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Public Universities Faculty and Leaders' Perspectives on the Role of Public Egyptian Universities in Developing National Innovation System

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Abstract
This paper describes university faculty and leaders' perspectives on the role of Public Egyptian universities in developing national innovation system(NIS), as universities are often cited as a critical institutional actors in national innovation systems, most of the literature on national innovation systems defines them as the institutions and actors that are critical for the creation, development, and diffusion of innovations. This qualitative study is based on interviews with 73 University Faculty and Leaders in Egypt, finds possible advantages for Public Egyptian universities to develop national innovation system, as well as a number of barriers that hinder the Public Egyptian universities to develop national innovation system. The main objective of this paper is to discuss the relevance of innovation systems to economic growth , analyze the Egyptian NIS beginning with a brief introduction of the role of innovation and an examination of the elements that comprise national innovation systems, interaction between various actors involved, and shows how the Public Egyptian universities are important players in developing the National Innovation System. One important theme in this paper is to define the challenges that faces the Public Egyptian universities to substantially support NIS. Three existing Frameworks ("Mode 2 " ,"Triple Helix" and "Entrepreneurial University) to explain the significance of universities linkages to NIS are discussed, and the context of developing innovation systems in Egypt and the government initiatives in that regard will be explored.
Keywords: Innovation ,National Innovation System; Egyptian universities; knowledge Innovation; education reform; Mode 2; Triple Helix.

1.Introduction

As universities are often cited as critical institutional actors in national innovation systems (Nelson, 1993), most of the literature on national innovation systems defines them as the institutions and actors that are critical for the creation, development, and diffusion of innovations. The capacity to innovate is fast becoming the most important determinant of economic growth and a nation's ability to compete in the 21st century global economy. Innovation encompasses not only research and the creation of new ideas, but the development and effective implementation of the technology into competitive products and services.

Many developing countries have recognized the need to adopt a long term economic strategy that shifts some of its focus to developing a more extensive knowledge based economy. The traditional role of universities were education, basic research and science . In the 21st century new functions were taken over: knowledge and technology transfer to industry, commercialization of knowledge, more active role in national and regional innovation systems (NIS and RIS).

A survey in the "Economist" suggested the concept of the knowledge based economy serves to "portray the university not just as a creator of knowledge, a trainer of young minds, and a transmitter of culture, but also as a major agent of economic growth: the knowledge factory, as it were, at the center of the knowledge economy" (David, 1997, 4). From this perspective, universities are expected to support the emergence of dynamic industrial clusters and, thus, act as crucial contributors to economic development.

Universities are widely recognized as a key driver in developing and sustaining an innovation economy (Aubert & Reiffers, 2003; Etzkowitz & Dzisah, 2008; Razak & Saad, 2007; Villasana , 2011), but for the Egyptian universities, developing a research environment sufficient to support an innovation economy represents a significant shift in their operations. Thus far, universities have contributed to the Egyptian economic development through the production of a skilled and educated workforce. However, the development of an innovation economy requires universities to go beyond training workers to incorporating knowledge generation as a core activity (Villasana, 2011).

An innovation economy entails the generation of new ideas and technology and the mechanisms to move them to the market (Datta & Saad, 2011), Such a process requires a robust network of people, firms, universities, and government organizations to share knowledge and generate new ideas that are relevant to local realities and cognizant of international contexts (Razak & Saad, 2007; Villasana, 2011). Etzkowitz and Dzisah (2008) describe the central role that universities play in promoting networks that circulate individuals among academia, government, and industry. Flexible institutional boundaries provide the means for individuals to circulate across

sectors, promoting an exchange of perspectives and fostering new ideas (Etzkowitz & Dzisah, 2008; Villasana, 2011). The growth of new ideas and innovation is particularly important for Egypt, as locally-generated knowledge can facilitate the country's continuing development.

2. Significance of the study

1. The results of this study will make known what should be done to NIS in Egypt for more efficiency and effectiveness to reach sustainable impacts on innovation and competitiveness.
2. NIS appears to be very complex and influenced by many determinants. Thus, it is very difficult for policy makers to decide where or how to start. Policy makers, especially in emerging and developing countries, usually are looking for well structured descriptions of a NIS and clear recommendations about how to improve the functionality of a NIS through universities as critical actors .

3. Scope and Objectives of the Study

The main objective of this study is to identify public universities faculty and leaders' perspectives on the role of Public Egyptian universities in developing national innovation system.
The study focused on the following : -

1. Get a better understanding of the NIS.
2. Identify "Mode 2," and "Triple Helix" as approaches for conceptualizing the role of universities within the NIS .
3. Analyze the context of developing national innovation system in Egypt.
4. Identify challenges that face Public Egyptian universities in developing the NIS .
5. Give recommendations as foundation for decision-making in terms of possible interventions to support the role of Public Egyptian universities in developing national innovation system .

4. Problem of the Study

The problem will be clarified through answering the following questions:-

1. What is national innovation system ?
2. What are the approaches that focus on the role of universities in national innovation systems ?
3. What are the international trends of cooperation between university, industry, government (UIG) ?
4. What is the context of developing national innovation system in Egypt?
5. What are the challenges that faces the public Egyptian universities to substantially support the NIS?
6. How could public Egyptian universities improve to better serve the national innovation system?

5.Methodo1ogy

5.1 The overall approach has been applied in this study can be divided in the following steps:

A. Analysis of literature on NIS.
B. Conducting in-depth interviews with public universities faculty and leaders .
C. Deducting recommendation how to improve the role of Public Egyptian universities in developing NIS.

5.2 Types of Data Required

The research design begins with the types of data needed to answer the research questions. This study is designed with the objective of yielding appropriate and sufficient data that would allow to answer the research questions mentioned above. The study demands general yet precise descriptive data and perspectives on the role of Public Egyptian universities in developing national innovation system. The data required can be obtained through qualitative method, in-depth interviews, is adopted to further investigate related issues, experiences and opinions on the relationship and to generate recommendations to improve the role of Public Egyptian universities in developing NIS.

5.3 The Source of Data

A. Secondary data: obtained through related references , and Faculty of Education and Ain Shams University documents (strategic plans, faculties programs , facilities, human resources, labs, ...etc.)

B. Primary data: collected through in-depth interviews. The views presented in this paper are based on 73 interviews conducted between January and April 2013. Interviewees include leaders and faculty members from 6 public universities.

5.4 Population and the sample

A. **Population of the study**

Faculty and Leaders of public universities.

B. The sample and sampling techniques

The sample for this study is obtained through a purposive sampling technique as follows:

All participants came from public universities: Ain Shams University, Cairo University, Helwan University, Minia University, Mansoura University and Suez University, the participants were university leaders and faculty members from the faculties of Science, Agriculture, Engineering , Medicine and Education. The participants were selected from a variety of ages and positions. The method of choosing the participants was to select them by purposive sampling from each university.

6. Theoretical Background and Contexts

6.1 Innovation

The idea that innovation matters for economic development is present in the work of the classical economists. Innovation plays an important role in the introduction to Adam Smith's classical work on the Wealth of Nations. Innovation can be defined at different levels and from different perspectives. It is closely related to knowledge: "new combinations" give rise to new knowledge. Innovation may be defined as new solutions adding value to both customers and firms. It can be distinguished between incremental innovation (e. g. further development of existing products and technologies, often realized by SMEs without involving any R&D institutions) and radical innovation (completely new solutions, technologies or products not yet available on the market, usually involving R&D institutions) (Kergel ; Müller ; Nerger, 2010).

