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Moving towards a knowledge-based economy: What is needed to enable science, technology and innovation in post-revolutionary Egypt.

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MOVING TOWARDS A KNOWLEDGE-BASED ECONOMY: WHAT IS NEEDED TO ENABLE SCIENCE, TECHNOLOGY AND INNOVATION IN POST-REVOLUTIONARY EGYPT

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Submitted by

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ABSTRACT

The purpose of this research is to examine the current state of Science, Technology and Innovation (STI) in Egypt. Provide a careful view of the obstacles and challenges Egypt is facing in enhancing its STI system and how this is hindering Egypt's transformation to a knowledge-based economy. Applying qualitative methods through in-depth interviews with the different experts from the field along with research conducted helped develop policy recommendations that could act as a road map that guide us in our pursuit for revolutionary transformation. The research findings indicate that the process of transformation to a knowledge-based economy is a holistic process; it requires full commitment and participation from government, policy makers and the people, it requires a vision that would unite the efforts and hard work towards achieving a certain goal to be able to reap the success of many of the exemplary attempts initiated, and requires bottom-up approach in setting the ground, changing the culture and building the right foundation that would lead us to a sustainable knowledge-based society.

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AHC:	Aswan Heart Center
EIR:	Economic Incentive and Institutional Regime
EIU:	Economist Intelligence Unit
GCI:	Global Competitiveness Index
GCR:	Global Competitiveness Report
GERD:	Gross Domestic Expenditure on R&D
GII:	Global Innovation Index
ICT:	Information and Communication Technology
IIAG:	Ibrahim Index of African Governance
IP:	Intellectual Property
IT:	Information and Technology
KBE:	Knowledge-Based Economy
KBS:	Knowledge-Based Society
KE:	Knowledge Economy
KEI:	Knowledge Economy Index
KMA:	Knowledge Assessment Methodology
MEK:	Misr El Kheir Foundation
MNC:	Multinational Companies
MSC:	Malaysia's Multimedia Super Corridor and Expansion Project
NGO:	Non-Governmental Organization
NGOS:	Non Governmental Organizations
OECD:	Organization for Economic Cooperation and Development
PWD:	People With Disabilities
R&D:	Research and Development
S&T:	Science and Technology
STDF:	Science and Technology Development Fund
STI:	Science, Technology and Innovation
UNDP:	United Nations Development Program
UNESCO:	United Nations Educational, Scientific and Cultural Organization
WIPO:	World Intellectual Property Organization

I. Introduction

> *"The people have spoken and said;* ***We are not going to let go,*** *and that what is refreshing about the whole revolution; is that people are expressing themselves and whether you agree or not is not the point; the point is that they are expressing their views freely. There are countries which have been exposed to this sort of transformation and have experienced it such as South Korea, Norway, Brazil and have turned up their economies tremendously by helping their own people making fantastic doubling, quadrupling of their income at both country level and the individual level and it's all through Science, Technology and Innovation."* ***Sir Magdi Yacoub***

The word "Revolutionary" is defined by the Oxford dictionary as- new, novel, original, unusual, unconventional, unorthodox, newfangled, innovative, state-of-the-art, cutting-edge, futuristic, and pioneering. When using the term Post-Revolutionary Egypt, it does not simply refer to the time or period after the revolution; rather it looks at the transitional stage in which the "new" Egypt is going through. The concept refers to whether after a change of path has occurred, is the new direction geared towards leading drastic and innovative change, thus embodying the image of "Revolutionary Egypt".

Despite the current turmoil taking place on both the political scene and within the state bureaucracy, there are several outcomes in the public sphere that need to be acknowledged. These include an increase in the public's feeling of ownership and citizenship that has manifested in different forms, even just by the sheer number of demonstrations in the past two years. This has also been seen in the increase of political awareness and to a certain extent participation, which has widened public debate across different sectors that may have been marginalized, such as youth. As these public spaces have grown, issues that may have been

previously disregarded are now being advocated for, even if they fall on deaf ears. One such issue that is also the topic of this research is the development of a Knowledge-Based Economy.

Transforming to a Knowledge-Based Economy might seem like a far-fetched dream with Egypt's current deteriorating state of Science, Education, Scientific Research, Technology and Innovation as presented in this research. Several challenges and obstacles lay ahead for the country to be able to undergo this transformation, which makes it seems as impossibility, but so were calls for regime change. The beauty of the revolution was that it gave the nation hope and pushed its citizens' believe that change is possible. Thirty years ago, we would not dare to dream because we did not believe in ourselves or our capabilities but after the revolution, we broke all the shields that long covered our dreams for Egypt. A knowledge-Based Economy is an economy that is built on innovation and so was the Egyptian revolution; it was original and innovative and above all, driven by the love of people to their country who had great faith in Egypt's potential.

A. Background

Although knowledge has always been an important factor for growth and development, still the concept of Knowledge-Based Economies (KBE) gained awareness when the Organization for Economic Co-operation and Development (OECD) published in 1996 its report on KBE. The term 'Knowledge-Based Economy' stems from this fuller recognition of the place of knowledge and technology in modern economies. (OECD, 1996) KBE is now generally regarded as a meaningful economic concept, one worthwhile pursuing. (Asian Development Bank, 2007) Wealth creation through application of human knowledge and creativity is steadily outpacing wealth creation through extraction and processing of natural resources. Productivity and growth have become more dependent on knowledge and accordingly, knowledge has increasingly become an important means of value creation. (Asian Development Bank, 2007)

The Arab Human Development Report (2003) considered that knowledge was a tool to expand the options and abilities of human beings, and it was the main key to achieving comprehensive development. It also defined the *"knowledge society as one based on the dissemination and production of knowledge, employing it efficiently in all areas of community activity, economy, civil society and politics, as well as in private life where knowledge has increasingly become a powerful engine for economic and social transformations"*. (UNDP & RBAS, 2003)

The Arab Knowledge Reports published by the UNDP and Mohamed Bin Rashid Al Maktoum Foundation argues that the concept of "knowledge society" is broader than just scientific and technological dimensions but should include cultural, political and civilizational dimensions.

It states that "*Knowledge has become the principle and driving force for all dimensions of economic, social, political and culture changes taking place around us in today's world*" (UNDP and Mohamed Bin Rashid Al Maktoum Foundation, 2010)

Egypt is going through a major transition stage right now and it is our obligation towards this country to take part of the decision making process of where we want our country to head. Our vision should be clear by now, our priorities should be determined and the strategy towards implementation should be put into action. Because Egypt is facing a lot of challenges within this process of transition, our aspirations for a better Egypt should be raised and the quest for transforming to a knowledge-based economy should not be neglected among all the obstacles we are facing right now and thus the aim of this research is to set the framework and policy guidelines for how this transition can occur.

B. Importance of Research and Problem Statement

The main research problem is trying to identify what is needed to enable science, technology and innovation in Egypt at this transitional stage and establishing the linkage between the current constitutional, legislative and political environment and its effect on Egypt's transformation to Knowledge-based society. And whether an article in the new constitution of Egypt or a sound legislation for Science, Technology and Innovation and implementing a National Innovation Strategy could overcome such problem.

