Globelics 2010
8th International Conference

Making Innovation Work for Society: Linking, Leveraging and Learning

1 - 3 November 2010
University of Malaya, Kuala Lumpur, Malaysia

BENCHMARKING INNOVATION LEADERS

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Globelics
The Global Network for Economics of Learning, Innovation, and Competence Building Systems

UNIVERSITY OF MALAYA

Abstract

The worldwide competition for innovation is dramatically intensifying. This calls for new approaches to innovation as well as great renewal capability from companies and nations. Some countries do really manage to be innovative in all spheres while others significantly lack innovation activities. A country's ability to innovate is directly related to its growth and development. The purpose of this paper is to investigate which countries have the highest innovation performance indexes, identify factors of their innovation success, learn weaknesses of Kazakhstan in innovation sphere and provide guidelines for improvement of innovation activity in Kazakhstan. It was discovered that Japan, Switzerland and Finland are innovation leaders. A number of weaknesses were identified for Kazakhstan among which are scarce investment in research in development, small number of researchers and weak collaboration between universities, research institutions and business organizations.

Keywords: innovation, innovation performance ranking, Kazakhstan, Japan, Switzerland, Finland, research and development, science and technology

Introduction

The world is currently evolving around increasingly strong trends such as globalization and digitalization, with many countries facing various challenges ranging from environmental problems to dwindling natural resources. The worldwide competition for innovation is dramatically intensifying. This calls for new approaches to innovation as well as great renewal capability from companies and nations.

As a concept, innovation has expanded and diversified considerably in the past few years. In terms of the related strategy, innovation is perceived as an exploited, competence-based competitive asset, which, in addition to the application of technology, can be founded on new service and business models, working and operating methods, or the management of product concepts and brands. Innovation is a change in the thought process for doing something or "new stuff that is made useful" states Max McKeown.[1] Joseph Schumpeter defined economic innovation in "Theorie der Wirtschaftlichen Entwicklung" (1912) as following:

- ✓ The introduction of a new good – that is one with which consumers are not yet familiar – or of a new quality of a good.

- ✓ The introduction of a new method of production, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially.
- ✓ The opening of a new market that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before.
- ✓ The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.
- ✓ The carrying out of the new organization of any industry, like the creation of a monopoly position or the breaking up of a monopoly position. [2]

A country's ability to innovate is directly related to its growth and development. The purpose of this paper is to investigate how the most innovative countries managed to achieve their high innovation performance ranks, identify weak points of Kazakhstan in terms of innovation and based on the success factors of innovation leaders provide recommendations for Kazakhstan.

Innovation Performance Ranking

In 2007 the Economist Intelligence Unit, sponsored by Cisco, developed an innovation index that ranked 82 countries based on their innovation capacity from 2002 to 2006, which was later updated for the years 2004-2008, and forecast their performance through to 2013.

To rank countries, the Economist Intelligence Unit distinguishes between "innovation output" (performance) and "innovation inputs" (enablers).

Innovation output is measured by the sum of patents granted by three major government patent offices: the European Patent Office (EPO), the Japanese Patent Office (JPO) and the US Patent and Trademark Office (USPTO). The data are averaged over four-year periods, and normalized as number of patents per million to create an index on a 1-10 scale.

Innovation inputs include both direct drivers and the broad economic, social and political context, or innovation environment. They are based on the scores from the Economist Intelligence Unit's Business Environment Ranking (BER) model averaged over five-year periods: 2002-06 for the original ranking, 2004-08 for the update and 2009-2013 for the forecast. Innovation inputs include the following: research and development (R&D) as % of gross

domestic product (GDP), quality of local research infrastructure, education of workforce, technical skills of workforce, quality of information technology (IT), political stability, macroeconomic stability, institutional framework, regulatory environment, tax regime, flexibility of labor market, openness of national economy to foreign investment, ease of hiring foreign nationals, openness of national culture to foreign influence, popular attitudes towards scientific advancements, access to investment finance, and protection of intellectual property.[3]

The forecast for 2009-13 has been affected by the severe business downturn and the global economic crisis, which will have a negative impact on countries' long-term ability to innovate. While developed countries will continue to top the list of innovators in the medium term, poor business conditions will sap their innovation capacity. But China and India are among the countries that will continue to gain ground.

