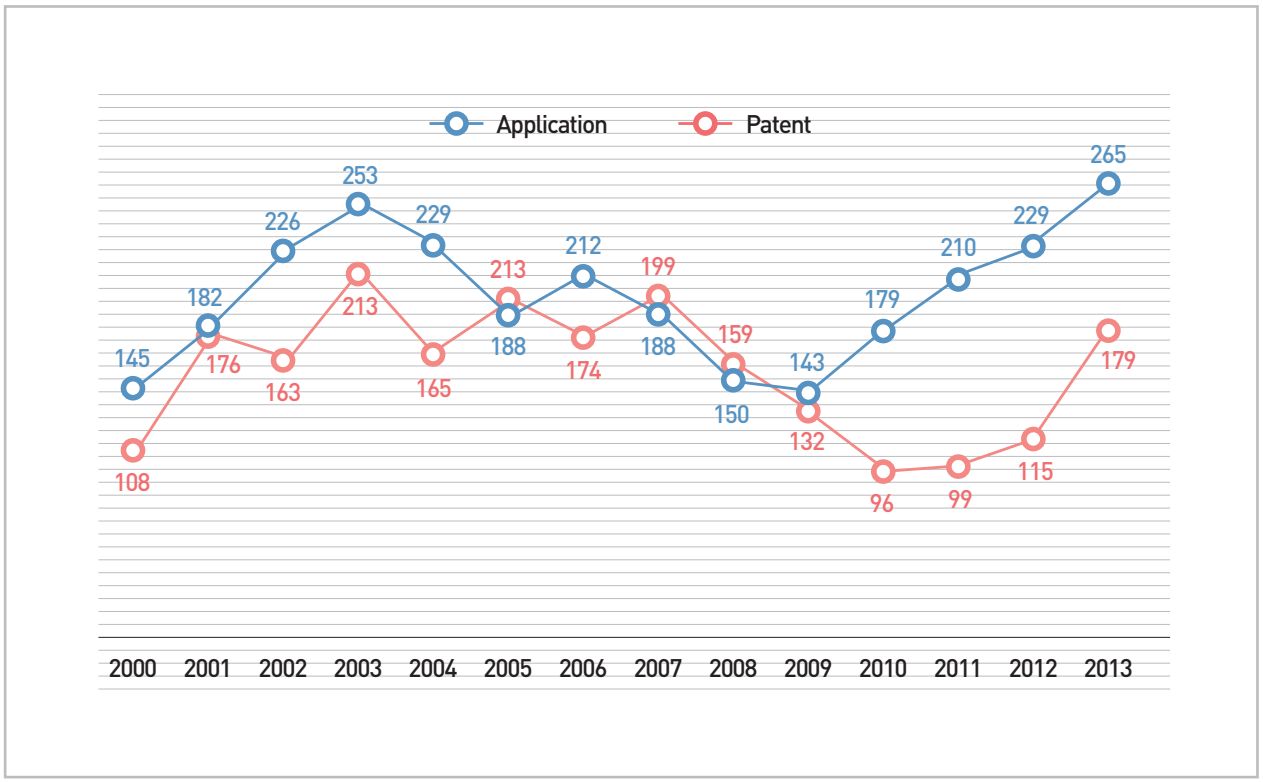

Fig. 5. Number of registered patents and filed applications in Mongolia

Source: Intellectual Property Office of Mongolia 2014

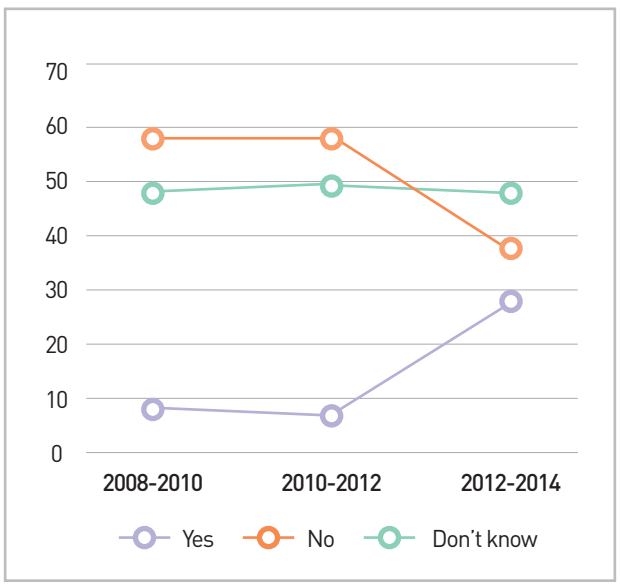

Fig. 6. Number of entities that file a patent application(s) during the specified periods from 2008 to 2014

Source: Dashdondov et al. 2014

the R&D organizations; even so, there was IPOM's statistics about patents and applications by year as shown above in <Fig.5>.