C. Purpose of the Research

The purpose of this research is clarify what are the current obstacles Egypt is facing in the fields of Science, Technology and Innovation and how this is hindering Egypt's transformation to a knowledge-based economy. The research shall examine the effect of the current legislative and political environment in Egypt on the advancement of Science and Technology. Also, the successful transitional cases of other countries that shall be studied and presented will serve as a guideline for the case of Egypt.

D. Research Question

The research attempts to answer the following central question:

How can Egypt transform to a Knowledge-based Economy?

The study, and especially the data gathering process, will be guided by the following Sub-questions:

1. What is the current state of Science, Technology and Innovation in Egypt?
2. What are the main obstacles and challenges facing Egypt now?
3. By examining the effect of the current constitutional and legislative, cultural and political environment in Egypt on the advancement of Science, Technology and Innovation. What needs to be altered to allow such transformation?
4. What is the role of the government, private sector; public and private research centers and civil society in this transformational process?
5. What are the recommendations for post-revolutionary Egypt to overcome the current challenges and move towards a knowledge-based economy?

II. Methodology

This is a qualitative research paper that is based on ethnographic field methods of in-depth interviews and the research carried out shall essentially rely on two data sourcing approaches:

First: Literature review for topics surrounding the theme of Science, Technology and Innovation The search shall cover all relevant issues such as, what is a Knowledge-based economy, Science, Technology and Innovation policies in Developing countries, legislatives of knowledge-based communities, Successful global experiences, and the case of Egypt. Critical analysis of obtained references shall be carried out to help identify the framework and guidelines for a successful transition to Knowledge-based economy and the diversity of legislative environments controlling Science, Technology and Innovation in different communities and how can we apply it on Egypt.

Second: In-depth interviews with activists in research and technology from government, private sector and civil society as well as prominent public figures. These interviews will aim at addressing the challenges facing the advancement of Science, Technology and Innovation in Egypt from governance, funding and legislation points of view. It also will help draw a picture for the status now in Egypt and capturing the missing links in the scientific community that is leading to the current grossly underdeveloped state of science, technology and innovation in the country.

A. Research Design

It is a qualitative research paper with descriptive research questions and design, which aims at examining and understanding the current status of Science, Technology and Innovation in Egypt.

B. Data Collection

The primary data collection technique used is in-depth interviews with specified sample. The sample consisted of 7 participants. The candidates selected for the interviews represented the main players in Egypt; the government, the private sector; public and private research centers, civil society and prominent public figures; and this was meant to ensure the representation of the sample, the credibility and reliability of the data to obtain a wide varied perspectives for the topic under investigation.

C. Interviews and Sample Selected

This research was preliminary designed to investigate solely the effect of the current constitutional and legislative framework on the advancement of science, technology and innovation in Egypt and therefore, the sample selected at the beginning of the research were mainly focused at addressing the challenges facing the advancement of STI in Egypt from governance, funding and legislation points of view.

During the preparation of the research work, Egypt was going through the process of constitution making and the participants selected for the research were involved in the process and accordingly, the interview questions and sample selected were developed to investigate how the constitution of Egypt handled the reference to Science, Technology and Innovation [STI] in comparison to other world constitutions where STI were referenced at different levels and with different connotation.

The interviews with professionals and activists in the scientific research community in Egypt confirmed the need for both the constitution reference and the legislative framework.

HE Sir Prof. Magdi Yacoub, Professor of Cardiothoracic Surgery at Imperial College London and Founder of "Magdi Yacoub Heart Foundation" was invited by the Egyptian Constituent Assembly to make a statement regarding the articulation and referencing of STI in the new constitution of Egypt. The interview tackled his crucial statement in the assembly as well as his own personal views regarding what needs to be done in the coming period to enhance STI in Egypt. The full statement of HE Prof. Sir Magdi Yacoub can be reviewed from the website of the Constitution of Egypt at: [http://www.dostour.eg/component/content/article/91].

The Civil Society representative selected for the interview was Dr. Alaa Eldin Adris, Chief Knowledge Officer, who serves on the boards of both government and non-government organizations focused on STI, Including Misr Elkheir Foundation (NGO), STDF, RDI (Research, Development and Innovation Fund).

He was also involved in the process of constitution making and was invited as a representative of Civil Society Organizations in Egypt to speak about STI and education articles in the new constitution and provide his views and feedback on these matters. MEK foundation has arranged two major events over the past year to advocate for the importance of having strong sound articles for science, technology and innovation in the new constitution. The details and conference proceedings can be found on MEK website at: [http://www.misrelkheir.org/d.html]

Two interviews were conducted with civil society representative, one focused on constitutional and legislative framework and the other one was broadly discussing the transformation of Egypt to a KBE from civil society perspective.

Two ministries were selected to represent the government sector, the Ministry of Scientific Research represented by Dr. Venice Kamel Gouda, who held the post of the Egyptian Minister of State for Scientific research from October 1993- to July1997. The Ministry of Communication and Information Technology (ICT for Social Services Unit) represented by Dr. Abeer Shakweer, Advisor to the ICT Minister and who also worked as Planning and Monitoring Manager at the STDF From 2008-2010; and was engaged in the process of drafting the law for science, technology and innovation in Egypt.

Dr. Magdi Ishak- Orthopedic Surgeon and president of the Egyptian Medical Society UK And Chairman of the Scottish-Egyptian Association, Vice Chairman of the British Egyptian Society and members of the board of "Aswan Heart Center" provided the views of the Private Sector complemented by the views of Prof. Shabaan Khalil, Director of Center for Theoretical Physics at "Zewail City of Science and Technology".

The Public Research Center was represented by NRC, the largest of all institutions affiliated to the ministry of Scientific Research that employs about 60% of all scientists working in these institutions. The NRC was established as an independent public organization in 1956, with the aim "to foster basic and applied scientific research, particularly in industry, agriculture, public health and other sectors of national economy". (National Research Center) Prof. Dr. Hany El Nazer, former President of the National Research Center [http://hanyelnazer.com/about.php] was selected to participate in the study having held the position of NRC President for two full terms from 2001-2009.

Furthermore, the successful case studies represented in the research were derived from the interviews where three diverse case studies were used as a demonstration of some of the exemplary initiatives Egypt has undertaken to enhance its STI system. The Aswan Heart Center (Non-Profit Organization and Research Center), MEK Knowledge (Non-Profit Organization) and the Ministry of Communication and Information Technology- ICT for Social Services (Government).

Check Appendix for List of Interviewed Participants.

D. Research Limitation

First, some of the interviews were conducted at an earlier stage with different research questions than the final ones agreed upon for the research and though they are relevant but still do not answer precisely the main research question.

Second, It was difficult to reschedule all the old interviews again due to the participant's tight schedule and thus the old versions were kept and used in their original forms except one of them, which the researcher managed to update it and add the new research questions.