6.2 Concept of National Innovation System

The term national innovation system has been around for more than 20 years and today it has become widely spread among policy makers as well as scholars all over the world. The most common definitions of innovation system refer to national, regional, sectorial , and technological innovation systems. In addition, recently there has emerged literature on other innovation systems, particularly at the firm level. As suggested by their names, national and regional innovation systems refer to innovative activities within national and regional boundaries, respectively. Sectorial innovation systems refer to individual sectors or industries, while technological innovation systems are defined by a particular technology or set of technologies rather than by a geographic region or industry. Although there is no harmonized definition, these both options try to better explain what is meant by a NIS

" .. the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman, 1995).

" .. the elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge ... and are either located within or rooted inside the borders of a nation state"(Lundvall, 1992).

Innovation systems consist of complex functions and interactions among various organizational actors, including government, enterprises, universities and research institutes, as well as institutions in the forms of governmental policies and social norms . The most important determinants of innovation are industry R&D, university research, highly skilled labor, and network and firm characteristics. (Edquist, 1997; Kumaresan & Miyazaki, 1999; Lundvall, 1992; Nelson, 1993; OECD 1999) . In the fields of innovation system, research policy, and higher education research, the Triple Helix model has been commonly used as a normative framework for understanding interactions between key actors in innovation systems. It has also become a common strategy of many governments in developing national and regional innovation systems. The key determinants for innovative activity are the introduction of broad measures to improve performance in areas like R&D, education, entrepreneurial activity and knowledge flows .

When the first edition of Lundvall (1992) and of Nelson (1993), the concept 'national innovation system' was known only by a handful of scholars and policy makers . Over a period of 15 years there has been a rapid and wide diffusion of the concept .The term "national innovation system" was coined by Christopher Freeman . A review of the literature on national innovation system shows that there is no one definition of a national innovation system, most definitions reflect the web of interactions within the system involving the flow of technology and information among society, firms, universities and government institutes. More concretely, a national innovation system includes the public agencies that support and/or perform R&D; universities which may perform research and play an important role in the training of scientists and engineers; the firms within an economy that invest in R&D and in the application of new technologies; any public programs intended to support technology adoption; and the array of laws and regulations that define intellectual property rights.

There is no formal common organizational framework for a NIS, neither in the Middle East nor elsewhere in the world. The main elements of a NIS in terms of education and research institutes, firms, industrial parks, incubators, governmental institution, etc. exists, but differs in terms of how they are coordinated or meshed. The key players in a national innovation concept typically include:

- Governmental and public authorities
- Firms
- Educational entities
- Research institutions
- Intermediaries
- Banks and financial institutions
- Other enablers.

Innovations typically are the result of a complex set of relationships among actors in the Innovation System, which includes all actors mentioned above. The innovative performance of a country depends to a large extent on how these actors relate to each other as elements of a collective system of knowledge creation and in what extend they utilize technologies.

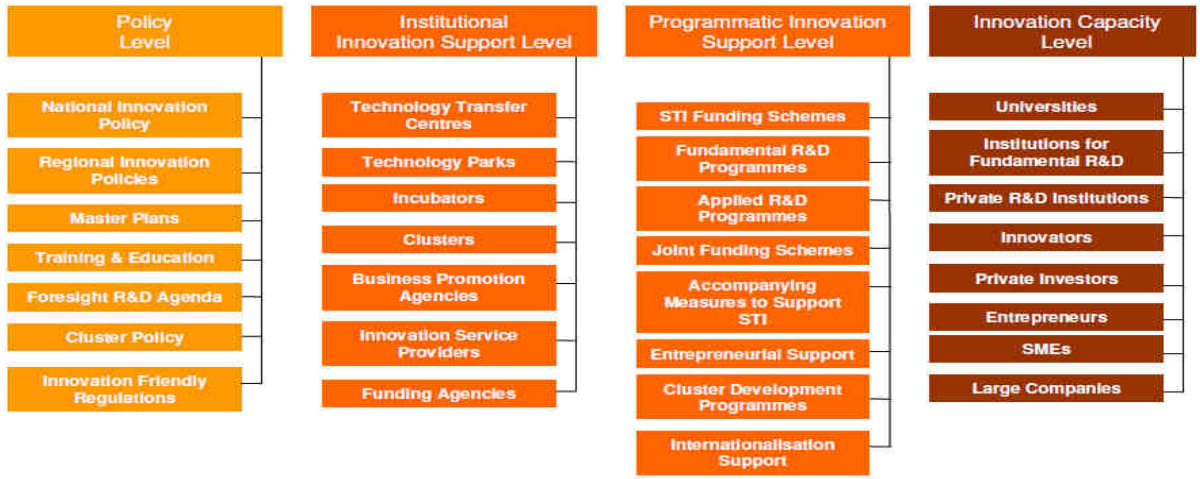
In short the NIS is a network between the state with its provided frame conditions, the technology-related and R&D institutions, the education system and the industry level. For policy-makers, a better understanding of their own NIS can help to identify leverage points for enhancing innovative performance and overall competitiveness of a nation.

National innovation is mainly influenced by 30 determinants that may be grouped according to a three level hierarchy:

- Macro Level: Innovation Policy Level
- Meso Level: Institutional Innovation Support Level
- Meso Level: Programmatic Innovation Support Level
- Micro Level: Innovation Capacity Level

The 30 determinants' level classification is shown in figure 1.

Figure 1: Main determinants of a national innovation system



Source: Kergel ; Müller; Nerger 2010 .

University-industry interactions are discussed within the theoretical framework of NIS. The innovative performance of a country depends to a large extent on how these various actors relate to each other as elements of a collective system of knowledge creation and with respect to the technologies they use. These relationships often take the form of joint research, personnel exchanges, cross-patenting, purchase of equipment and a variety of other channels. In the NIS-related literature, one of the roles of universities and research institutes is to channel their knowledge toward firms; also universities follow the process of diffusing knowledge by producing qualified students and interacting with firms through cooperative programs (Eom and Lee, 2010).

1.3 Frameworks Focusing on the Role of Universities in Developing NIS

With the move to a knowledge economy, universities are now part of the whole value generating chain of the economy. The time has now come to strengthen the role of the universities as engines of innovation and entrepreneurship. The research university plays an important role as a source of fundamental knowledge, and mediator for local knowledge circulation, source of highly qualified labor, knowledge provider in university-industry linkages, incubator for academic spin-off companies and, occasionally, industrially relevant technology in modern knowledge-based economies. In recognition of this fact, governments throughout the industrialized world have launched numerous initiatives since the 1970s to link universities to industrial innovation more closely. Both Mode 2 knowledge production (Gibbons et al., 1994) and the Triple Helix approach focus on

science and the role of universities in innovation.

6.3.1 "Mode 2," Framework

Mode 2 is a conceptual framework that has been applied recently to descriptions of the role of academic research in "post-modern" industrial societies. The "Mode 2" concept of research, identified by Michael Gibbons and colleagues (Gibbons et al., 1994) is associated with a more interdisciplinary, pluralistic, "networked" innovation system (Mowery and Sampat, 2004). It is contrasted with the traditional "Mode 1" production of knowledge that is generated by scientists of a particular field, while Mode 2 is characterized as the production of knowledge for multidisciplinary application (i.e. bioengineering) (Huff, 2000, 288). The "Mode 2" framework is consistent with characteristics of modern innovation systems, notably the increased inter-institutional collaboration that has been remarked upon by numerous scholars.

6.3.2 "Triple Helix" and "Entrepreneurial University" Frameworks

In every country, the key point for national development is the existence of close and redoubtable relations among the university, industry and government, which are the most effective institutions. The rise of the Triple Helix framework is along with the rise of the knowledge-based economy and innovation system, in which economic growth is based on continuous innovation and advancement in science and technology. One fundamental statement in the Triple Helix thesis is that the Triple Helix relations between academia-industry-government (UIG) relations are indispensable conditions for fostering innovation (Etzkowitz & Leydesdorff, 2000; Leydesdorff & Etzkowitz, 1998). Particularly, university has transformed from a secondary to primary institution for economic growth in the modern society (Etzkowitz, 2008, 41).

