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Lessons from Korea, Switzerland and Norway: Improvement in innovation management in Iran

Seyedreza Haghi[*]

Ferdows Higher Education Institute, Department of Management, Mashhad, Iran

C H R O N I C L E	A B S T R A C T
	This article is devoted to the study of strategic issues for modification of the national innovation system of Iran. In recent years, National Innovation System is accepted as a conceptual framework and analytical instrument for countries' innovation activities by the international organizations such as Organization for Economic Cooperation and Development, United Nations Conference on Trade and Development and Euro stat. The main purpose of this study is to find solutions modification of the national system of Iran. The subject of the research is the international experience of development of national innovation systems, peculiarities of innovation systems in countries with developed and emerging markets, as well as systems of support and management of national innovation systems in Iran and abroad. The results of this study may be useful for students, managers in public and private sector, government officials, researchers, economists and all those interested in financial and economic issues.

1. Introduction

Innovation is a powerful force for sustainable economic growth. Innovation is relatively linked to economic growth and improved productivity. Improving the conceptual and empirical links between innovation and economic performance is the primary objective of innovation policy. In recent years, the national innovation system (NIS) is taken as a conceptual framework and analytical tools for innovation activities of international organizations and commissions, such as the Organization for Economic Cooperation and Development (OECD), UNCTAD and the Euro-Stat. This research study concentrates on the effective design and implementation of a national innovation system. It describes that the concept of sectoral innovation system is a good tool for the creation of an effective national innovation system, since it can effectively create a variety of regional innovation systems in various

 *Corresponding author. Tel: +989153195443
E-mail address: srhaghi@gmail.com (S. Haghi)

regions. Based on this theoretical overview, this study will analyze the Iranian sectoral innovation system in terms of display innovation actors.

Researcher will provide strategic recommendations based on the experience and success of some selected countries. These recommendations will include a new institutional mapping for Iran, and macro-policy changes on the basis of the SWOT survey and analysis. The National Innovation System (NIS) of the flow of technology and information among people, enterprises and institutions, are the keys to the innovation process at the national level. According to the theory of the innovation system (Giger & Trojer, 2007), innovation and technology development are the results of complex interactions between the participants in the system, which includes enterprises, universities and public research institutes (Fagerberg, 2004). National innovation system has been defined as follows:

> • "The network of organizations in the public and private sectors whose activities and interactions initiate, import, modify and spread of new technologies" (Freeman, 1988).
> • "elements and relationships which interact in the production, distribution and use of new and economically useful, knowledge ... and are either located in or rooted in the borders of the nation state" (Lundval & Johnson, 1994).
> • "National organizations, their incentive structures and their competencies, that determine the speed and direction of technological learning (or the volume and composition of the changes in the business) in the country" (Patel & Pavit, 1994).
> • "It's a lot of institutions that collectively and individually contribute to the development and dissemination of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such, it is a system of interconnected organizations to create, store and transfer knowledge, skills and artifacts that define new technologies" (OECD, 2009a).

Technological innovation system is a concept developed in the field of innovative scientific research that serves to explain the nature and pace of technological change (Lundvall, 1988; Lundvall & Johnson, 1994; Kuznetsov, 2002). Technological innovation system can be defined as "dynamic network of agents interacting in a specific economic /industrial area under a particular institutional infrastructure and involved in the generation, distribution and use of technology" (Bergek et al., 2008). This approach can be applied to at least three levels of analysis: By technology, in the sense that knowledge of the field, to the product or artifact, or to a set of products and artifacts designed to meet the specific function (Jacobsson & Johnson, 2000; Negro, 2007).

With regard to the latter, the approach is particularly well in explaining why and how sustainable technologies are developed and disseminated in society, or were not able to do it. The concept of technological innovation system was introduced as part of a broader theoretical school, called the innovation system approach. The basic idea of this approach is that the determinants of technological change are not to be found in individual firms or research institutes, but also in the wider social structure in which the firm, as well as academic institutions are embedded (Van Lente, 1993; Freeman, 1995; Lundval, 1988; Smits, 2002). Since the 1980s, the study of the innovation system pointed to the influence of social structures on the technological changes, and indirectly on the long-term economic growth within countries, sectors or technology areas. The purpose of the analysis of technological innovation system is the analysis and evaluation of the development of a technological field in terms of structures and processes that support it. In addition, its focus, there are two more analytical, features that set technological innovation system approach differs from other approaches innovation system (Hekkert et al., 2007).