Third, there were a lot of constraints faced by the researcher during the secondary data collection process due to the shortage of information and data published on Egypt and therefore, some indicators used in the research remained blank as Egypt is not covered till today in some indicators which also posed a problem in verifying the information provided by the interviewed participants and thus only most recent and available date from verifiable sources were used.

Fourth, most of the interviews were conducted in Arabic, and then translated to English. It was a challenge for the researcher to translate some Arabic words to English, so this must be taken into consideration.

Fifth, there were location constraints as some interviews had to be conducted outside of Cairo which required traveling by plane to different governorates of Egypt.

Finally, many of the respondents during the interview were out of topic but the researcher overcame it by managing the interview to reach its purpose. Some of the participants tended to provide general statements, personal opinions and broad insights and reflections on certain issues which the researcher had to account for and try as much as possible to verify these statements and personal opinions through consulting secondary data sources.

E. Ethical Considerations

Based on the American University of Cairo requirements; the application was reviewed and approved by the Institutional Review Board (IRB) at AUC to ensure all procedures are in line with the ethical guidelines. They reviewed the methodology, questionnaire, and the consent form is available in the Appendix.

All participants were informed verbally and in writing about the study and participation was on a voluntary basis. The purpose of the research, and the research questions were demonstrated clearly to the participants prior to conducting the interview. In my explanation of the research, participants were asked for their permissions to record these interviews and participants had the right to withdraw from the study at any time. As such, both principles of confidentiality and anonymity were upheld during these interviews; yet, what is interesting is that all interviewees agreed to being quoted by name and mentioned in the study.

III. Literature review

This section aims to review different studies, reports, and cases about the Knowledge-Based Economy and the growing importance of the role of knowledge in shaping the global economy.

A. *First part is the introduction: Literature focuses on discussing what is a Knowledge-Based Economy*
B. *Second Part: Literature discusses the Knowledge Assessment Methodology*
C. *Third Part: Literature discusses the importance of transforming to a Knowledge-Based Economy*
D. *Fourth part: Literature focuses on discussing the main challenges and obstacles facing Arab and Developing countries in building an efficient Science and Technology System and transform to a Knowledge-Based Economy*
E. *Fifth Part: Literature aims at discussing different international experiences and lessons learned from these successful models*

A. Knowledge-Based Economy

The OECD uses the term "Knowledge Economy" to draw the attention to the importance of knowledge in all economic activities. (World Bank , 2008) A knowledge economy is one that uses knowledge as the key engine of economic growth. (World Bank Institute, 2007) It is an economy in which knowledge is acquired, created, disseminated, and used effectively to enhance economic development. (World Bank Institute, 2007) Contrary to some beliefs, the concept of the knowledge economy does not necessarily revolve around high technology or information technology (IT). (World Bank Institute, 2007) A "Knowledge Society" however**,** refers to the type of society that is needed to compete and succeed in the changing economic and political dynamics of the modern world. It refers to societies that are well educated, and who therefore rely on the knowledge of their citizens to drive the innovation, entrepreneurship and dynamism of that society's economy. (Asian Development Bank, 2007) It is a force for fundamental global change in business, socioeconomic development and wealth creation with implications at the macro and micro levels. (Kamel, 2010) It requires developing new forms of partnerships and cooperation among the different players in society, the people, the government, and the private sector that can induce change, diffuse best practices and develop ICT applications with the primary goal of promoting growth and enhancing competitiveness. (Kamel, 2010)

A knowledge-based economy is characterized by high investment in R&D, high literacy, high tertiary education enrolments, good technology-related capacity and skills, strength in innovation, and high ICT penetration and internet usage. Its GDP derives mainly from knowledge-based and knowledge-enabling industries such as high- and medium-technology industries, financial and other business services, and the teaching profession. (UNPAN, 2010)

And these industries are characterized by high demand for educated and skilled labor, which requires the government to focus its policies more towards upgrading human capital through promoting access to education and a range of skills, and especially the capacity to learn; enhancing the 'knowledge distribution power' of the economy through the configuration of national innovation systems which entails collaborative networks among industry, government and academia to build an efficient science and technology system as en important economic determinant and provide an enabling environment for the acquisition and sharing of information and knowledge. (OECD, 1996)

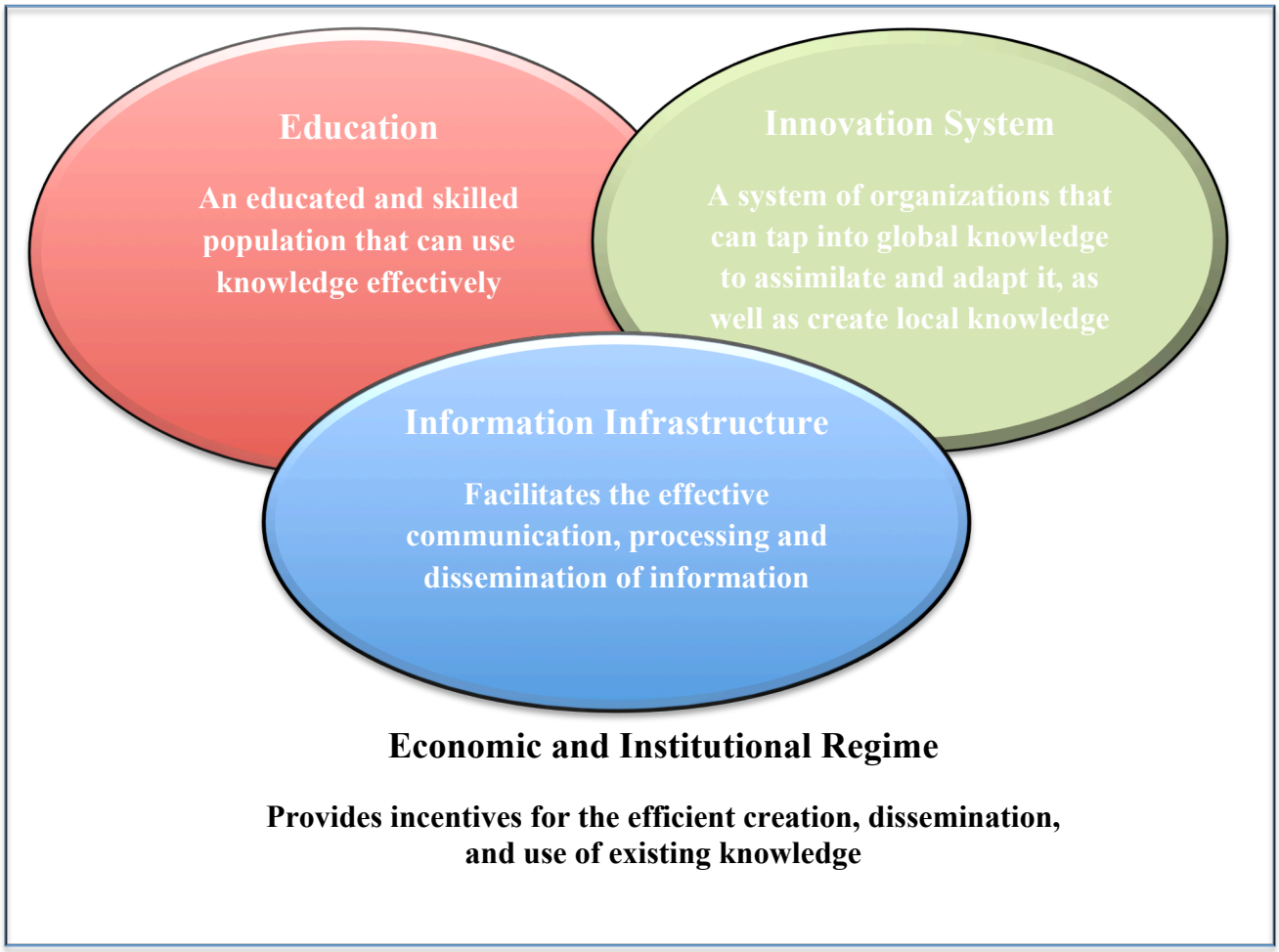
Transforming into a Knowledge-based society requires a country to take serious steps in building its science and technology capacity at a holistic level- in all levels of education and training, in commercializing ideas, in developing business and quickening the pace of wealth- creation and employment generation, and thus enabling government to better serve their citizens and provide basic tools to society at large for self and collective advancement. (World Bank, 2008). Successful transition to a knowledge economy usually involves investment in education, developing innovation capacity, building and modernizing ICT infrastructure, and having an efficient and conductive economic environment that fosters the creation, dissemination and use of existing knowledge. (World Bank, 2007)