As a result of the above survey, the fact that 42% of the total professionals in charge of the R&D, innovation and technology answered "They do not know, whether the new patent application is filed or not at the organization's level" supports our hypothesis of no innovation culture, particularly intellectual property culture is set among the most innovation actor institutions. On the other hand, it may also signify human resource continuity issues in the field.

The majority of the survey participants reached consensus on the importance of innovation and its positive impacts on the economy. However, the result shows strong evidence that there are little or no networks, interactions, collaboration, cultures, infrastructures, and regulatory environments. As a result, we may conclude the NIS of Mongolia is incomplete, and not well operational due to missing links, or failed elements within the system.

Finally, all of the above mentioned remarks require further research, including a comprehensive survey in the future to prove the hypothesis.

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5. ASSESSMENT OF ICT SECTOR IN MONGOLIA

We used the "Base structure model" of NIS as a base to evaluate and compare the elements in order to study ICT sector in Mongolia. We collected the information from available sources to compare the elements taking into account of the following(s):

- Elements of Innovation System
- Elements of Innovation Ecosystem

5.1 Elements of Innovation System

Based on comparison of above-mentioned innovation system elements, we can summarize the ICT sector's innovation system elements are relatively complete. The capabilities of the elements are beyond the purpose of this paper.

5.2 Elements of Innovation Ecosystems

Based on a comparison of the above-mentioned ecosystem elements, we summarize that the ICT sector in our country is in good position in all indexes except capital. For example, we are in 38-

Table 1. Comparison of Mongolian National Innovation System's elements

	General state of Mongolia	Achievements of ICT sector
Government	Regulatory Environment: Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia Law on Innovation and other laws, regulations Implementation institution(s): The National Science and Technology Council Department of Innovation, Ministry of Education, Science and Culture Foundation for S&T Ministries, agencies Local self-governing bodies: Aimags	Regulatory Environment: Policy to develop ICT in Mongolia by year 2020 e-Mongolia national program Law on Innovation and other laws, regulations Implementation institution(s): Information, Communications Technology and Post Authority of Mongolia Communications Regulatory Commission of Mongolia National Committee on ICT
Knowledge creation	Global Innovation Index 2014 PCT resident app. – 82 Global Competitiveness Index 2014 PCT resident app./million pop - 82 Universities, Research Centers	Global Information Technology Index 2015 ICT PCT Patents, app./million population - 64 Universities, Research Centers
Industry	Large & SMEs Global Innovation Index 2014High-&medium-high-tech manufactures, % – 88	NITP received 300 applicants since 2003. Accepted 100 startups into the Park's business incubator, and there are 55 startups graduated as of April, 2015.
Customer	Global Innovation Index 2014 GII 2014-56 /out of 143/ Education index-60	Global Information Technology Index 2015 GITI-62 /out of 148/ Quality of math&science education - 46 Usage subindex - 78 Affordability - 6 Int'l Internet bandwidth kb/s per user - 46 Use of virtual social networks - 44 E-participation - 30 Mobile phone subscriptions/100 pop - 52
Infrastructure	Global Innovation Index 2014 Knowledge&technology outputs - 89 Knowledge diffusion– 123	Global Innovation Index 2014 Infrastructure - 51 Impact subindex - 65 NITPark since 2002

Table 2. Comparison of Innovation Ecosystem's elements

	General state of Mongolia	Achievements of ICT sector
Innovation culture	Global Innovation Index 2014 Innovation linkages - 113	Global Information Technology Index 2015 Business and innovation environment - 60 No. procedures to start a business - 38 IP protection index – 124 Business-to-business internet use - 48 Business-to-consumer internet use - 64
Regulatory environment	Global Innovation Index 2014 Regulatory environment - 56 Law on Innovation and other laws, regulations, and its implementing institutions are ready	Global Information Technology Index 2015 Laws relating to ICTs - 88 No. days to enforce a contract -19 Law on Innovation and other laws, regulations, and its implementing institutions are ready
Talent	Global Innovation Index 2014 R&D index - 90 Education index - 60 Knowledge workers - 58 Global Competitiveness Index 2014 Quality of scientific research institutions - 107 Availability of scientists and engineers - 73 Country capacity to retain talent - 111 Country capacity to attract talent - 114	Global Information Technology Index 2015 Quality of math&science education – 46
Capital	Global Innovation Index 2014 Investment index - 67 Global Competitiveness Index 2014/144/ Venture capital availability -141 Availability of financial services - 111 Strength of investor protection - 22	Global Information Technology Index 2015 Venture capital availability -140
Density	Global Innovation Index 2014 State of cluster development - 129 University/industry research collaboration – 109	Global Innovation Index 2014 ICTs & business model creation - 89
Infrastructure	Global Innovation Index 2014 Knowledge&technology outputs - 89 Knowledge diffusion– 123	Global Innovation Index 2014 Infrastructure - 51 Impact subindex - 65 NITPark since 2002