The Triple Helix thesis states that the university can play an enhanced role in innovation in increasingly knowledge-based societies . The triple helix emphasizes the existence of a spiral pattern of relations and links the three institutional actors of industry, university and government, among which university tends to have a critical part in the context of a knowledge-based economy (Antonelli, 2008). Etzkowitz and coauthors (Etzkowitz et al., 1998) further assert that In addition to linkages among institutional spheres, each sphere takes the role of the other.

Etzkowitz et al. (1998, cited in Mowery and Sampat 2004, 6) further asserts that:

> "In addition to linkages among institutional spheres, each sphere takes the role of the other. Thus, universities assume entrepreneurial tasks such as marketing knowledge and creating companies even as firms take on an academic dimension, sharing knowledge among each other and training at ever-higher skill levels. "

The Triple Helix denotes the university-industry-government relationship as one of relative equal, interdependent, institutional sphere which overlap and take the role of one another. Bilateral relations between government and university, academia and industry and government and industry have expanded in to triadic relationships among the spheres (Etzkowitz, 2002). Nowadays one observes an increasing interest in the entrepreneurial behavior of universities. In this contribution the role of entrepreneurial universities within national innovation systems is situated. Specific attention is being paid to the alleged presence of unintended side effects on the level of scientific activities, and the role of legislative framework conditions that might foster a more active role of universities in terms of technology development.

Entrepreneurial university, introduced by (Etzkowitz et al., 2000) , encompasses the third mission of economic development in addition to research and teaching and emerges as a key component of the NIS (Eom and Lee, 2010). The role of the university is increasingly controversial, especially as entrepreneurial formats emerge in academic venues of such 'public' and ivory tower' universities, and academic institutions with a traditional practical bent such as polytechnics, engineering, and agricultural schools.

Topics discussed include organizational formats such as technology transfer offices, canters, research groups, incubators; technology parks; cooperative research schemes; patenting and intellectual property issues; the university's regional role; changing academic norms and values; faculty and student roles in firm formation; conflict of interest and obligation issues; entrepreneurial education; co-production of research or external influence on direction of research; the privatization of the university; academicization of firm; and the development of new universities as an overlay on science parks (Etzkowitz and Zhou, 2006).

The "national innovation systems," "Mode 2," and "Triple Helix" frameworks for conceptualizing the role of universities within the innovation processes of knowledge-based economies emphasize the importance of strong linkages between universities and other institutional actors in economies. Both "Mode 2" and the "Triple Helix" argue that interactions between universities and industry, in particular, have increased in both practice and demand. According to the "Triple Helix" framework, increased interactions are associated with transformation within the internal culture and norms of universities (Mowery and Sampat 2004; Lundvall 1988 and 1992; Nelson 1993; Edqvist 1997; Gibbons et al. 1994; Nowotny et al. 2001; Etzkowitz and Leydesdorff 1997, 2000).

6.4 International Trends of Cooperation Between UIG

From the literature, the situation of university, industry, government UIG linkages differs between developed and developing countries. While there are few studies of UIG linkages in developing countries, its related practices have been studied in developed countries for a long time. The studies show that different nations' histories and environments vary the types and effectiveness of these linkages. For example, the cooperation between UIG in Japan started gradually during the 1990's by having seen successful examples of cooperation between industry and university in the U.S. Since Japan is a manufacturing country, it needs a system for transforming knowledge into technology so that it can penetrate deep into industry. Joint research between universities and companies, therefore, is aimed at developing manufacturing technology or producing prototypes. However, in the U.S., the most successful examples of cooperation in the U.S. have been related to biotechnology and IT where the knowledge of universities is of interest to industry as a technology that can be applied in business ventures (Monaiyapong , 2004).

The major system in the U.S. requires research labs but does not need a broad manufacturing base. Cooperative research centers and research park are also a form of UI linkages that become quite popular since the initiative of the NSF (Stankiewicz, 1985; Michael I. and Goldstein, 1991; Enriquez, 2003). In both countries, the government role is merely to support the system and create a good environment for technological activities (Hane, 1999; Odagiri, 1999).

6.5 The Context of Developing Innovation Systems in Egypt

Egypt is a young country with a developing higher education system. The country's first university was founded in 1976, but there has been rapid growth over the past four decades and today the higher education system has grown to over 100 universities, including public, private, and foreign institutions (CBERT, 2011; Commission for Academic Accreditation, 2011). Through most of its history, the focus of higher education development has been on increasing the availability and quality of education offered to students. This has been done by establishing universities to increase the number of seats available to Egyptian and expatriate students, and by bringing in foreign-trained personnel to create universities that emulate Western models of higher education. This development strategy has created a higher education system that is predominantly focused on teaching rather than on research and knowledge production.

Egypt is a diversified middle-income economy and one of the most leading industrial countries in Africa and in MENA region, with GDP real growth rate of 1.8% (2013 est.) as an estimate of 2013 in comparison with 4.7% in 2009 according to CIA World Fact book. The GDP composition by sectors if as follows; Agriculture 14.5%, Industry 37.5%, and Services 48% (2013 estimate) with 27.69 million work force where the unemployment rate remains at 13.4%. The distribution of labor force across the sector is as follows: Agriculture 29%, Industry 24% and Services 47%. The major industries are Textiles, Food Processing, Tourism, Chemicals, Pharmaceuticals, Hydrocarbons, Construction, Cement, Metals and Light Manufactures with Industrial Production Growth Rate of 5.1%.

Egypt's science, technology and innovation (STI) system is highly centralized and dominated by the public sector, with R&D happening mostly in state-run universities and research centers supervised by the Ministry of Higher Education and Ministry of Scientific Research. R&D indicators state that Egypt ranking is 40th worldwide for the published articles (around 10,000 papers in 2011), while the numbers of issued patents (350 local and 50 international in 2011) is still far beyond expected. Over the last few years, it was repeatedly mentioned in Egypt's national competitiveness reports that Egypt performs poorly in terms of global competitiveness rank as per the World Economic Forum in pillars such as macroeconomic stability and those related to human capital development, including education, innovation and labor.

6.3 .1 Egypt's Higher Education ,Training, and Innovation Indicators

Higher Education Landscape

The youth is Egypt's greatest asset. The number of students enrolled in basic education (prior to university education) is 17.7 million, in addition 2.5 million who are enrolled in higher education. Yet, Egypt's rank in higher education and training has been deteriorating over time. Both quantity and quality of higher education have been worsening over time. Egypt's rank in terms of higher education quality declined from 80th out of 114 countries in 2005/06 to 128 out of 139 in 2010/11, whereas the quantity of education declined from 57th out of 114 in 2005/06 to
141 out of 144 countries in 2014/15, as a result of the reduction in enrollment rates for both secondary and tertiary education. Secondary enrollment rate raised from 85.3 percent in 2005/06 to 86.3 percent in 2014/15. As for tertiary enrollment rate it raised by 2.3 percentage point to 30.3 percent in 2014/15 as compared to 2005/06.

The higher education system in Egypt is made up of 23 public and 19 private universities in addition to 18 public and 81 private higher institutes of education. The country also boasts one of the oldest continuously running universities in the world: Al-Azhar University, founded in the late 10th century. The number of

universities has increased since the revolution.