According to the World Bank Knowledge Assessment Methodology (KAM: www.worldbank.org/kam), these four elements may therefore be considered as pillars of the knowledge economy: (World Bank Institute, 2007)

- "**An economic incentive and institutional regime** that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship;

- **An effective national innovation and enterprise upgrading system**: a system of research centers, universities, think tanks, consulting firms, and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new knowledge;
- **An educated and skilled population that can create and use knowledge**; and
- **A dynamic information infrastructure** that can facilitate the effective processing, communication, and dissemination of information." (World Bank , 2008)

Figure 1: The Four Interactive Pillars of the Knowledge Economy

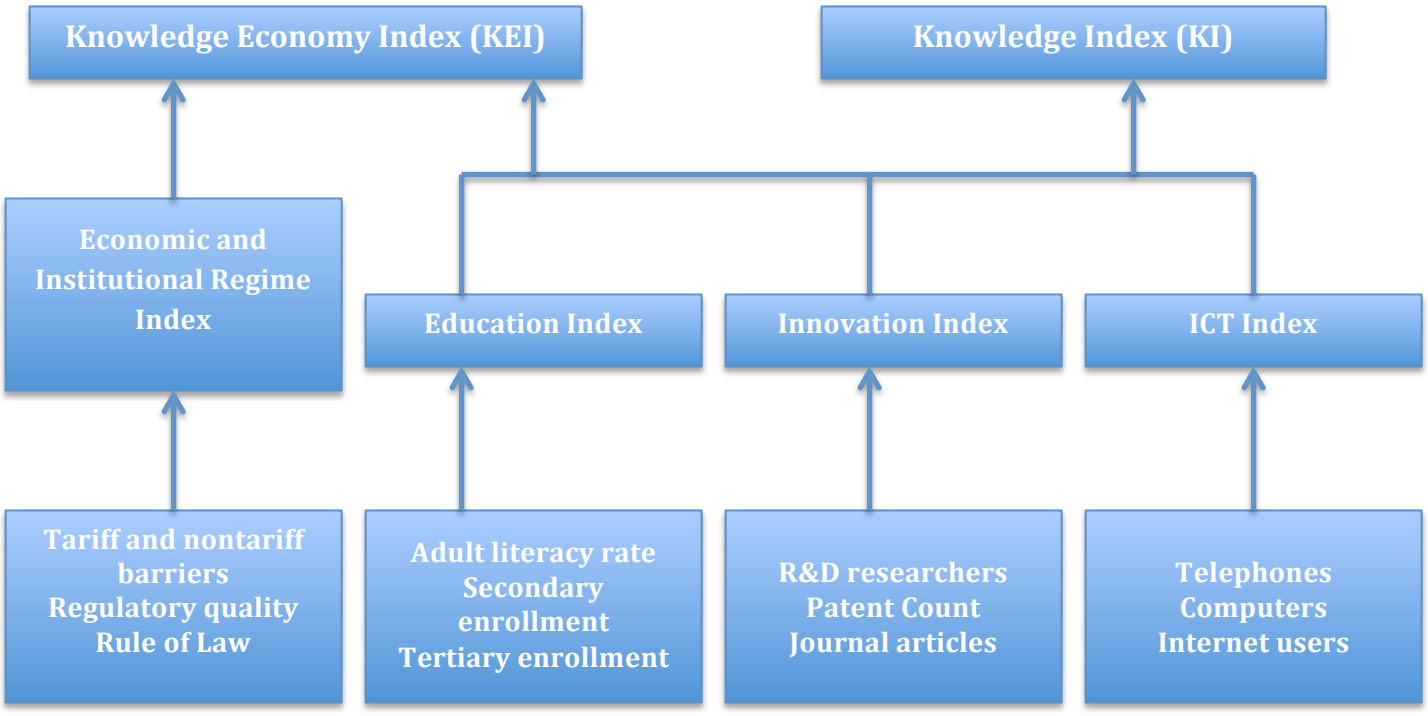


Source: (World Bank Institute, 2007)

B. Knowledge Assessment Methodology

The World Bank's KAM produces the Knowledge Economy Index (KEI) which is an aggregate index representing the country's overall preparedness to compete in the knowledge economy. The KEI summarizes performance over the four KE pillars and is constructed as the average of the values of the four KE pillar indexes. The Knowledge Index (KI) however, is the simple average of three KE pillars: Education, Human resources, the innovation system, and information and communication technology. It measures the countries ability to generate, adopt and diffuse knowledge.(World Bank Institute, 2007) And this is the Index we are going to apply in our research to measure and assess the readiness of Egypt to transform to a knowledge-based economy.

Figure 2: Knowledge Indexes



Source: (World Bank Institute, 2007)

It is worth noting that the Knowledge Assessment Methodology has been criticized for adopting a top-down approach in measuring knowledge reducing the complex phenomena to a single composite index that over-simplifies the subject's manifold dimensions and masks the information content of constituent indicators as argued by the Arab Human Development Report. (UNDP & RBAS, 2003)

The report explains that knowledge is not easy to measure whether conceptually, methodologically or practically as knowledge consists of abstract, symbolic structures in the human mind that are almost impossible to grasp, even on an intellectual level, let alone when it comes to concrete measurement. It states "*Measurement becomes even more difficult when considering knowledge capital, the determinants of its growth and its effectiveness on the societal level. As a result, the comprehensive measurement of knowledge must involve a relatively large number of indicators that would be difficult for the human mind to deal with simultaneously. To surmount this challenge, known statistical methods for constructing composite indices can be adopted."* (UNDP & RBAS, 2003)

The KAM is the most widely used methodology for measuring KE readiness of a country despite its shortfalls; it is used in this research in order to arrive at a first approximation of knowledge capital, its growth rate, characteristics and the infrastructure for its formation and development.