124th place by the index related to innovation culture, in 19-88th places by indexes of legislation, and 46th place by quality of mathematics and science education. The ICT sector of Mongolia has a policy to develop based on a cluster structure, and in order to achieve its goal the authority of ICT established a techno park to foster IT companies in 2002 as a first step. The development of a venture investment mechanism which promotes start-up businesses in technology is also required.

As we can summarize from the above, the ICT sector is in a better position from overall tendency according to the innovation ecosystem readiness indexes, and therefore it will be easy to engrain the culture. As the ICT sector is providing services to other sectors, if Mongolia manages to develop a complete technological innovation system and its ecosystem based on IT, then it can be a pioneer model and could serve as a pre-condition for spreading to other sectors. In another word, the ICT sector is

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ready to be used as a pilot sector to develop the Mongolian NIS through sectoral or technological innovation system.

The following roles and duties could be carried out in an innovation ecosystem by leading and developing ecosystems in ICT:

- The short product developing timeframe in ICT could positively impact customers to engrain a culture of using new technology and new products.
- Increased customer knowledge could lead to increased productivity in other sectors, and therefore in the innovation environment
- As ICT forms its national base infrastructure for innovation, it will serve as a positive impact to develop the infrastructure of other sectors in a diverse country like Mongolia.
- The concept of science and technology shall be revised and appropriate amendments made based on the experience and lessons learned while developing a model system. It could serve as pre-conditions and NIS could be based and developed on the ICT's innovation system.
- The global ICT sector is becoming and developing as an open and integral system to multi-national technology development, manufacturing and consuming. Therefore, Mongolian ICT's innovation system could be a pilot system for the NIS to join into the Global Innovation System.

COMMENTS AND CONCLUSIONS

- From the result of the survey, a lack of culture, the missing link of networking, interaction and collaboration leads to an incomplete infrastructure in the NIS of Mongolia. A requirement to improve and create relevant culture should be set. Moreover, more research is needed to locate broken links between elements and identify the problems.
- In order to create relevant culture, lessons learned from the past should be considered. A similar system to the ShBOS is needed to set the culture.
- We should pay attention to the fact that the number of patent applications filed is relatively low, especially filing applications through organizations. And, we believe this leads to forming the gap in innovation links. Promoting intellectual property culture shall be considered an initial step toward implementing and developing innovation culture.
- The innovation system of the ICT sector is in good shape except in the capital field comparing with the overall tendency. This makes it easier to shape up the innovation culture. Therefore, considering limited resources of property and HR, NIS can be developed through technological innovation system focuses on the best practices of ICT as a pilot sector.
- Considering the fact that there is no recognized methodology, it is important to note that we should develop a NIS which fits into its national attribute and extended resources. It is also important to define procedures such as collecting base data, processing, sorting and making it publicly available. Furthermore, there is a need to develop study methods on innovation awareness and readiness and all participants shall be surveyed in Mongolia.

REFERENCES

Adner, R. (2006) "Match Your Innovation Strategy to Your Innovation Ecosystem," *Harvard Business Review* 84: 98-110.

Carayannis, E. G., and Campbell, D. F. (2011) "Mode 3 Knowledge Production in Quadruple Helix Innovation Systems," *SpringerBriefs in Business* 7: 1-63. doi:10.1007/978-1-4614-2062-0_1

Carlsson, B. (1995) *Technological Systems and Economic Performance: The Case of Factory Automation*, Dordrecht: Kluwer Academic Publishers.

Carlsson, B., Jacobsson, S., Holmen, M., and Rickne, A. (2002) "Innovation systems: analytical and methodological issues," *Research Policy* 31(2): 233-245. doi:10.1016/S0048-7333(01)00138-X

Chung, S. (2002) "Building a national innovation system through regional innovation systems," *Technovation* 22(8): 485-491.