"One of my main priorities," said Dr Ashraf Hatem, secretary general of the Supreme Council of Universities, "is providing access to higher education. We're in the phase of access rather than the phase of quality at this stage." Hatem, who is a former minister of health, explained that only about 25%-28% of high school graduates in Egypt go on to get a higher education. "What government is trying to do now is to focus on making sure we have enough universities and to decongest the ones we already have," Hatem told *University World News*. About 2.5 million students were enrolled in higher education institutions in 2012-13. This number is expected to rise to 2.8 million in 2013-14. Since the revolution, seven new public universities have been founded, largely by turning already existing university branches into fully fledged universities. These new universities are located in governorates other than the densely populated Cairo, Giza and Alexandria and thus provide more opportunities for students based in other parts of the country to have access to a higher education within or near to their home towns.

6.3 .2 Public Funding on the Rise

Public funding of education in Egypt – at primary, secondary and tertiary levels – is also on the rise. According to the Ministry of Finance's 2012-13 published financial statement, just under EGP50 billion (US$7.2 billion) was spent on education in the 2011-12 fiscal year. This rose to EGP66.6 billion in 2012-13 and there are plans to increase funding to EGP82.5 billion in 2013-14, a hike of 23.9% from this year. "This sector represents 11.9% of the total government expenditure, which is EGP692.4 billion, as well as is the equivalent of 4% of the GDP," the financial statement reads. This is indeed an increase in public expenditure on education, which according to the 2013 Human Development Report, was 3.8% of Egypt's gross domestic product (GDP) in the period 2005-10. It is still quite low. Public spending on higher education has remained at an average of 28% of total public expenditures on education over the past few years, according to World Bank data.

Moreover, the poor quality of higher education is reflected in the ranking of national universities in the top world 500 universities for instance. Egypt has only 1 university in the last fifty of the top 500 universities, namely Cairo University, Egypt's National Innovation System . All those indicators reflect the need to improve the efficiency of expenditure and the need to raise the quality of higher education institutions. Egypt has always produced brilliant science graduates, but today they are in a small minority. With universities complaining that they have to retrain new students to "think like scientists" and businesses critical of graduates' ability to apply knowledge appropriately, calls for a complete overhaul of school curricula and of teaching methods seem justified. School reforms have been under way for five years, but with 55% of the population under 25, turning the system around remains one of the most important challenges.

6.3 .3 Current State of Egyptian Innovation

The World Economic Forum's Global Competitiveness Report 2014-2015 ranks Egypt 135 position out of 144 countries on the quality of its scientific research institutions , and 132 on its capacity for innovation(The Global Competitiveness Report 2014-2015) . The deterioration in Egypt's overall rank is attributed to a decline in Egypt's rank in capacity for innovation, quality of scientific research institutions, company spending on R&D, university-industry collaboration in R&D, and government procurement of advanced technology products.

Various measures of innovation are assembled in Table (1) below, showing Egypt's relative position to comparator countries, and indicating that there is room for improvement. With the exception of availability of scientists and engineers where Egypt has a competitive advantage, and University-Industry collaboration, where Egypt is better than Jordan, Egypt is the worst performer in all other indicators. Although some efforts are made in R&D and innovation, Egypt's position is falling behind other countries. Hence, is the need to adopt an educational curriculum that promotes creativity, innovation, and leadership skills at both school and university levels and the need to increase the university-industry R&D collaboration.

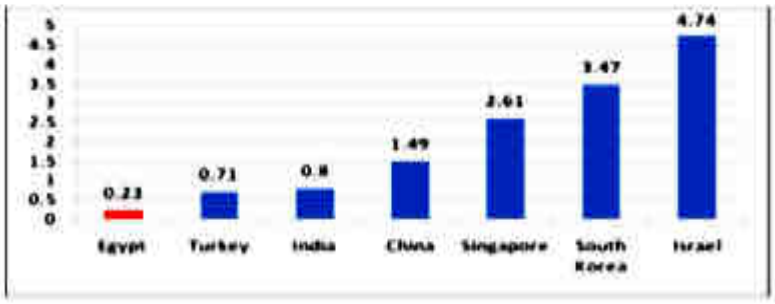
Table 1: Egypt's rank on a range of innovation measures.

	Overall rank out of 139 countries	Capacity for Innovation	Quality of Scientific Research Institutions	Company Spending on R& D	University –Industry Collaboration in R& D	Government Procurement of Advanced Technology Products	Availability of Scientists and Engineers	Utility Patents per Million Population
Brazil	42	29	42	29	34	50	68	61
Turkey	67	55	89	62	82	62	44	70
Jordan	68	96	98	116	99	57	26	76
China	26	21	39	22	25	12	35	51
Tunisia	31	36	38	35	41	14	7	76
Egypt	**83**	**109**	**110**	**74**	**120**	**86**	**25**	**84**
India	39	33	30	37	58	76	15	59
South Korea	12	18	25	12	23	39	23	5
Singapore	9	17	11	8	6	2	10	11

Source: WEF, 2010.

Egypt's expenditure on R&D is very low, compared to countries like China which has committed 2.5 percent of GDP to R&D by 20309. In order to overcome this loss of relative position, Egypt will need to catch up, move fast and make innovation one of the key national priorities supported by higher spending on R&D. Figure (13) compares Egypt versus other countries in terms of country spending on R&D, as a percentage of GDP.

Figure 3: Spending on R&D as % of GDP



Source: World Bank Indicators, 2007.

Key inhibitors to greater innovation include: limited financial resources and R&D expenditure; lack of education that encourages innovation; weak university-industry linkages, low private sector contribution to scientific research and low rates of technology transfer. For Egypt to achieve greater competitiveness there is a need to adopt a national strategy that would increase the youth capacity to innovate and commercialize new goods and services (Malak,2011). Egypt needs to have a national science, technology and innovation strategy. The adoption of a National Innovation System (NIS) should also be considered.

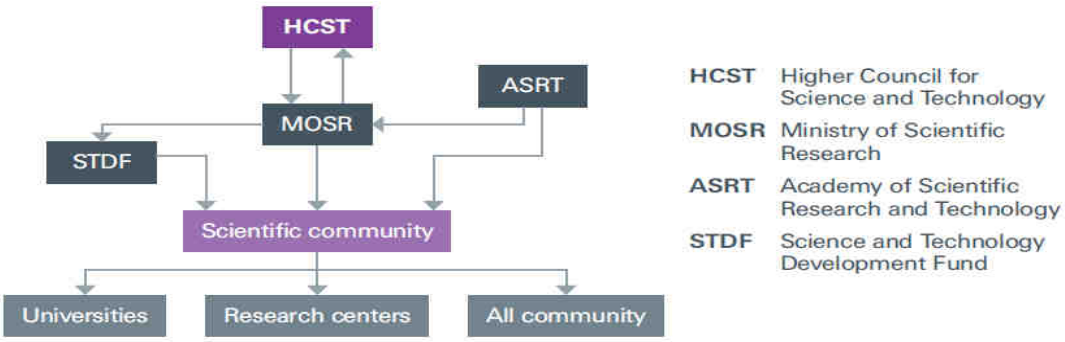
According to the most commonly used measure of scientific performance – the number of papers published in scientific journals – early indications are positive. Egypt's output rose from 4,922 publications in 2006 to 10,295 in 2011 (according to the SciMAGO SCOPUS database of country rankings), with notable improvements in agricultural sciences, engineering, computer science, medicine and biochemistry, genetics and molecular biology 13. Over the same period its global share of publications rose from 0.27% to 0.44%, and its regional share from 8.14% to 9.17%.