C. The Importance of Transforming to a Knowledge-Based Economy

The previous section described what is a KBE, and most of the definitions revolve around the same idea, that a KBE is an economy that is based on production, distribution and utilization of knowledge, where knowledge is regarded as the most critical factor of production and the primary engine of growth and wealth creation in the economy. (UNPAN, 2010)

In a KBE, knowledge generates more wealth than the other traditional factors of production, land, and capital. Knowledge has increasingly become an important means of value creation. The capacity of business corporations to earn can no longer be attributed mainly to its tangible assets but more to its tangible knowledge assets. Knowledge has increasingly become the repository of value. National economies, at whatever stage or type of economic development they are now in, are to a greater or lesser extent using knowledge for development. It is, therefore inappropriate to speak of being or not being a KBE. (Asian Development Bank, 2007)

Globalization and the information and communication technology (ICT) revolution are increasingly atomized, but universally networked, economies and societies. This revolution is widening the gap between developed and developing countries, and those countries that won't "capitalize on the opportunities derived from scientific and technological advancements and have capacity and the capability to access global knowledge and new technologies and utilize them for their productive activities shall remain marginalized." (Jarjis, 2006)

D. Challenges and Obstacles facing Arab and Developing countries in building an efficient Science and Technology System and transforming to a Knowledge-Based Economy

As argued previously in the Arab Human Development Report (2003) that knowledge has a broader dimension than advancing in Science and Technology and that advancing towards a knowledge-based economy requires the expansion of the scope of human freedoms, enhance the capacity to guarantee those freedoms through good governance and achieve the higher moral human goals of justice and human dignity which according to the report, contrasts with the state of the Arab countries and in this research, it is applicable on the case of Egypt. (UNDP & RBAS, 2003)

The Arab region's expenditure on scientific research is one of the world's lowest in terms of Arab GNP. Research and development institutions are weakly integrated with the cycle of production. The development returns of Arab scientific research are very weak and do not correspond to the magnitude of annual Arab expenditure on them, which tops $2 billion and which, in the period 2002-2006, resulted in no more than approximately 38.2 patents per year and 5,000 published scientific papers. (UNDP and Mohamed Bin Rashid Al Maktoum Foundation, 2010) The lingering political conflicts in the region which have erupted into violence since the turn of this century have caused many Arab countries to divert resources towards security, military and defense budgets at the expense of resources earmarked for development. The military expenditure in the Arab countries as a percentage of GDP is the highest ratio in the world, even if it has declined in relative terms. Much of this spending goes on the purchase of expensive armaments from industrialized countries. (UNESCO, 2010)

The weakest point in Arab knowledge performance may be the lack of enabling environments appropriate to the establishment of a knowledge society. “Arab regimes are torn between upholding national security-as they perceive it- and maintaining social order on the one hand, and generally adopting good governance practices, on the other; these practices include promoting democracy and the ‘rule of law’ promulgating accountability and combating corruption.” (UNESCO, 2010) The Arab states have made no tangible progress with respect to freedom of thought and of expression. Apart from the proliferation of Arab satellite channels and Internet blogs, which have provided a safety valve for a noticeable upsurge in activity by the region’s youth, the outlook for freedom of thought and of expression remains gloomy. Most media and knowledge diffusion mechanisms remain state-owned and operate alongside a limited number of large media and entertainment companies transmitting to the Arab countries from the countries of the Gulf or from outside the region. (UNDP and Mohamed Bin Rashid Al Maktoum Foundation, 2010)

Arab countries are still exporters of primary resources and importers of high value-added products with high knowledge content and Developing countries are mostly dependent on outside world for acquisition of new technologies and are essentially consumers of technology. The political leader and policy makers have to change the approach from a “consumer attitude” to “producer attitude” in the process of technology-acquisition. (Qurashi, Kazi, & Hussain, 2010)

The Arab governments are unable to capitalize on their competitive advantage of the high percentage of youth among its population where over 30% of the population of Arab countries is less than 15 years of age. (UNESCO, 2010) The young population can simulate growth and create dynamic societies, particularly if they are well trained and well educated which is not the case of

the Arab countries, since most Arab countries face multi-layered problems in their educational systems preventing them from performing their central function of fostering the necessary conditions for entry into the knowledge society and expanding the productive capacity to create a repository of jobs to overcome the high unemployment rates in the region which according to the World bank will increase by the year 2020 to 100 million jobs that the region needs to secure to employ the young men and women joining the employment market. (UNESCO, 2007)

Major obstacles facing Arab and Developing countries in building an efficient Science and technology system can be summarized as follows: (Qurashi, Kazi, & Hussain, 2010) (UNESCO, 2010)

- The inability of political leaders and policy makers to grasp the effective role and impact science and technology can have on socio-economic development and thus causing a poor capacity to innovate according to society's needs;
- The absence of an S&T governance mechanism at state level;
- The absence of a national science, technology and innovation policy due to the diminishing role of research institutions in the country and the challenges facing organizations involved in science;
- Low gross domestic expenditure on R&D (GERD);
- The misallocation of funds for education, research and development, where 85% of those funds, end up supporting salaries and buildings;
- Bureaucrats rather than scientists and experts in the field set science and technology policies;
- Lack of cooperation between scientific organizations and productive sectors;
- A lack of database providing information on S&T;

- A low technology component, leading to few manufactured exports and a limited number of high-tech exports.

The main role now of the government of the Arab states and Developing countries is first, realize the impossibility of achieving an Arab knowledge and development renaissance through reliance solely on improvement in economic freedom–even if the latter is supported by intellectual property rights– given the continuation of the restrictions imposed on the freedoms, particularly those of thought and of expression. It is not possible to create environments that stimulate knowledge without the existence of an integrated package of freedoms. Similarly, any hope of the equitable social distribution of the results of development will disappear in the absence of a democratic climate that provides popular oversight and fights corruption. (UNDP and Mohamed Bin Rashid Al Maktoum Foundation, 2010)

Second, they need to charge their educational systems with the task of disseminating knowledge among the broader public and the formation of the human energies that form the backbone of the knowledge society. (UNDP and Mohamed Bin Rashid Al Maktoum Foundation, 2010) Education should not be limited to teaching the basic skills of reading, writing, and arithmetic but should be expanded to enlightening young minds, nurturing creativity and scientific inquiry and generally encouraging people to work harder through the development of analytical and critical abilities, organizational and decision making skills, the powers of creativity and innovation, and other higher behavioral and mental competencies. (UNESCO, 2010)

Third, employ modern information technology tools for determining STI and educational indicators on a regular basis, and their utilization in the process of STI policy formulation and implementation. The formulation of Science, Technology and Innovation policies needs the

involvement of all stakeholders, particularly politicians, planners, scientists, engineers, industrialists and NGOs. Furthermore, policy should be supported by adequate financial inputs, appropriate trained manpower and infrastructure with targets/goals. Also, there should be provision to revise the policy periodically according to the changing needs. (Qurashi, Kazi, & Hussain, 2010)