1.1. Problem Discussion

Iranian national innovation system is relatively weak. The existing institution and national innovation system in Iran should be modified and further developed based on the active support by the central

government. The primary objective of this study is to use various instruments such as comparative study, survey study and Strength, Weakness, Opportunity and Threats (SWOT) analysis to find the solutions for modification of the NIS of Iran.

1.2. Research Significance

During the last three decades, a new conceptual framework appeared in the science, technology, research and innovation: the national innovation system. The structure suggests that the ultimate objective of the study is the innovation system, and that system is part of a larger system composed of sectors such as government, universities and industry, and their environment. The framework also emphasized the linking between the components or sectors, and "cause" that explains the effectiveness of innovation systems.

1.3. Main Objective

Finding the strengths, weaknesses, threats and opportunities in the internal and external environment of National Innovation System of Iran and suggesting the solutions for modification of NIS of Iran are the main objectives of this research study. The recommendations will be included a new institution for Iran, and macro strategic recommendations.

2. Methodological Procedure

This research study is placed in the category of exploratory research (survey study). Researcher in this study, using the indicators (based on experiences of selected OECD countries such as Norway, Switzerland and Korea) (North, 1990; Haghi, 2010) tries to use a questionnaire to measure the effectiveness of implementation of National Innovation System of Iran. Therefore, in terms of data collection, research is a field study, and causes to generalize the results, so it is applicable study. Statistical society are the experts in the fields of parliament of Iran, policy making, technology and innovation policy coordinators such as state experts, experts employees in the ministries of sciences, researches and technologies, industries and mines, research and innovation facilitators, research and development centers, innovation developers such as consultancy firms and incubator centers in the universities and parks of technology and innovation users such as organizations, state and private corporations. In this study, 100 experts from the population are examined. Questionnaires include set of questions that interviewees selected the best choice of defined options.

For planning the questionnaire, through brain storming sessions with experts and university professors, a list of internal and external factors of national innovation system was provided. The questionnaires were distributed among a number of parliament members, university professors, members of entrepreneurship incubators, research and development centers, production companies, engineering and consulting experts, and the public and private sectors and the filled ones were collected.

The next step was to analyze the results using the following procedure: All the answers used in the survey were allocated as follow:

1- Very weak/Threat 2- Weak/Threat 3- Mead 4- Good/Opportunity 5- Very Good/Opportunity
The responses were averaged for each question; the responses were also recorded to indicate the range of the scattering and the validity of each question. Therefore, for each group of internal factors that had earned three or higher average as strong point- and those who had earned on average of less than three points were identified as weak point. In addition, for each class of external factor that had earned three or higher were identified as an opportunity, and those who had earned the average point less than three were identified as threat.

3. National Innovation System in OECD and Developing Countries

The OECD is a unique firm where the governments of the 30 countries work together to address the economic, social and environmental problems of globalization. The organization prepares a setting where countries can compare policy experiences, seek answers to common challenges, identify good practice and work to co-ordinate local and international policies. The Commission of the European Communities contributes in the work of the OECD (OECD, 2008).

3.1 National Innovation System in OECD Countries

In this article, researcher will examine some of the individual OECD innovation policy, such as Norway, Switzerland and Korea, which have received a successful national innovation systems in Europe and Asia:

Norway: In a research study by OECD in Norway, 6 levels in the policy system organizational mapping of the NIS are found (Finn & Sevin, 1997) as follows,

• Organizations, laying down the general policy framework,
• Technology and innovation policy formulation organizations (including funding, coordination, monitoring and evaluation),
• Research and innovation promotion agencies and modulation,
• Innovation, Research & Development companies,
• Organizations that promote the spread of technology,
• Producers of goods and services.

3.2 Switzerland Experience

In this section, the Swiss National policy innovation system are considered, "Switzerland is one of the highest gross domestic product per capita in the OECD" (OECD, 2011a). In this research study, in Switzerland, the strengths, weaknesses, opportunities and threats are distinguished to find solutions for the modification of the national innovation system of the country, such as the formal institutions are state laws and policies and company guidelines or contracts belong to this category. An example of regulations is the responsibility of feeling, to prevent or clean up the waste. Examples are cognitive heuristics or rules of finding a solution to the problems of procedures. They are also associated with the dominant vision and expectations held by the actors (Van Tape, 1993, 1998).