Japan, Switzerland, Finland, the United States, and Sweden remain at the top of the index, although their relative positions have changed. Japan and Switzerland are still ranked 1st and 2nd respectively. Finland, however, rises from 5th to 3rd position, while the US slips from 3rd to 4th place. Sweden drops from 4th to 5th position (see Table 1).

Table 1: Current and Forecast Innovation Performance Ranking

	Rank			Change in Rank		
	2002-06	2004-08	2009-13*	From 2002-06 to 2004-08	From 2004-08 to 2009-13	From 2002-06 to 2009-2013
Japan	1	1	1	0	0	0
Switzerland	2	2	2	0	0	0
Finland	5	3	3	2	0	2
USA	3	4	5	-1	-1	-2
Sweden	4	5	7	-1	-2	-3
Germany	6	6	4	0	2	2
Taiwan	8	7	6	1	1	2
South Korea	15	11	11	4	0	4
Singapore	17	16	16	1	0	1
Hong Kong	23	21	22	2	-1	1
Malaysia	34	31	35	3	-4	-1
India	58	56	52	2	4	6
China	59	54	46	5	8	13
Thailand	53	58	57	-5	1	-4
Kazakhstan	62	69	66	-7	3	-4
Vietnam	79	78	78	1	0	1

***Forecasted data**
Source: Adapted from An Economist Intelligence Unit Report, "A New Ranking of the World's Most Innovative Countries", The Economist (April 2009). Available at:
http://www.eiu.com/site_info.asp?info_name=cisco_innov_09&page=noads&rf=0

The high rank for three small wealthy European states (Switzerland, Finland, and Sweden) reflects the fact that their economic, social and political conditions favor innovation. In addition, there are specific factors that stimulate innovation, including highly skilled labor forces, a long-standing policy support for ICT and R&D, and specialization in innovation-intensive industries such as telecommunications, biopharmaceuticals, machine tools and precision instruments. The rise of Finland in the ranking reflects these factors as well as the significant improvements in its business environment in recent years.

The slippage of the US confirms the gradual erosion in recent years of the country's traditional position as the world's technological leader. To some extent, the erosion in the US's position reflects the fact that other countries are catching up. But it is also a result of the weakening US innovation environment and this is likely to be accentuated by the current economic crisis.[4]

China is the biggest gainer among all economies, developed and emerging. China is rising strongly in the global innovation performance ranking (from 59th two years ago to its current position of 54th), in contrast to the modest improvement in India's position (from 58th to 56th). One reason for such a jump is that China is making a concerted effort to build a more innovative economy. The country is investing heavily in R&D and education, and its innovation environment is improving.

China now leads the world in the number of people engaged in science and technology. The country accounted for 6% of the number of scientific articles published worldwide in 2005, up from 1.6% in 1995, and it is ranked fifth globally. University graduates with degrees in science and engineering represent 40% of the total, almost twice the OECD average and far above the 15% recorded in the US. Much of China's FDI will continue to target innovation-intensive sectors, and foreign companies have been opening research centers in the country. The prospects for China are not entirely positive; it also faces barriers to innovation. Weak protection of intellectual property (despite improvements in recent years) stands out.[5]

Kazakhstan occupies only 69th place in the global innovation performance ranking. In spite of political and macroeconomic stability in the country, its regulatory environment, tax regime, technical skills of workforce, quality of information technology (IT) and protection of intellectual property are considered to be poor. From one side, Kazakhstan can be justified for this as it is a developing state which has just started the implementation of its Strategy of

Industrial and Innovation Development, 2005-2015. From the other side, Kazakhstan's investment in research and development (R&D) is negligible of only 0.3% of GDP as compared to the most innovative countries. As shown in Table 2, Finland (3.47%) and Japan (3.33%) are the leaders in gross domestic expenditures on R&D among the four analyzed countries and can be used as benchmark for Kazakhstan.