Fourth, address the issue of brain drain of scientists and intellectuals. (UNESCO, 2010)

Fifth, ensure that universities and research centers operate within an environment of freedom, democracy and tolerance to be able to produce high quality R&D that responds better to socioeconomic needs of society. (UNESCO, 2010)

Despite all the economic and political uncertainty the region is suffering from, still Arab and Developing countries have no choice but to stimulate their science, technology and innovation, together with education sector to overcome many of their lingering problems like unemployment, food, water, and energy insecurity. They need to apply laws fairly and equally, develop government policies that support business and attract investments into their societies and apply good governance by allowing citizens to enjoy the basic freedoms of expression and association, allow them to participate in their own governance because "without good governance, achieving a knowledge society that simultaneously advances human development, innovation and economic growth will be difficult, if not impossible. And finally, learn from other successful models of socioeconomic progress attributed to STI enhancement such as South Korea, China, Brazil, India, and Malaysia. (UNESCO, 2010)

E. Successful Global Experiences

The coming section highlights three successful case studies, South Korea, Malaysia and India and the different policy actions these countries took in order to transform to a KBE by setting their growth processes on a knowledge and innovation-based track. (World Bank Institute, 2007). A High Income Country: The Republic of South Korea, An Upper Middle Income Country: Malaysia, and A Lower Middle Income Country: India and compare each country to the case of Egypt to try and gain a better understanding of how to build a knowledge economy and what is needed for that.

South Korea

Although the economy of South Korea is fairly advanced now compared to Egypt, but still the case of South Korea offers valuable policy lessons for other developing economies that are seeking to make the transition. The interesting thing regarding the case of South Korea is the fact that after World War II, South Korea's GDP per capita was comparable to the level of the poorest countries in Africa. (World Bank Institute, 2007) And was considered by many to be a hopeless case after the four years of privation and destruction caused by the war. (World Bank Institute, 2007) 45 years later, South Korea's GDP per capita has increased more than 12-fold, to more than US$13,000 equal to the mid-level economies of the European Union (EU). (World Bank Institute, 2007) So, what caused this major transition? It is the rapid and sustained knowledge-based economic growth. The contribution of knowledge, without it, South Korea's real GDP would still be below average. (World Bank Institute, 2007) Transforming to knowledge based economy, was based on the KE four pillars: "a conductive macroeconomic

framework, a modern information infrastructure, human resources development, and an effective innovation system." (World Bank Institute, 2007)

A snapshot of some of the strategies undertaken by the Republic of South Korea:

Education and the Skilled Workforce*:* South Korea has invested heavily in education, with a high level of literacy in the 1950s. It focused first on basic education, then later on higher education besides working on professional and vocational education to serve the growing industrial needs. Basic education is funded by the state while individuals fund higher education. (World Bank Institute, 2007)

In 1996, the government of South Korea initiated an online education system called "EduNet", where students, teachers, and the general public can gain access to valuable educational information via the Internet and creating online learning communities. "EduNet" has become the biggest educational information network providing an open and flexible venue to learn, share and disseminate knowledge through ICTs. (Asian Development Bank, 2007) The Government also launched a project called "IT Education for 10M People" in 2000, where it provided educational opportunities to "Internet illiterates", farmers, fishermen, housewives and the disabled. (Asian Development Bank, 2007)

National Innovation System: South Korea began to build the foundation for research and development (R&D) first, through the adoption of imported technology and later develop internal research, same as it began its rise by exporting light industrial goods as textiles and bicycles and gradually developed sophisticated production in heavy industries as shipbuilding and automotives, and later, electronics. It was one step at a time. (World Bank Institute, 2007)

South Korea has a centrally managed innovation system, with innovation policies coordinated at the level of Prime Minister and the private sector is invited to participate in the policy making process and setting the national innovation plan since they are engaged heavily in funding R&D activities. (Asian Development Bank, 2007) South Korea engaged the whole nation in its KE plan through launching an awareness campaign in the nation's main business newspaper and engaging other Ministries as Ministry of Finance to include everybody in the reform plans to be implemented across the nation and at all levels, in education system, R&D development, promotion of venture businesses, and the building of a dynamic information society. (World Bank Institute, 2007) South Korea's research and development strategy is directed towards developing innovative technology hence high-tech industries are promoted to ensure sustained competitiveness in the future. (Asian Development Bank, 2007)

Network and ICT: In South Korea's quest to transform to a KBE, it focused on the creation of a dynamic information society through the development and advancement of information technology infrastructure. (World Bank Institute, 2007) The government of South Korea keeps encouraging the private sector through offering incentives and different benefits to promote development through advanced ICTs as Internet, optical communications, digital broadcasting, wireless communications, and computer software. The government has also invested $120.7 million to gain technological competitive edge in the world market. (Asian Development Bank, 2007) The government has also initiated the Enterprise Networking Project in 2001 to support and maximize the use of ICT by SMEs by connecting them to the Internet and provides both hardware and training requirements for them. The government has launched E-Governance services through the National Basic Information System to deploy ICT applications in its five

core areas: Administration, Finance, Education and Research, National Defense, and Public Safety. (Asian Development Bank, 2007)

Policy and Regulatory Environments: South Korea's policy direction is clearly identified in the third ICT master plan called E-South Korea Vision 2006. The plan three goals are the following:

I. " Improve social system and productivity,

II. Transform the relationship between the government and the market (to allow the private sector to thrive and be creative), and

III. Encourage the pursuit of a "Lead Strategy" in key services and technology sectors." (Asian Development Bank, 2007)

South Korea has enacted a comprehensive set of legislation to set the stage for KBE, such as laws on protection of Intellectual Property Rights, Protection of Major Information Infrastructure Act, Privacy Act, Software Industry Promotion Act, Consumer Protection in E-commerce Act and several other acts. (Asian Development Bank, 2007)

Table 1: Stages of Economic Development in South Korea

	Development Goals	Major Policy Directions	Macroeconomic Governmental Policy Framework	Human Resource Development	Science and Technology
1960s	Build production base for export-oriented industrialization	-Expand export-oriented light industries. -Mobilize domestic and foreign capital	-Prepare legal and institutional bases to support industrialization	-Increase literacy -Establish national infrastructure	Build scientific institutions, legal and administrative framework
1970s	Build self-reliant growth base	-Promote heavy machinery and chemicals industries. -Build social overhead capital	-Maximize growth, and expand policy loans. -Intervene in markets	-Increase vocational training -Increase number of engineering graduates from colleges	Establish scientific infrastructure setting: specialized science &technology institutions.
1980s	Expand technology-intensive industries	-Industrial rationalization -Decrease export subsidies and expand import liberalization.	-Stabilization -Enhance private autonomy and competition	-Expand higher education system -Develop semiskilled labor capacity	-Promote R&D and private research center promotion. -Establish national R&D programs
1990s	Promote high-technology innovation	-Support technology development -Build information infrastructure.	-Liberalization -Reform and restructure	-Develop highly skilled labor in strategic fields such as IT. -Develop lifelong learning system	Leading role in strategic area: HAN programs
2000s	Transition to knowledge economy	Promote venture business and small and medium enterprises	-Globalization -Balanced national development	-Increase research productivity -Improve quality of university education	Build national and regional innovation system

Source: (World Bank Institute, 2007)

Malaysia

Malaysia began its quest to move towards a knowledge-based economy in 1990 with a vision by its fourth Prime Minister and leader Dr. Mahathir Mohamed that by the year 2020, Malaysia would transform into a fully developed and prosperous society that is built on knowledge. From a low-income agriculture based-economy into an upper middle manufacturing and service based-economy, it all started with a dream.