6.3 .4 Science, technology and innovation (STI) system in Egypt

Over the past four decades, Egypt's Academy of Scientific Research and Technology (ASRT) has been largely responsible for shaping the country's science and innovation system. Egypt's STI system is highly centralized and dominated by the public sector, with R&D happening mostly in state-run universities and research centers supervised by the Ministry of Higher Education and Ministry of Scientific Research (which recently promoted from a state ministry to a ministry with full portfolio). The MOSR, in collaboration with Academy of Scientific Research and Technology (ASRT), is responsible for the national research policy and the research strategy at the country's public universities and research institutes. Egypt's research centers, which used to be scattered across different ministries, are currently being reorganized under the umbrella of the MOSR's Supreme Council of

Scientific Research Centers and Institutes, which should ensure their activities are more harmonized.

Figure 4: Current Structure of STI System in Egypt after Restructuring

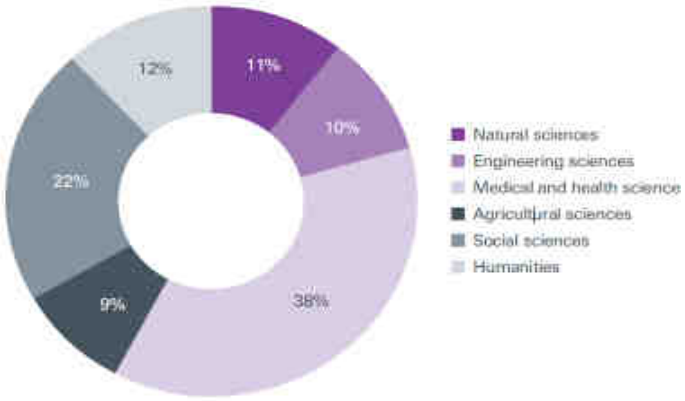


Source: Ministry of Higher Education and Scientific Research

6.3 .5 Egypt's Key Strengths in Research and Innovation

In Egypt's research output as a proportion of the world's, field by field, its most significant contributions in the 2005-2009 period were in pharmacology (0.71%) and the physical sciences (materials science 0.66%, chemistry 0.64%, engineering 0.57%, and physics 0.4%), which largely reflects the way its researchers are distributed across the disciplines (see Figure 5). It is also worth noting that in mathematics it exceeds the world average in citation impact.

Figure 5: Researchers in Egyptian governmental universities according to specialization 2009,10 .

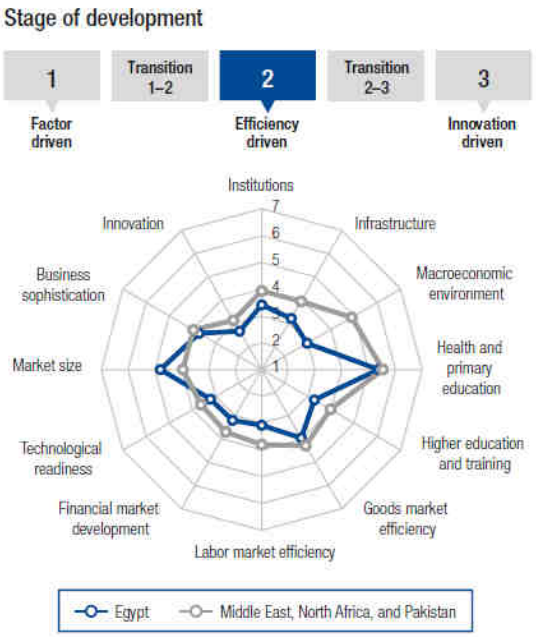


Source: ASRT 2011

Figure 6: How competitive is Egypt?

Global Competitiveness Index

	Rank (out of 144)	Score (1–7)
GCI 2014–2015	**119**	**3.6**
GCI 2013–2014 (out of 148)	118	3.6
GCI 2012–2013 (out of 144)	107	3.7
GCI 2011–2012 (out of 142)	94	3.9
Basic requirements (40.0%)	**121**	**3.7**
Institutions	100	3.4
Infrastructure	100	3.2
Macroeconomic environment	141	3.0
Health and primary education	97	5.4
Efficiency enhancers (50.0%)	**106**	**3.6**
Higher education and training	111	3.3
Goods market efficiency	118	4.0
Labor market efficiency	140	3.1
Financial market development	125	3.2
Technological readiness	95	3.2
Market size	29	4.8
Innovation and sophistication factors (10.0%)	**113**	**3.2**
Business sophistication	95	3.7
Innovation	124	2.7



Source: World Economic Forum (2014) , p. 172.

6.3 .6 Academia and industry

The lack of entrepreneurial incentive among academics and the indifference to R&D shown by industrialists appear to share a common foundation: a lack of understanding between academia and industry that makes it almost impossible for them to serve each other's needs. The World Economic Forum (WEF)'s latest Global Competitiveness Report ranks Egypt 133 out of 144 countries on the extent to which universities and industry collaborate on R&D (The Global Competitiveness Report 2014-2015).

6.3 .7 Government Initiatives to Build Innovation in Industry

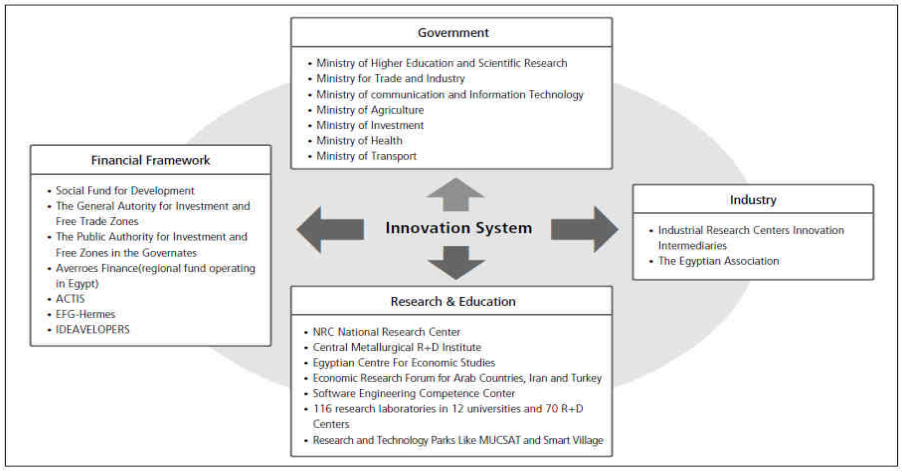
There are several government-backed schemes in place to promote industry-academia interactions and to boost Egypt's innovation culture. Foremost among these is the RDI programs , backed by EUR 31 million from the EU between 2007 and 2015 (the second phase, worth EUR 20 million, began in 2011). The RDI programs is designed to strengthen the links between the research sector and industry and – through its main component, the EU-Egypt Innovation Fund (EEIF) – support research that is useful to industry (RDI programs).

The Egyptian government took various measures to set up the main elements of a relatively comprehensive national innovation system to stimulate industrial modernization, SME development and entrepreneurship, investment, venture capital and business incubators. In the period 1985–2005, various long-term innovation policies were instituted by the Egyptian authorities and diverse government-controlled innovation programs carried out, funded mainly by third country donors (Hahn, P., and zu Köcker, G. M. , 2008) .

6.3 .8 Egyptian Innovation and Technology Transfer Centers

The Egyptian authorities have an increased awareness of the need for further steps to address the systemic nature of innovation and to harness resources residing in different ministries in a coherent way(Hahn, P., and zu Köcker, G. M. , 2008). A schematic diagram of the main actors of the Egyptian Innovation System is shown in Figure 2.