Table 2: Gross Domestic Expenditures on Research and Development as % of GDP of Japan, Switzerland, Finland, and Kazakhstan (2007)

Country	Expenditures on R&D as % of GDP
Japan	3.33%
Switzerland	2.9%
Finland	3.47%
Kazakhstan	0.3%

Source: OECD Factbook, 2009; Statistical Agency of the Republic of Kazakhstan (www.stat.kz)

In order to understand how Kazakhstan can become more innovative and improve its ranking, it is necessary to understand how the top three countries became so successful. The next part of the article investigates the success factors of the most innovative countries in the world such as Japan, Switzerland, and Finland.

Innovation Success Factors in Japan, Switzerland, and Finland

Japan. According to the research conducted by an Economist Intelligence Unit, Japan is the most innovative country in the world. Several factors propel Japan to the position of top innovator. For one thing, this resource-poor economy has long taken an "innovate or die" approach. For another, the economy has a large proportion of high-technology activities that are, by their nature, more innovation-intensive. The country has a large share of high-tech activities and scores high in Internet penetration. In Japan there used to be a symbiotic relationship between large companies and associated smaller firms that were closely integrated into so-called keiretsu and were under strong pressure to innovate. These ties have broken down, but they continue to drive innovation to some degree.[6]

In addition, Japan invests 3.33% of GDP in R&D (OECD, 2009) and more of that R&D is carried out by industry rather than universities and national laboratories. In 2007 Japanese businesses financed 78% of total R&D expenditures. Furthermore, Japan had the fourth largest

number of scientific researchers per relative to total employment. In 2007 there were 11 researchers per 1000 employed in Japan compared to an OECD average of 7.3.[7]

In 2007 Japan had second highest number of patents (111 per million inhabitants), after Switzerland (118). Japan is specialized in environment-related patents. It also accounts for 17% of nanotechnology and 12% of biotechnology patents, the second largest shares after the United States (over 40% in both fields). In 2008 Japan, together with Korea, became the first country with more fiber-based subscriptions than either DSL or cable. About 89% of Japanese firms have their own website.[8]

Japanese management system is characterized by a wide use of kaizen which directly leads to increase in innovations. Kaizen means "improvement". Kaizen strategy calls for never-ending efforts for improvement involving everyone in the organization – managers and workers alike. Management has two major components: maintenance and improvement. The objective of the maintenance function is to maintain current technological, managerial, and operating standards. The improvement function is aimed at improving current standards.

Under the maintenance function, the management must first establish policies, rules, directives and standard operating procedures (SOPs) and then work towards ensuring that everybody follows SOP. The latter is achieved through a combination of discipline and human resource development measures.

Under the improvement function, management works continuously towards revising the current standards, once they have been mastered, and establishing higher ones. Improvement can be broken down between innovation and Kaizen. Innovation involves a drastic improvement in the existing process and requires large investments. Kaizen signifies small improvements as a result of coordinated continuous efforts by all employees.[9]

Switzerland. Switzerland is the leading country in Europe when it comes to innovation. Switzerland has a particularly large proportion of small- and medium-sized enterprises (SMEs) whose innovative products and manufacturing processes have successfully penetrated world markets. No other European country has such a large proportion of innovative SMEs.[10]

Switzerland also has a remarkable ability to generate new knowledge, as attested by the large number of European patents (118 per million inhabitants, 2007), trademarks and designs for such a small population (EIS, 2008). Business expenditure on R&D (BERD) accounts for

over 70% of the total and public financing is strongly oriented towards universities and basic research. The number of scientific researchers in 2007 was 6 researchers per 1000 employed.