3.2.1 Strengths

S1: Strong industry (large and small firms), good framework conditions,
S2: Many sectors of Swiss industry (and services) are strong in innovation, high level of industrial research,
S3: Very good university sector,
S4: Strong research infrastructure,
S5: Strong academic output (people, publication, etc.),
S6: Strong application-oriented professional education,
S7: High quality approach in all sectors,
S8: Language skills and ability to master intercultural setting.

3.2.2 Weaknesses

W1: Slow economic growth,
W2: Lack of entrepreneurship and of competition in a number of sectors,

W3: Lack of 'demand orientation" in the innovation system,
W4: Some innovation system actors under developed, policy learning difficult,
W5: Innovation issues not strongly represented in the political arena,
W6: Small number of higher education graduates; educational system not preamble enough.

3.2.3 Threats

T1: Decline in innovative performance after extended period of stagnation,
T2: Exposure of SMEs to new international competition,
T3: Public sector deficits plus rising social security costs crowding out fresh money for innovation,
T4: Consensus-based policy making getting to strong in innovation policy,
T5: Competition between national and EU innovation funding.

3.2.4 Opportunities

O1: construction on scientific strengths,
O2: Attractiveness as a workplace for foreign experts,
O3: Clustering within Switzerland and in trans-border co-operations(OECD, 2006).

Based on the concept of the innovation system, a set of actors, issues and SWOT-analysis are included in Table 1 as Swiss innovation policy in OECD countries. (OECD, 2006)

Table1
SWOT Matrix for NIS of Switzerland

Opportunities /Threats	Strengths/Weaknesses	
	$S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8$	$W_1, W_2, W_3, W_4, W_5, W_6$
O1 O2 O3	1.Strategic planning for innovation 2.Greater attention to policy evaluation	1.increased public R&D expenditure 2. Transition to more project-based funding in public research institutions
T1 T2 T3 T4 T5	1.New governance structures for innovation policy 2.Increased attention to science-industry linkages 3.Growing concern about human resources for Science and Technology	----------------

There are some strong positions of features in the innovation system of Switzerland as followed:

1. Strategic planning for innovation,
2. Greater attention to policy evaluation.

That is commented as Federal multi-annual message, linking budgets to priorities no "grand design" beyond and implementing international good practice and there are some relatively weak positions of features in the innovation system of Switzerland as followed:

- Transition to more project-based funding in public research institutions
- Increased public R&D expenditure

3.3 Korean Experience

In a research study by OECD (2009) in Korea, according to the results of a series of interviews with key stakeholders in the innovation system are listed Korean strengths, weaknesses, opportunities and threats analysis were then extracted some strategic recommendations for changes in the national

innovation system Korea. The most important strengths and weaknesses, opportunities and threats, as follows: (OECD, 2009b)

3.3.1 Strengths

- o Strong, mobilizing national vision,
- o High growth rates in GDP,
- o Strong government support for innovation and R&D,
- o Good improving framework conditions for innovation,
- o High ratio gross domestic expenditure on R&D (GERD) to business enterprise expenditure on R&D (BERD),
- o Highly educated workforce,
- o Good supply of human resources for science and technology (HRST),
- o Read only adopters of new technologies,
- o Strong ICT infrastructure,
- o Exceptionally fast followers,
- o Strong and internationally competitive firms,
- o Learning society with a capacity to learn from failures and international good practices,
- o Capability to produce world-class talents.

3.3.2 Weaknesses

- o Underdeveloped fundamental research capabilities and weak research capacities in universities,
- o In education, rote learning, over emphasis upon university entrance exam, and crippling cost of private education,
- o Underutilization of female labor,
- o Low productivity in service sector,
- o Relatively weak SME sector,
- o Legacy of dirigisme which hampers the development of a diffusion-oriented innovation policy,
- o Unbalanced international linkages,
- o Uneven development across regions and sectors
- o Small domestic market (compared to China, Japan, USA),
- o Policy co-ordination problems between ministries.