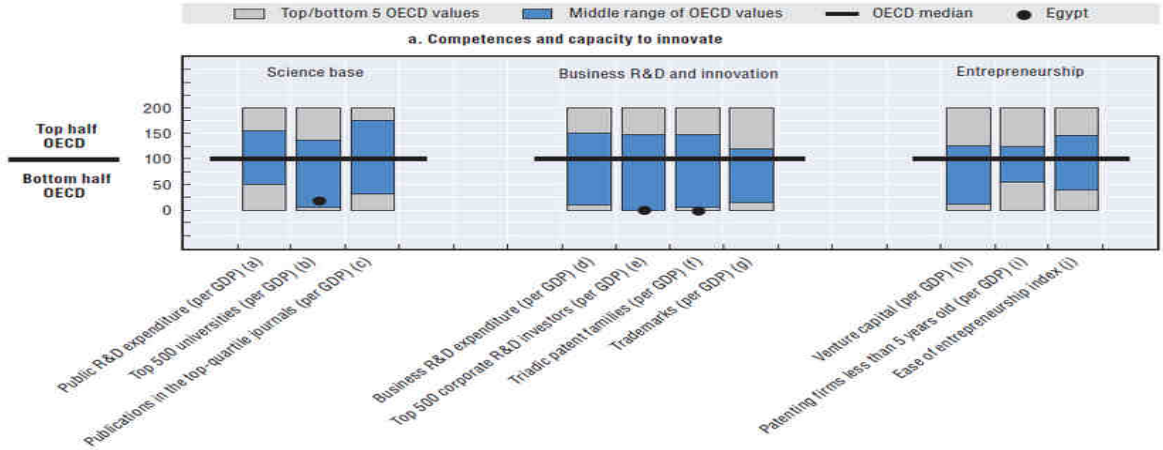
Figure 7: The main players in the Egyptian Innovation System (besides of industrial actors)



Source: Abdel-Fattah,et al. 2013, 100 .

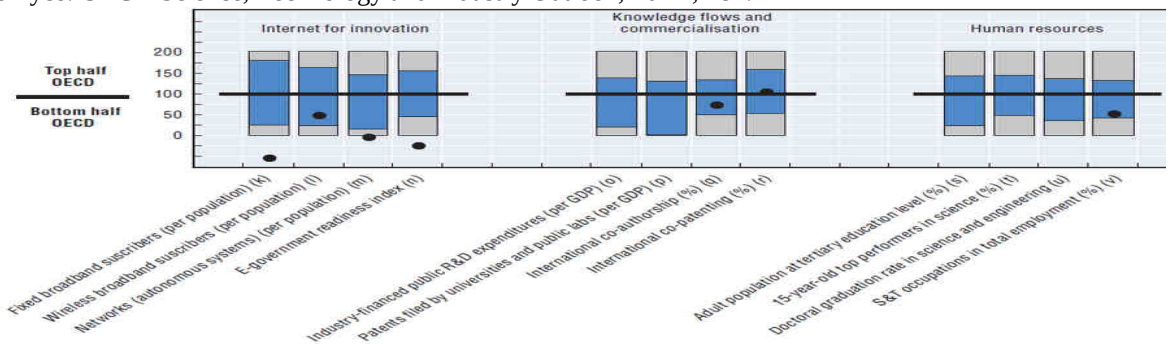
Recent economic reforms have permitted growing inflows of FDI and strengthened the presence of multinationals. The ICT sector has particularly benefited from liberalization. In 2010 revenues from telecommunications services accounted for 3.7% of GDP, on par with Japan and well ahead of the United States. The country's R&D capabilities and infrastructures are poorly developed. Firms' contribution to R&D is negligible (and no reliable data are available). The relative number of patents is very low (Panel 1(f)). Firms tend to innovate by adapting imported technologies and absorbing foreign knowledge through international collaboration.

Panel 1: Comparative performance of national science and innovation systems, 2011.



b. Interactions and human resources for innovation

Smyce: OECD Science, Technology and Industry Outlook, 2012 , 281.



Source: OECD Technology and Industry Outlook ,2012 , 281.

Human resources in S&T are poorly developed: only 22% of persons in employment were in S&T jobs in

2007 (1(v)) and the researcher population is small and shrinking (from 49 000 to 36 000 FTE between 2007 and 2009).

6.3 .9 Recent Changes in STI Expenditures

Egypt's GERD was a low 0.21% of GDP in 2009. After having increased in parallel to GDP from 2005, R&D expenditures decreased sharply in 2009 and GERD intensity felt below its 2005 level (0.24%). The global crisis and the Arab Spring events, which spread to Egypt from January 2011, have had profound political and economic consequences. However, the government has reinforced its commitment to S&T, increased the research budget significantly, and sets a target for GERD of 1% of GDP (OECD 2012, 280).

6.3 .10 Overall STI Strategy

Following an overall evaluation of the national S&T system (2006), Egypt launched the Decade for Science and Technology 2007-16 in order to foster co-operation with developed economies and to strengthen national S&T capabilities. The Developing Scientific Research Plan 2007-16 was introduced to restructure S&T governance, to improve national S&T capabilities (investments and human resources), to develop a complete value chain from research to commercialization, and to disseminate S&T culture across society. The Plan adopted a sector- and technology-oriented approach. In February 2012, a new strategy was announced, primarily to foster the commercialization of research.

Science Base

The bulk of research activities are carried out within universities, most of which have been established recently. Over-regulated and heavily centralized governance, as well as the lack of a clearly defined strategy, remain major obstacles to the formation of an efficient public research system. In addition few researchers in universities and PRIs are young, and many are absorbed by teaching assignments and heavy administrative duties to the detriment of research activities.

Business R&D and Innovation

The contribution of the business sector to R&D and innovation is essentially insignificant. There is now greater policy emphasis on the involvement of the private sector and the commercialization of research outcomes geared towards economic and social needs.

Knowledge Flows and Commercialization

Promotion of academia-industry collaboration has been the main policy instrument for increasing the business sector's contribution to R&D a nd innovation. Many STDF programs and grant schemes under the Research, Development and Innovation (RDI) Programs encmyage proposals by consortia of companies, universities and PRIs. Various infrastructures have been established to support public-private partnerships, such as the Zewail City of Science and Technology, inaugurated in 2011, which encompasses a university, research centers and a technology park. The Faculty for Every Factory Program also aims to accelerate knowledge flows between academia and industry by supporting the hiring of researchers by companies.

Human Resources

The government's efforts have focused on improving the quality of the education system. A National Strategic Plan for Pre-University Education Reform (2007/08-2011/12) was introduced to develop a system that would be more responsive to the requirements of a knowledge-based economy. The Higher Education Reform Strategy (2002-17) aims to improve the quality and efficiency of the higher education system, notably through the Higher Education Enhancement Programs Fund and the development of more efficient higher education funding mechanisms and the establishment of a National Quality Assurance and Accreditation Agency. Egypt needs (Malak,2011) to improve the quality and efficiency of the educational system; to invest heavily in the creation of employment, especially for the youth, and to invest in improving innovation capacity towards higher output growth and welfare.

7. Results and Findings

This part presents the analysis of secondary data and the in-depth interviews findings concerning public universities faculty and leaders' perspectives on the role of Public Egyptian universities in developing national innovation system.

7.1 Egypt's Higher Education Regulations Must be Changed

Respondents indicate that Egypt's higher education regulations must be changed, since they make it very hard for academics to move between universities. A researcher is more than likely to retire from the same faculty at

the same university from which he graduated. The imperative for higher education reform the Egyptian higher system is not serving the country's current needs well, and without far-reaching reform it will hold back Egypt's economic and social progress. The Government of Egypt already has embarked on a range of reform initiatives to improve higher education operations. The OECD/World Bank review panel commends the Government for its considerable efforts. However, in several areas where substantive reform is required .