Switzerland has strong vocational upper secondary professional schools. About 26% of tertiary-level graduates take degrees in science and engineering. The country awards a high share of PhD degrees relative to its population, and 37% are granted to women. Foreign students account for 42% of students enrolled in PhD programs. [7]

According to Dr. Thomas-Borer-Fielding, Switzerland shows a great strength as a center of innovation due to the following factors:

(1) Superb International Image: The superb international image of Switzerland is still dominated by the label "Heidi & High Tech", promising a mix of innovative success and an unrivalled standard of living, a factor which is gaining in importance in the competition for the qualified and flexible among the worldwide labor force.

(2) New Technologies: Switzerland is among the leading countries in new technologies as a recent OECD study shows. To name a few: biotech, pharmacy, chemistry, micro- and nanotechnology, financial services, environmental technology.

(3) High Degree Integration in Global Economy: Swiss banks are known all over the world and Swiss companies are active worldwide. Not only Switzerland attracts fine minds to its universities and internationally active enterprises, but those minds are the key to knowledge and know-how, which otherwise might be restricted to other countries and pass by.

(4) Political Stability: The political stability experienced in Switzerland is uncommon even for Western democracies. Stability has been and still is a very attractive feature for long-term investments, such as innovation.

(5) Top European Location: Compared to its neighbors in the European Union, Switzerland supersedes every single EU-member in terms of innovation climate attractiveness according to the recent innovation survey by the ETH Zurich. The country offers the best location factors for industrial and service investment in Europe, its infrastructure is unrivalled for so small a country.

(6) Widespread Innovative Businesses: Another very important aspect is that innovation in Switzerland is widespread. About two thirds of Switzerland's companies are among the "innovators". The country is not overburdened with ancient industries or large territories undergoing structural change, such as fisheries, coal or steel but can rather offer a business landscape dominated by modern oriented companies and enterprises.

(7) Excellent R&D Spending, High Patent Rate: The wide diffusion of innovation in Switzerland's economy can also be read of the patent rate. Patents granted per GDP stand at 68% compared to 22 in Germany and 48 in the Netherlands. The high patent rate is also an expression of the excellent current R&D spending that is being done.

(8) Attractive Education Location. Among the OECD countries, Switzerland has the highest proportion of foreign students. A great number of the worlds best and brightest are drawn to this country and many of them stay there, as well. Foreign labor can expect much wider acceptance there than in the case in many other countries in the world. A reason why Switzerland is so attractive to fine minds is the excellent education system which retains a high reputation.[11]

Finland. Finland has succeeded well in international comparisons of education, research and technology, being one of the leading countries in the world in terms of innovation and the quality of enterprises' operating environments. Finland's success has largely been based on its high-quality educational system, long-term investments by enterprises and the public sector in research & development, and its well-functioning networked institutions.[12]

Finland ranks second in the OECD in terms of R&D intensity (at 3.47%) and aims at 4% of GDP by 2010. The country leads in the number of scientific researchers in the labor force, 15.7 researchers per 1000 employed (2007). Finland's intensity of higher education R&D has doubled over the past 15 years. R&D investment is basically concentrated in certain manufacturing sectors, especially electronics, and is dominated by a handful of large domestic multinational companies. For example, Nokia alone accounts for almost half of overall business R&D.

This strong investment in R&D is reflected in robust scientific and technological performance: Finland ranks fourth among OECD countries in terms of scientific articles and above average in number of triadic patents per capita. Finnish companies, especially large firms, also rank high in new-to-market product innovations and obtain a sustainable share of their turnover from these advances. [7]

The innovation system of Finland consists of a group of institutions that together and separately contribute to the development and dissemination of new knowledge and new technologies and that form the structural and legislative framework within which the government implements policy that promotes innovation activity.