3.3.3 Opportunities

- o Geographical positioning in one of the most dynamic regions of the world,
- o Free trade agreements,
- o Globalization, including R&D,
- o Growing Korean S&T Diaspora,
- o Developments in S&T (technological change) , particularly information technology, nanotechnology, biotechnology and environmental technology and their possible fusion,
- o Growth of china and other newly industrializing economics, both in the region and worldwide, offering new markets for Korean exports.

3.3.4 Threats

- o Low fertility rates and an aging society,

o   Arrival of strong new competitors in fields in which Korea excels, e.g. ICTs, particularly from China,
o   Geopolitical developments in the region,
o   Disruption in the supply of imported natural resources and energy upon which the Korean economy is highly dependent,
o   Global economic outlook and its consequences for export-oriented economies.

3.3.5   Strategic tasks and guiding principles in Korea

The main strategic objective of the Korean innovation policy is to achieve convergence with the more developed economies in the OECD. It needs to achieve this in the context of declining fertility rates and increased competition from newly industrializing countries, particularly china. Korean innovation policy therefore needs to speed up the transition of the innovation system of catch-up to more creative models, supporting more fundamental research in various areas, increase innovation and opportunities for the development of small and medium-sized enterprises, as well as more closely associated with international sources of knowledge. In addressing these challenges, the policy should follow certain guidelines:

o   International openness,
o   Diversification,
o   Shift from economic development programs toward more public and generic research,
o   Incorporating a long-term perspective when assessing the costs and benefits of public R&D funding,
o   Balancing competition with the development of co-operation and trust,
o   Systematic and evolutionary approach to the promotion of innovation,
o   Comprehensive approach to fostering innovation beyond support for R&D and Hi-tech,
o   Gender mainstreaming (increase female participation rates in science & Technology in order to maintain economic growth.),
o   Participatory governance of S&T.

3.4 The innovation landscape in developing countries

A number of exogenous factors generate systemic innovation landscape in developing countries, such as macroeconomic uncertainty, instability, physical infrastructure (lack of basic services such as electricity or old communication technology); institutional fragility, lack of social awareness about innovation, risk off nature of the businesses, lack of entrepreneurs, the existence of barriers to business start-up, the lack of public policies to support business and management training. (OECD, 2005). Instability in the micro and small business can mean that some of them have good potential to upgrade the national innovation and function called the cradle of the innovators, and some lack of resources and support for any innovation. Macro uncertainty limits any long-term innovation. (OECD, 2005). The economies of developing countries depend largely on informal practice, informal not a favorable environment for innovation. Sometimes great creativity invested in solving the problems in the informal economy does not lead to a systematic application and, therefore, leads to the isolated actions that are neither increase nor the capacity to help establish an innovative way of development. Many businesses in the developing countries work in an unusual and innovative economic environment due to the existence of, and in some cases, the prevalence of state-owned enterprises (China) or mass of parasitic enterprises (some Arab states), where there is no competition sometimes discourage innovation or drains local markets innovative capacity, although the large state-owned enterprises (for example, in sectors such as oil, aerospace and telecommunications) sometimes become technology leaders through important investments in the development of experimental work (as in some countries in Latin America). Moreover, in countries with less

developed economies, the large state-owned S & T policies and programmers may have more impact than innovation and strategies of private enterprises (OECD, 2005).

4 Results

In this section, as SWOT view, the results of National Innovation System of Iran studies are categorized in four following categories:

4.1 Strengths

S1. The role of innovative companies, in the law of supporting the Knowledge –Based companies and inventions has been identified and approved.

S2. According to patent and innovation law, recording of new products and production processes can be done (Parliament of IRI, 2007).

S3. Formulation of innovation policies and planning based on legislation is the task of High Council of Science and Technology.

S4. After 2013, 0.5 % of GDP will be assigned to innovation, research and development fund.

S5. Research studies in the academic centers have a good ability for innovative solutions in industries.

4.2 Weaknesses

W1. High Council of Science and Technology doesn't cover the policy making of two identified functions of innovation i.e. organizational innovation and marketing innovation.

W2. Patent Law doesn't cover two innovation types (organizational innovation and marketing innovation).

W3. There are not official and legal organizations for registration and marketing of research ideas and achievements.

W4. High-speed and secure networks infrastructure and IT applications are not strong.