"*Malaysia is crossing the threshold into the information age with hope and confidence. We are embracing the borderless world, and opening ourselves up to new forms of partnership and commerce made possible by revolutionary changes in computing, communications, capital flows and consumer tastes. While some see these changes as a threat, Malaysia sees them as unprecedented opportunity to 'leapfrog' our development and achieve our vision 2020 goals"* The way Forward-Vision 2020 - Dr. Mahathir Mohamed (Abdulai, 2002)

With all the success Malaysia has achieved over the years, still it always suffered growing tensions over religious freedom and Islamic identity as a Muslim country, which is what currently Egypt is going through. Although both countries have constitutions that protect religious freedom, still the current legal environment fails to protect religious minorities; creating a social norm that affects the way people behave causing the current tension and violence. (Council on Foreign Relations, 2010) Despite the political and legal challenges faced by Malaysia as a Muslim country, it still managed to achieve its 2020 vision and transform to a KBE. We hope that Egypt could follow the same path, learn from the Malaysian experience, and embark on an ambitious plan to move towards the knowledge society.

A snapshot of some of the strategies undertaken by Malaysia:

Education and the skilled Workforce: Malaysia has focused on reforming its education system and improving the learning abilities and skills of its graduates, through three main strategies:

First: The promotion of lifelong learning

The promotion of lifelong learning includes retraining and re-skilling of workers and this is done in alignment with private sector to identify the required skills and provide incentives for skills development, the strategy also entails the provision of distance learning and virtual education. (Asian Development Bank, 2007)

Second: Re-orientation of the education and training systems to prioritize science and technology to link the university education with industry requirements.

In its quest of becoming a fully industrialized nation, Malaysia had to focus highly on creating a pool of knowledge workers, scientists and skilled workers through shifting its education system towards science and technology education. (Asian Development Bank, 2007)

Third: Applying the "Brain Drain Program"

The brain drain program is intended to attract global talents to Malaysia and encourage the return of scientists to their home countries through offering different incentives such as tax exemptions; car import duty and sales tax exemptions and these incentives among others are particularly directed towards returning scientists in the fields of ICT, science and technology, industry, finance and accounting, arts, and medicine and health. (Asian Development Bank, 2007)

National Innovation System: It began with a nation wide vision by its leader Mahathir Mohamed, Vision 2020 to move to a KBE, and then derived from it the national innovation

vision for Malaysia. Malaysia has developed a National Innovation Council (NIC) chaired by the Prime Minister to set the direction and the implementation framework for the National Innovation Agenda. (Jarjis, 2006) The National Information technology Agenda (NITA), aimed to foster the development of IT as a strategic enabler for economic development and move Malaysia into a high- knowledge-intensive society. (UNPAN, 2010) In 1996, Malaysia launched the (MSC) project (Malaysia's Multimedia Super Corridor and Expansion Project) aiming to make the nation a global technology hub by 2020. (World Bank Institute, 2007) The MSC was considered as the spark of the innovation in ICT. (World Bank, 2008) This state-of-the-art technology infrastructure was designed to be the engine of economic growth of the 21st century and has attracted several Multinational Companies (MNCs) to locate in Malaysia and perform their R&D activities there. (Asian Development Bank, 2007) Applications implemented through the MSC project included Smart Schools, Tele-health, E-Business, Smart Card technology and E-Government. (World Bank, 2008)

Networks and ICT: Information and Communication technology (ICT) is considered the forefront of the development strategy adopted by Malaysia in pursuit of its 2020 vision to turn to a knowledge-based society. The national IT Agenda focuses on five areas: e-economy, e-community, e-sovereignty, e-learning, and e-public services, which Malaysia has deployed for its community and business development; (Asian Development Bank, 2007)and among the projects implemented are the following:

Community-Directed Projects: includes TaniNet Project and CyberCare.

- TaniNet: is an ICT based portal developed for farmers as a mean or cyber communication tool to learn and share information about agriculture and biotechnology. (Asian Development Bank, 2007)
- Cybercare: is intended to serve the underprivileged communities particularly those in orphanage through building an online community of children, corporations, government sectors, and administrators. (Asian Development Bank, 2007)

Business-Directed Projects: includes MSC and Flagship Applications Project.

- MSC: provides the ideal technological environment to attract MNCs and FDIs.
- Flagship Applications Project: Offers business opportunities and services and helps connect Malaysia and MNCs with leaders in the multimedia industry, research and academic institutions. (Asian Development Bank, 2007)

Government-Directed Projects: E-Government services

Such as electronic delivery services of driver and vehicle registration, licensing and summons services, utility bill payments. (Asian Development Bank, 2007)

Policy and Regulatory Environments: In order for Malaysia to achieve its vision, it had to first establish and build the institutions necessary to allow the transition to a KBE. And that was one of the strategies identified by the KBE plan formulated to respond to the country's national agenda set based on the Vision 2020. (Asian Development Bank, 2007) There were seven strategies identified listed as follows:

1. "Cultivate and secure the necessary human resources;
2. Establish the institutions necessary to champion, mobilize, and drive the transition to a KBE;

3. Ensure that the incentives, infrastructure, and info structure necessary to prosper the optimal and ever-increasing application of knowledge in all sectors of the economy and to the flourishing of knowledge-enabling, knowledge-empowering and knowledge-intensive industries;
4. Dramatically increase the capacity for the acquisition and application of science and technology (including ICT) in all areas;
5. Ensure that the private sector is the vanguard of the KBE development;
6. Develop the public sector into a knowledge-based civil service; and
7. Bridge the knowledge and digital divides." (Asian Development Bank, 2007) (UNPAN, 2010)

India

Once known as the "the land of mystery" for its rich culture and history, remains a land of mystery for succeeding to position itself as a leading developer and provider of ICT services, "The Outsourcing Center of the World" during the year 2002-2005, with 35% of its population living below the international poverty line of $1, and 52% illiteracy rates among women and 27% among men. (World Bank Institute, 2007) India's quantum leap over the past decades has been contributed to the spectacular success achieved by Indian firms and professionals in the information technology (IT) arena despite the socio-economic challenges India is facing such as the high levels of poverty and illiteracy among its population. (Konana & Balasubramanian, 2001)

The case of India is quite unique and different from other countries, while most countries begin their transformation process to a knowledge-based economy using the Bottom-Up approach as in the case of South Korea and Malaysia to ensure a sustainable KBE, India capitalized on its competitive advantage of high mass of educated, skilled, English-speaking workers with cutting-edge IT and design capabilities. (Asian Development Bank, 2007) Investing millions of dollars promoting IT-based initiatives and IT industries as vehicles for social and economic transformation (Konana & Balasubramanian, 2001). The Annual Innovation Trends Report for the PRC has identified India as a low-income country with developing National Innovation System that is likely to become a global player in the near future with crucial role in innovation. (Asian Development Bank, 2007)

India's President, APJ Abdul Kalam has expressed his views clearly regarding India's serious commitment to transform to a knowledge-based economy in the speech he gave during the Ceremonial Reception at Bessastaoir in Reykjavik, Iceland on May 30, 2005.