The most crucial actors of Finland's innovation system at national level include the ministries, the Science and Technology Policy Council, the Academy of Finland, National Technology Agency of Finland Tekes, National Fund for Research and Development Sitra, the universities, Technical Research Centre of Finland VTT, sector research institutions, Finpro, Finnvera, Finnish Industry Investment and venture capital investors. Some of the important actors at local level include various technology centers, TE Centers, so-called centers of competence, local venture capital investors, as well as industry-related municipal bodies.

Finnish enterprises are succeeding and growing on the international market due to their competitive strength which is a consequence of expertise, and the enhancement of their productivity. The public sector in Finland is also reforming its service systems and operating methods actively, by developing innovations. Public financing incentives for innovation activity are targeted at enterprises and communities that are thought to operate in the manner required for success, i.e. based on a demand and user focus.

In Finland, innovative enterprises cooperate with customers to a greater extent than in many other EU countries on average. Innovation activity involves market-based innovation seizing the opportunities opened up by the market. Value chains are being steered from customers and consumers towards producers and developers, not vice versa. For instance, in international comparisons, the connections between producers and users of information are exceptionally close in Finland. Generally, Finland's innovative enterprises cooperate with other parties exceptionally often.

Cooperation relationships welling forth from the operating environment have a significant effect on Finnish innovativeness. Surveys have indicated that the most important sources of innovations in enterprises include customers and subcontractors, and often also competitors. Interaction between universities and enterprises is also a significant source of innovations. The innovation system has indeed been supported by the idea that innovations are not created and organizations and individuals do not innovate in a vacuum: an organization is always a part of its environment and many social factors influence the innovation activity of enterprises and other organizations.

Defined more broadly, the innovation system includes the structures, actors and interdependencies, as well as the operating environment created by regulations. Finland's national innovation policy affects the innovation system as well as innovation activity. The main

levels of innovation policy are: development of structures and infrastructure, and supporting the innovation processes of enterprises and development of services, as well as the promotion of an innovation culture and the creation of shared visions.[13]

In spite of their successful practices Japan, Switzerland, and Finland are the most innovative countries in the world, they don't stop developing new strategies and programs for the improvement of their innovation system.

Industrial and Innovation Development of Kazakhstan

In Kazakhstan, innovative companies are few in number. Only 4% of enterprises are involved in innovation activities, the rest 96% are innovation passive. In local research laboratories external to the companies, most successful innovation efforts tend to be modest in scope. Technological breakthroughs are rare in Kazakhstan because the country invests miserable amount of money in R&D as compared to innovation leaders. Total investment in R&D of Kazakhstan is 38,988,7 mln tenge which is 0.3% of GDP.[14]

The number of scientific researchers in 2009 was 1.28 researchers per 100 employed which is lower than in 2007 by 12% (1.46). A large portion of the R&D specialists in Kazakhstan carry out their activities at education and research organizations (50.5%). [14] A limited number work is in the R&D or production departments of a few medium and large companies. Still others are entrepreneurs who have set up their own businesses to develop and market their ideas to other businesses, to government organizations, or directly to individual consumers. Many of these Kazakhstani specialists are competing against or co-operating with international providers of goods and services that are also seeking a share of the Kazakhstani and global markets for their technologies.

The government has been establishing a variety of mechanisms to improve the integration of education and research (e.g., upgrading student laboratories, creating programs for students to spend more time in research settings) and to transfer technologies from universities to commercial enterprises (e.g., student internships in companies, university technology transfer offices, incubators). But these mechanisms, however well designed, will be useful only if significant research activities are integrated into the education system and if competitive technologies are developed that are of interest to the commercial sector. Only the human

resources that are available in Kazakhstan can ensure that R&D activities are meaningful and that competitive science and technology (S&T) products flow through the system.