W5. Data based information network for linking between researchers and applicants is not strong.

4.3 Opportunities

O1. Globalization is a good opportunity.

O2. Approach of women to enter to the universities has increased the potential of laboratories and R&D centers.

O3. Quantity and quality of universities to support research and innovation is an opportunity.

4.4 Threats

T1. Rapid transfer of new technology into the country is under sanction.

T2. Transferring money for developing the innovative technology is suffering from sanctions.

T3. Purchasing the modern and technical equipment are very difficult

By placing the noted strengths, weaknesses, opportunities and threats, strategic recommendations according to the proposed strategic SWOT analysis are suggested as followed (see Table 2).

Table 2
SWOT matrix analysis

Opportunities/Threats	Strengths/Weaknesses	
	S1,S2,S3,S4,S5	W1,W2,W3,W4,W5,
	SO1	WO1
O1	SO2	WO2
O2	SO3	WO3
O3	SO4	WO4
	SO5	WO5
T1	ST1	WT1
T2	ST2	WT2
T3		

4.5 SO (Strengths, Opportunities) Strategies

For improving the strengths and achieving the opportunities against National Innovation System of Iran, the following strategic recommendation are suggested:

SO1. Improving policies and plans for technology-based skills,
SO2. Investing more in the public and private sector for research and development,
SO3. Encouraging and supporting the conversion scientific knowledge to technology and technical expertise to the wealth and enterprising,
SO4. Creating and developing the innovative network of small and medium enterprises in the country,
SO5. Improving and planning to provide scholarships for graduate studies by enterprises.

4.6 WO (Weaknesses, Opportunities) strategies

To minimize the effect of weaknesses and achieving the opportunities against National Innovation System of Iran, the following strategic recommendation are suggested,

WO1. Covering two innovation functions included organizational innovation and marketing innovation for registering and recording in Patent Law,
WO2. Acceptation of high-risk finance in the field of research and development and innovation by innovation and development fund,
WO3. Covering the organizational and marketing innovation for registering and recording by Industrial Property Organization,
WO4. Improving the cooperation between industries and universities through common projects,
WO5. Establishing an institution by taking part of government, university and industry.

4.7 ST (Strengths, Threats) strategies

For improving the strengths and minimize the effects of threats against National Innovation System of Iran, the following strategic recommendation are suggested:

ST1.Optimizing the energy consumption plans in industry and universities,

ST2. Developing of teamwork culture between different groups of scientific, industrial and research teams.

4.8 WT (Weaknesses, Threats) strategies

To minimize the effect of weaknesses and threats against National Innovation System of Iran, the following strategic recommendation are suggested:

WT1. International cooperation and relations to reduce the effects of sanctions in the field of rapid transfer of new technologies and modern technical equipment purchasing.
WT2. Improving the conditions of internal investments for the development of innovation