7.2 Explicit Strategies Supporting Innovation Goals for Universities

Almost all of the interviewees pointed out the necessity the existence of an innovation agenda and the university's interest in pursuing it, an explicit strategy is also perhaps the widest window on innovation culture at the university. An explicit, published strategy on innovation is the clearest signal to demonstrate to the outside world that the university has a clear vision on innovation and the universities role in the NIS.

7.3Explicit Leadership

Study participants view the importance of the creation of a senior role at the university – Vice-president for entrepreneurship, business development, enterprise or innovation as an explicit step in confirming an innovation agenda at the university. An innovation strategy could equally be in the hands of an existing position, such as Vice-president for Graduate Studies and Research, but creating a senior role expressly dealing with innovation not only creates a focal point for the activities but also outwardly elevates the importance of innovation to a similar level to that of research and education. Creating an explicit role to head the university's entrepreneurship and innovation activities demonstrates a level of prioritization.

7.4 Enabling Environment for Innovation

7.4.1Criteria for hiring and promotion

Fostering an innovation culture in a university depends in large part upon members of staff. While providing incentives for innovation activities may encourage staff members to consider what possibilities for innovation their work affords. Considering innovation activities as part of the criteria for promotion is another step which would encourage existing staff members to pursue these activities. Some would see pitfalls in such a policy – vanity patents, unbalancing teaching and research work – but a university employing such a system would either have largely overcome these or be possessed of a culture which does not perceive them as pitfalls, both of which provide valuable insight into the university's attitude towards innovation activities.

7.4.2 Ability of Staff to Work outside the University

Participants observe that external consultancy by academics can be an opportunity to gain valuable insight into industry, an opportunity for the university to profit from its academics' expertise. A university could focus to encourage external consultancy to keep its academics at the cutting edge. External consultancy, under such conditions, is effectively brought in-house to become a university project, and university may encourage it as an outside pursuit which may benefit the academic's teaching and research without detracting from time spent on university projects.

7.5 Technology Transfer Offices

One interviewee described technology transfer offices (TTOs) "as generally the front line of university commercialization. They are useful when university generates industrial interest or there is a lack of well-established networks between academe and industry in the relevant area. The value of TTOs to the universities is when a universities submit, enforce and license patents on their innovations, but this then makes it a core part of any innovation strategy the university might produce".

Some interviewees emphasized that universities must understand how the process of technology transfer works and how it works most effectively. They must then develop strategies to increase the scope and impacts of technology transfer.

7.6 Science parks

Science Parks have been seen by almost all of the interviewees as the quintessential expression of university innovation. Incubators How an incubator is used and developed speaks to the university's policy on its spin-outs.

7.7 The Need for Entrepreneurial Culture

Study participants pointed out that in order to develop an entrepreneurial culture in university, strong leadership and good governance are crucial. Many universities include the word "entrepreneurship" in their mission statements but this needs to be more than a reference. If a university wants to develop itself as an entrepreneurial university with an entrepreneurial culture the entrepreneurial activities should be established in its strategy. The strategy could have specific objectives for entrepreneurship with associated performance indicators (e.g.

generating entrepreneurial motivation, cognition, and attitudes; generating entrepreneurial competences and skills; support business start-ups; commercialize research results through technology transfers and business start-ups; generate revenues for the institution from spin-off activities; strengthen co-operation between the institution and local firms) .

7.8 The Need for More Interdisciplinary Research

Both the faculty member and the leaders find that The deleterious effects of Egypt's rigid academic culture are apparent in the lack of cross-fertilization not only between universities, but also between different faculties at the same university. Faculties tend to work independently; interdisciplinary research is rare. Some institutes have started to encourage scientists to work across their traditional academic boundaries.

7.9 Organizational barriers within universities

Within public universities there appears to be little incentive to network or collaborate with other institutions. Some respondents report that a culture of competition and distrust limits interactions and information sharing among universities. One leader describes the culture in the public Egyptian higher education environment:

> "This environment is so secretive. You go onto any university website [in another country] and you can pull up policies and all sorts of things, and here – well, they don't even want to give out their academic dates. . . I just think that it's [the] mindset. We have to keep our information secret. I think it's cultural. . . And I think competition is pretty so fierce here. So I think people like to keep things fairly close to their heart. The less others know the better."

Both the faculty member and the leaders find that the public Egyptian universities do not contain groups or associations that facilitate interactions among academics with similar research interests or administrators with similar roles. There is also a reported lack of incentives for faculty to spend time building networks outside of their university. The time spent soliciting and developing relationships is "invisible time" that is not valued for faculty evaluation or promotion. This serves as a disincentive for faculty to build external relationships. One faculty member describes the barriers he sees for faculty interested in working with organizations outside their universities:

> " Time for organizing conferences and schedule flexibility to allow for consulting for industry . . . need to be given by universities and articulated in their policies . These things need to count for promotion to make it worthwhile for faculty to engage in them. Faculty are reluctant because such activities do not count for promotion."

This faculty member suggests that for robust network building to occur, universities must recognize the time that building such relationships requires. If faculty's work with outside organizations does not count for promotion, then they will not be motivated to do it. Likewise, if outside engagement is not part of accreditation requirements, universities will not be compelled to promote faculty activity outside the university.

Study participants see little interaction between industry and public universities in regard to research or consultation. The perception is that industry prefer to hire consultants from abroad rather than consult local academics. The common view among study participants is that international consultants lack accurate knowledge of the local context and thus produce consultation reports that often cannot be implemented. One participant states that the trend towards outside consultants limits Egypt's capacity to generate locally-based knowledge:

> "The goal is not to develop a research environment, the goal is just to purchase an existing solution. So it's not about developing new knowledge and technologies. It's about purchasing what's there, putting it to work."

Some organizations /institutes and industry that do engage with local universities are perceived as doing so in the spirit of community outreach rather than seeking universities to address core business problems:

> "It's a two way process. One, industry thinks they are doing the universities a favor and universities think that they are doing industry a favor. . . For them it's a lot of time and investment and they don't see a direct result. . . So for an industry to get involved, they are only getting involved for may be social responsibility ."

7.10 Overcoming the Barriers to Innovation

Study participants see that support for innovation first requires attention to key framework conditions including adequate investments in R&D, the security of intellectual property, a strong scientific and skills base, and a modern physical, legal, and cyber infrastructure. This includes business regulations that are simple and transparent as possible, consonant with public policy objectives such as health and environmental safety.

Study participants also emphasized that :-

- Universities cannot produce highly qualified and industrially relevant graduates due to the lack of

equipment and industrially experienced faculty member;

- Universities do not understand the nature of industry; so they neglect finding real industrial needs, and research outputs are not applicable;
- Universities do not get sufficient funding from government or industrial support;
- Universities do not seriously cooperate with other related sectors due to the lack of trust, incentive and institutional collaboration.

Support for innovation also requires my attention to common barriers that can forestall the cooperation needed to bring new ideas to the marketplace. For example, cultural barriers often separate those in industry from academia, where the focus is more on understanding basic phenomenon than on achieving concrete results. These barriers are often reinforced by a legacy of organizational incentives; universities have traditionally emphasized the need to publish rather than commercialize research (Saguy, 2011).

7.11 More Power to the Universities

Study participants believe that public universities would be more likely to break down cultural norms that are hindering innovation if they were given more administrative and political autonomy. Though defined in law as independent entities, in practice much of what state universities can do – including how they structure their councils, faculties and departments, appoint their teaching and research staff and set their curricula – is directed by the Ministry of Higher Education and Scientific Research and other governmental bodies. The OECD's 2010 report on higher education in Egypt maintains that Egyptian law "places severe limitations on public universities regarding employment, promotion, and dismissal of academic staff" OECD, 2010) . All of this makes it hard to implement a real culture of innovation.