The effectiveness of the Kazakhstani higher education system will continue to be a critical determinant of the country's future. Kazakhstan is fortunate to have a highly literate population that appreciates the value of education and is proud of the country's high-technology achievements in the nuclear and space fields. The prospect of benefiting from the increased resources available to the government has been a strong incentive for many Kazakhstani specialists to search for their niches in private business with or without the benefits of higher education.[15]

Frequently, not enough attention is given to the essential personal interactions and to the related feedback among the participants involved in the entire chain of events if a new or improved process or product is to become a commercial success. In short, the Soviet government's "requirement" that participants work together throughout the process has disappeared. Now, success depends on collaborative efforts that rest largely on personal confidence and trust among participants to overcome organizational barriers as well as technical problems.

Some Kazakhstani researchers contend that a latent demand for their products is reflected in global trends that indicate clear needs for their products. They believe that if their products have performance or cost attributes that are superior to the products of competitors, there will automatically be a global market. Therefore, they seek financial support from government or private-sector investors for their R&D efforts even though they have no indication of interest in their ideas by specific customers who would purchase their products. Clearly, an important aspect of marketing research is analysis of trends in the likely markets for products. But without linking research to the interests of specific customers, the likelihood of successful commercialization is not high.

The government of Kazakhstan gives high priority to stimulating greater demand for innovative technologies by companies in Kazakhstan. Presumably, this increased demand is to be reflected in company investments in specific R&D activities. As previously mentioned, the government has set a goal of private-sector financing of 50% of the nation's R&D budget by 2012, in comparison with 7% in 2005. A related goal calls for the private sector's share of the R&D budget to increase eventually to 67%.

The government is also promoting incubators, techno-parks in tax-free zones, technology transfer offices, government/industry matching grants for researchers, engineering centers, training programs concerning protection of intellectual property rights, and other approaches. But technological commercialization is a complicated process, particularly in a country with little history of market economics as the framework for commercial activity. According to Kazakhstani officials, the success of technological commercialization of new products has yet to be demonstrated on a significant scale in the country.

Kazakhstan has an ambitious program to increase its technological competitiveness in the global marketplace during the next few years. For example, National Innovation Fund (NIF) was established in 2003. The main objective of the Innovation Fund is to increase the overall innovation activity in the country, including the promotion of high-tech and knowledge-intensive industries, such as the information sector, electronics, biotechnology and others. The existence of the Innovation Fund system should solve the problem of the lack of efficient market mechanisms for innovation, which is inherent in all post-Soviet countries.

Government leaders have emphasized that achieving success both internationally and domestically will depend in large extent on the effectiveness of upgraded science and technology (S&T) capabilities – within the education system, research and development (R&D) institutions, and Kazakhstani production companies and service organizations.[16]

Conclusion

The research showed that the most innovative countries tend to have large investment in research and development activities, government support for ICT, high quality educational system, highly skilled labor force, high number of researchers per 1000 employed, high patent rates and collaboration between universities, research institutions and business enterprises. Innovation leaders specialize in innovation-intensive industries such as telecommunications, biopharmaceuticals, machine tools and precision instruments, chemistry, micro- and nanotechnology, financial services, and environmental technology.

Innovativeness of the nation can be improved by the development of appropriate policies. In order to achieve high ranking in innovation performance, successful practices of innovation leaders can be adopted by Kazakhstan:

- ✓ Larger portion of GDP should be invested in research and development;

- ✓ The government should motivate people to be engaged in R&D activities by offering higher salary and attractive compensation package;
- ✓ The research and development should be developed with a view to continuous improvement of the quality and relevance of the research;
- ✓ Small and medium enterprises must be encouraged to be innovation active through financial support;
- ✓ Research activities should focus on breakthrough technologies such as telecommunications, biopharmaceuticals, physics, chemistry, micro- and nanotechnology, financial services, and environmental technology;
- ✓ Universities, research institutions and business enterprises need to expand collaboration among themselves;
- ✓ The quality of education must be improved to international standards where each university would perform research activities;
- ✓ New policies should be adopted in order to better protect intellectual property and reduce major barriers to receiving a patent.

Focusing on these recommendations, after five years Kazakhstan can achieve improvement in innovation performance ranking at least by five points.

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