5. Conclusion and Suggestions

By using the experiences of selected OECD countries and local conditions of specifications of National Innovation System of Iran, the researcher suggests the strategic recommendation in last part and model of NIS included institutional mapping for Iran as followed:
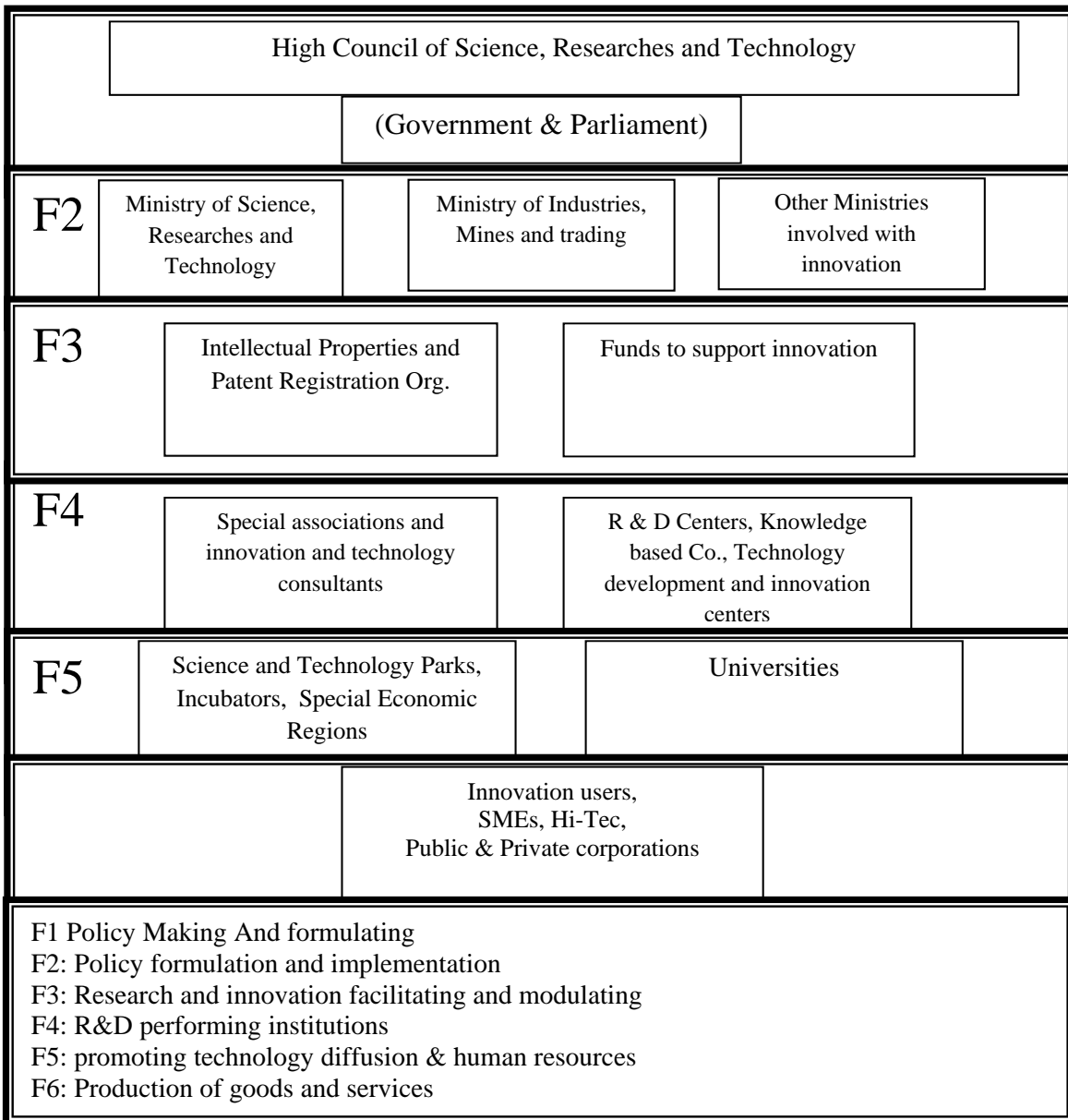
High Council of Science, Researches and Technology
(Government & Parliament)

F2	Ministry of Science, Researches and Technology	Ministry of Industries, Mines and trading	Other Ministries involved with innovation

F3	Intellectual Properties and Patent Registration Org.	Funds to support innovation

F4	Special associations and innovation and technology consultants	R & D Centers, Knowledge based Co., Technology development and innovation centers

F5	Science and Technology Parks, Incubators, Special Economic Regions	Universities

Innovation users, SMEs, Hi-Tec, Public & Private corporations

F1 Policy Making And formulating
F2: Policy formulation and implementation
F3: Research and innovation facilitating and modulating
F4: R&D performing institutions
F5: promoting technology diffusion & human resources
F6: Production of goods and services

Fig.1. Suggested institutional mapping for NIS of Iran

In suggested model:

1. The role of Ministry of Industries, Mines and Trading and Other Ministries involved to innovation for innovation policy formulating are respected.
2. The role of Industrial and Intellectual Properties and Patent Registration Organization for covering the total types of innovation as legal intellectual facilities are respected.
3. The role of Professional associations, innovation & Research & Technology Organizations as Promotion the technological entrepreneurship and developing technology & innovation are respected. In existing conditions**,** above mentioned roles for those organizations and institutions are ignored.

Acknowledgement

LIST OF ABBREVIATIONS
NIS   National innovation system
UNCTAD   United Nations Conference on Trade and Development
SME   Small and medium scale enterprise
OECD   Organization for Economic Cooperation and Development
SWOT   Strengths, weaknesses, opportunities and threats
S&T   Science and Technology

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