7.12 More Collaborative Relations between Organizations /Institutes and Industry and Universities

Regarding interviewees' advice on collaborative relations between organizations /institutes and industry and universities, should directly collaborate through 1) study or research for technological solutions, 2) expert exchange programs between organizations /institutes and industry and universities, and 3) research/innovative financial support to develop new technology. The other model is that 4) the organizations /institutes and industry might collaborate through a revolving organization which acts as collaborator between industry and universities by collecting common problems from organizations /institutes and industry and encouraging universities to find solution to given problems.

The interviewees make it clear that the universities, through necessity, have been developed to be training institutions. The universities' linkages to industry were not made through research and invention, but rather as a supplier of a trained workforce. Later, as research was added in to universities' mission through the national education policy, the traditional method of communication with industry was through publication and academic journals.

7.13 Universities as a Central players in Developing NIS

The common view among study participants is that universities' roles as a central players have two sides to serve in the collaboration with government, industry and other organizations/institutes;

A. University as supplier

Universities are to serve the industry in the following areas:-

1. Quality graduates relevant to industrial and social needs,
2. Research/knowledge/innovation,
3. Incubation services,
4. Technology transfer services,
5. Solutions to problems/challenges,
6. Management consultancy and training.

B. University as demander

Universities require resources and collaboration with both government and industry to effectively serve the industry as mentioned above in the following areas:

1. Financial and equipment support,
2. Enterprise strategy to become entrepreneurial universities,
3. Technology transfer from organizations /institutes and industry,
4. Collaboration with organizations /institutes and industry for internship, cooperative program, and laboratories/instruments.

7.14 Funds for innovation

The common view among study participants is that all the activities outlined above need funding . This funding could come from competitive bids to government or it may be a strategic decision from the university to provide

such funds from a core endowment or operating funds.

8. Conclusions and Recommendations

8.1 Conclusions

From linear innovation processes to innovation systems, the National Innovation System (NIS) approach is a recent paradigm for organizing innovation in national economies. This systems approach represents a more holistic view of innovation processes and has the potential to improve innovation outputs and outcomes for firms, industrial sectors, and nations.

The concept of National Innovation System (NIS) has been recently applied in the context of developing nations even though it was originally developed in relation to the more developed economies. Public Egyptian universities are expected to develop national innovation system throw playing the role of a provider of produce graduates highly relevant to the need of related sectors and social needs, conduct basic and applied research, to collaborate with organizations /institutes and industry to create new technology/innovations , to develop incubation services ,to promote technology transfer services, to come up with solutions to problems/challenges, and to manage consultancy and training . In the main time Public Egyptian universities are expected to play the role of a demander of Financial and equipment support, enterprise strategy to become entrepreneurial universities, technology transfer, collaboration with firms for internship, cooperative programs , and laboratories .

In order to adjust Egyptian universities' roles to develop NIS and economic development more effectively and efficiently, Public Egyptian universities have to establish closer relationships and networks with communities, business and industries whilst integrating university functions as a component of the industrial/production process of the Egyptian economy. The government does not only expect to see universities producing graduates efficiently, but also graduates with employability and value-added skills to effectively serve as a productive workforce.

However, there are challenges for Public Egyptian universities to substantially support NIS. These challenges are : (1) Public Egyptian universities do not produce highly qualified and industrially relevant graduates, (2) Public Egyptian universities do not understand and accommodate the nature of industry, (3) Public Egyptian universities do not have sufficient resources , (4) Public Egyptian universities are not recognized as a critical player in economy, and (5) Public Egyptian universities do not seriously cooperate among themselves and with other related sectors. To deal with the challenges and to enhance universities' competitiveness/relevance in developing NIS , the paper recommends that Public Egyptian universities could be improved by establishing a track record, culture and strategic plan to enhance NIS.

The structural development of the National Innovation Systems in Egypt relies upon foreign multinationals to drive technological development and innovative activity. Public policy is now beginning to emphasize indigenous talent development in order to capture more economic and technological spillovers domestically. Initiatives are being introduced that seek to enhance innovative capabilities by forging local, regional, and international channels that facilitate flows of knowledge and information. The next phase of the Egyptian economic growth will be more reliant upon the performance of its national innovation systems .

At present, the collaboration between the Public Egyptian universities and industry in R&D is relatively weak. In cases that there has been such a relationship, the most common practices are simple monetary contributions from corporations to universities and informal collaboration, such as consulting services. Interaction between industry and the universities has largely been informal and personal. One significant reason for this is the rules and standards governing the universities and faculty members that do not favor the entrepreneurial exploitation of university-based research.

8.2 Recommendations

Recommendations to enhance the role of Public Public Egyptian universities in developing national innovation system are the following:-

(1) Where appropriate, universities that are interested in an industrial relationship should identify and expand their traditional missions (teaching and research), to the third mission of economic, social and industrial development.

(2) Government should provide financial and equipment support to universities operating industrial support units such as a technology transfer office, incubation unit, etc.

(3)U-I-G linkage model could be more effective only if some U-I-G mechanisms are adjusted to create more confidence, mutual trust and common interest among the three partners, while improving effectiveness and efficiency of units/mechanisms within.

(4) Universities must generate graduates increasingly relevant to NIS's needs through cooperative education programs, expert exchange program in teaching and curriculum designing, project-based learning with industry for technological solutions.

(5) Teaching is expanded from lecture and discussion to a project mode , with teacher serving as facilitator, and ensuring that teaching-learning reflect the skills needed in industry.
(6) Where appropriate, universities may embed entrepreneurial activities and spirit. This can be done through developing incubation services and testing services to support (SMEs), developing spin-offs and firms to further connect with industry and real world business while generating innovation; developing satellite campus/learning centers and programs in the industrial cluster to understand the industry and serve it well, employing entrepreneurship education to train students and technicians to realize business and corporate value and educating the managerial workforce to manage organizations more effectively.
(7) Developing technology transfer capability.
(8) Extending teaching from educating individuals to shaping organizations through entrepreneurial education and incubation.
(9) Providing a supporting infrastructure for teachers and students to initiate new ventures with intellectual, commercial and conjoint characteristics.
(10) Universities should strengthen their research and innovation through, Conducting research with identified commercial potential, Identifying, promoting and working on specifically competitive research areas.
(11) Developing a U-I unit such as a technology transfer office, encouraging faculty staff to support the work of the university and industry which, in turn, can generate income, etc.

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Appendix A

Interview Guide for Public University Faculty and Leaders

I. University profile: (name, location, organization, policy and mission, function, etc.)

II. University's role

1. How does the university directly involve in the NIS ?
2. How does the university promote the technology transfer?
3. How does the university develop the entrepreneurial culture?

III. Technology transfer process

1. What is the scientific position of the university's research?
2. How does the university's research cooperate with the industry?
3. What are the university's research spin-offs?
4. Does the university have any programs to support the graduates establishing new companies?
5. What kind of processes does the university use to connect between firms and the graduates?
6. Where are the university's research financing allocated from?
7. Does the university establish the science park for strengthening the interaction between the university and industry?
8. Does the university develop any internship programs with the industry?
9. Does the university have skilled-training joint with the industry?

10. Does the university have consultancy with the industry? If yes, how?
11. Does the university have incubation services to support the industry?

IV. The support from industry needed/Government policy/ cooperation model between university and firms

1) What kind of support you need from the industry?
2) How to make your relationship with the industry/firms more fruitful?
3) Does the government determine the direction and policy on relationship between university and firms/ industry? If yes, how is the policy? If not, what is the impact on the cooperation?
4) How the university should be supported in order to develop firms competitiveness in sustainability?
5) What is the appropriate cooperation model of university and firm/ industry?

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