Cooke, P., Urangab, M. G., and Etxebarriab, G. (1997) "Regional innovation systems: Institutional and organisational dimensions," *Research Policy* 26(4-5): 475-491. doi:10.1016/S0048-7333(97)00025-5

Dashdondov, B., Nergui, S., Choimaa, L., and Zundui, T. (2014) *Mongolian Innovation Survey* 2014, Ulaanbaatar.

Demberel, D., Gombo, G., and Batjargal, T. (2000) *Invention Patent*, Ulaanbaatar: MUST Press.

Durst, S., and Poutanen, P. (2013) "Success factors of innovation ecosystems - Initial insights from a literature review," *CO-CREATE 2013: The Boundary-Crossing Conference on Co-Design in Innovation* (pp. 27-38), Helsinki: Aalto University Publication.

Freeman, C. (1987) *Technology, Policy, and Economic Performance: Lessons from Japan*, London: Pinter.

Godin, B. (2009) "National Innovation System: The System Approach in Historical Perspective," *Science, Technology & Human Values* 34(4): 476-501.

Government of Mongolian People's Republic (1987) *Collection of the laws of Mongolian People's Republic*, Ulaanbaatar: Government press.

Intellectual Property Office of Mongolia (2014) Statistics, Retrieved from Intellectual Property Office of Mongolia. available at: http://www.ipom.mn/index.php?option=com_content&task=blogcategory&id=28&Itemid=43

Jackson, D.J. (2011) *What is an innovation ecosystem?* Arlington, VA: National Science Foundation. available at: http:// www. erc-assoc. org/docs/innovation_ecosystem. pdf.

Jucevicius, G., and Grumadaite, K. (2014) "Smart development of innovation ecosystem," *Procedia - Social and Behavioral Sciences* 156: 125-129. doi:10.1016/j.sbspro.2014.11.133

Leydesdorff, L., and Zawdie, G. (2010) "The Triple Helix Perspective of Innovation Systems," *Technology Analysis & Strategic Management* 22(7): 789-804. doi:10.1080/09537325.2010.511142

Lundvall, B.-Å. (1988) "Innovation as an interactive process: From user-producer interaction to the national systems of innovation," In G. Dosi, C. Freeman, R. Nelson, G. Silverberg, & L. L. Soete (Eds.), *Technical change and economic theory* (pp. 349-369), London: Pinter.

Malerba, F. (2002) "Sectoral systems of innovation and production," *Research Policy* 31(2): 247-264. doi:10.1016/S0048-7333(01)00139-1

Metcalfe, S. (1995) "The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives," In P. Stoneman (Ed), *Handbook of the Economics of Innovation and Technological Change* (pp. 409-512), Oxford (UK)/ Cambridge (USA): Wiley-Blackwell Publishers.

Mongolian Youth Federation (1981) "ZTB system to develop children and youth's science and technological inventions," *Young Inventors* 4(1).

Organization for Economic Cooperation and Development (OECD) (1997) *National Innovation Systems*, Paris: OECD Publishing.

Oh, D.S., Phillips, F., Park, S., & Lee, E.H. (2014) "Innovation Ecosystems: Global Trends and Key Ideas," *Proceeding of Daejeon Global Innovation Forum* (pp. 246-269), Daejeon: UNESCO and World Technopolis Association.

Oyuntsetseg, L. (2009) *National innovation system of Mongolia: Theoretical and methodological framework*, (Doctoral dissertation), Ulaanbaatar. Retrieved from Mongolian Foundation for Science and Technology, #2472

Ranga, M., and Etzkowitz, H. (2013) "Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society," *Industry and Higher Education* 27(4): 237-262.

Schlegel, F. (2014) "Promoting a Culture of Innovation in Developing Countries: UNESCO's Strategy and Key Actions," *Proceeding of Daejeon Global Innovation Forum* (pp. 171-183), Daejeon: UNESCO and World Technopolis Association.

Sharif, N. (2006) "Emergence and development of the National Innovation Systems concept," *Research Policy* 35(5), 745-766. doi:10.1016/j.respol.2006.04.001

The Secretariat of the State Great Hural (2008) "The program to develop National innovation system in Mongolia", *State Information Bulletin* 539(14).

The World Bank (2010) *Innovation Policy: A guide for Developing Countries*, Washington DC: The World Bank. doi:10.1596/978-0-8213-8269-1

GENERAL REFERENCES

Meuer, J., Rupietta, C., and Backes-Gellner, U. (2015) "Layers of co-existing innovation systems," *Research Policy* 44(4): 888-910. doi:doi:10.1016/j.respol.2015.01.013

Mytelka, L. K., and Smith, K. (2002) "Policy learning and innovation theory: An interactive and co-evolving process," *Research Policy* 31: 1467–1479.

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