"Since ancient times, our society has greatly valued knowledge. Our democracy has enabled us to spread the benefits of knowledge more widely. Today we live in a knowledge era in which every social and economic activity is driven by knowledge." (Kalam, 2005)

A snapshot of some of the strategies undertaken by India:

Education and Skilled Workforce: In its commitment to increase educational attainment, and enhance its education system, India has taken some constructive measures such as amending its constitution in 2002 to make elementary education a fundamental right for every child. Initiated the National program for Universal Elementary Education, "Education for All" project. Encouraged the private sector to use ICT's in delivering education. (Asian Development Bank, 2007)

In higher education, India has a top-quality university system that includes world-class institutions, such as the Indian Institutes of technology, Indian Institute of Management, and the Indian Institute of Science. The establishment of such high ranking and high- quality education institutes has helped create a large pool of students to overcome the chronic problem of Indian diaspora. Also, in 2007, the government of India invested 100% FDI in higher education in India. (World Bank Institute, 2007)

National Innovation System: In 2005, the National Knowledge Commission was established to guide the government of India into a KBE.

"The National Knowledge Commission is a high-level advisory body to the Prime Minister of India, with the objective of transforming India into a knowledge society. In its endeavor to transform the knowledge landscape of the country, the National Knowledge Commission has submitted around 300 recommendations on 27 focus areas during its three and a half year term. While the term of the NKC has come to an end, the implementation of NKC's recommendations is currently underway at the Central and State levels." (The National Knowledge Commission , 2005)

The main strategies formulated by the Commission are summarized in three main areas:

- First: The creation of Knowledge: through strengthening the education system, develop R&D capacities, enhance and encourage foreign partnership for knowledge transfer and learning.
- Second: Application of Knowledge: use ICT to serve different areas such health, agriculture, industry, and government.
- Third: Dissemination of Knowledge: focus on improving access to education to all especially marginalized groups, and create lifelong opportunities for skill acquirement. (The National Knowledge Commission , 2005)

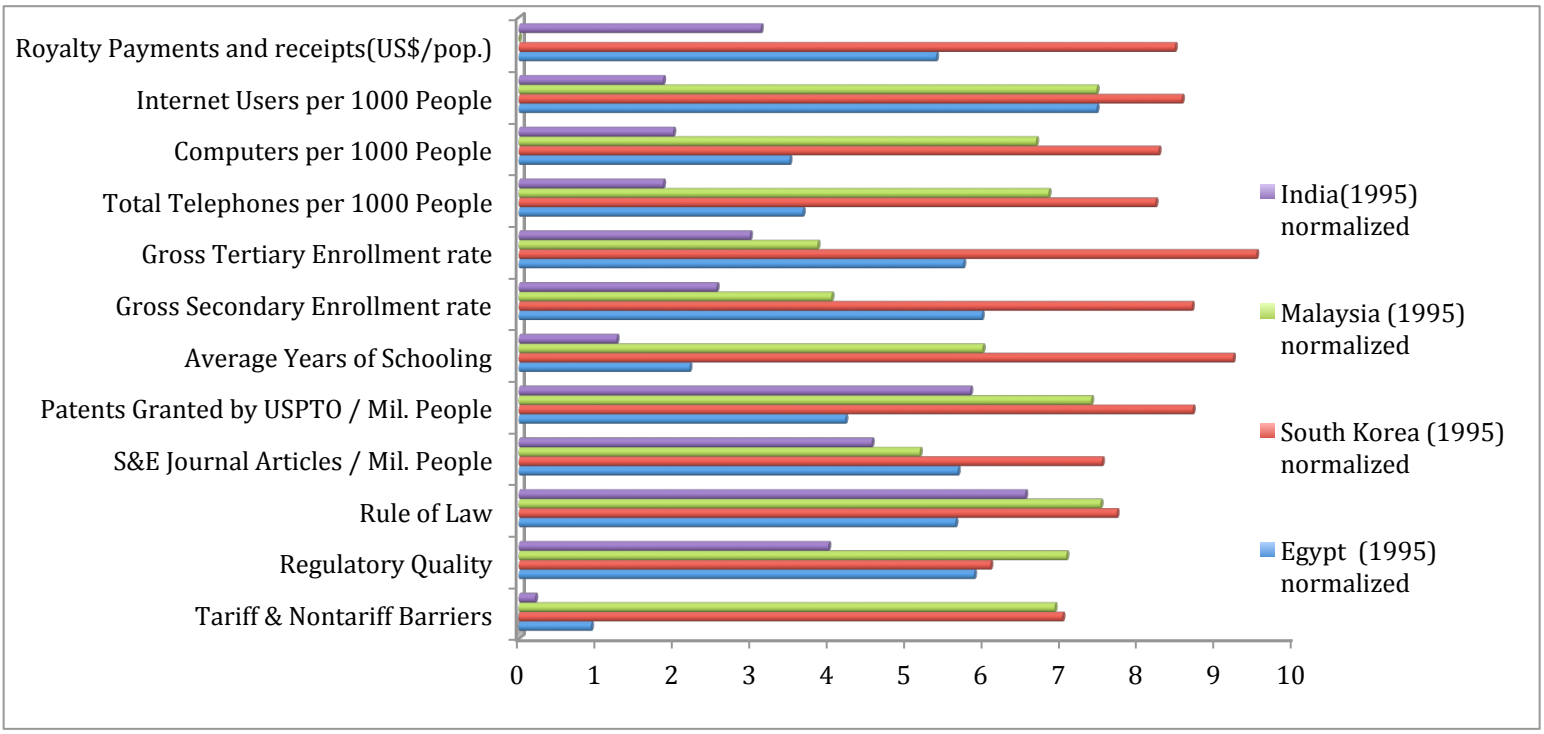
Among the other strategies undertaken by India in developing its Innovation system is the increase on R&D spending by the private sector. Also, big companies have funded R&D activities carried out by educational institutions. The government of India has formed the

National Innovation Foundation as part of developing the science and technology sector of India. (Asian Development Bank, 2007)

Networks and ICT: India has developed its IT- related industries to serve a variety of sectors; community e-centers in health care, education, and E-governments services. Also some programs were developed to serve specific group as women and children, vulnerable and marginalized groups as well through providing information and access to NGOs to assist them virtually. (Asian Development Bank, 2007)

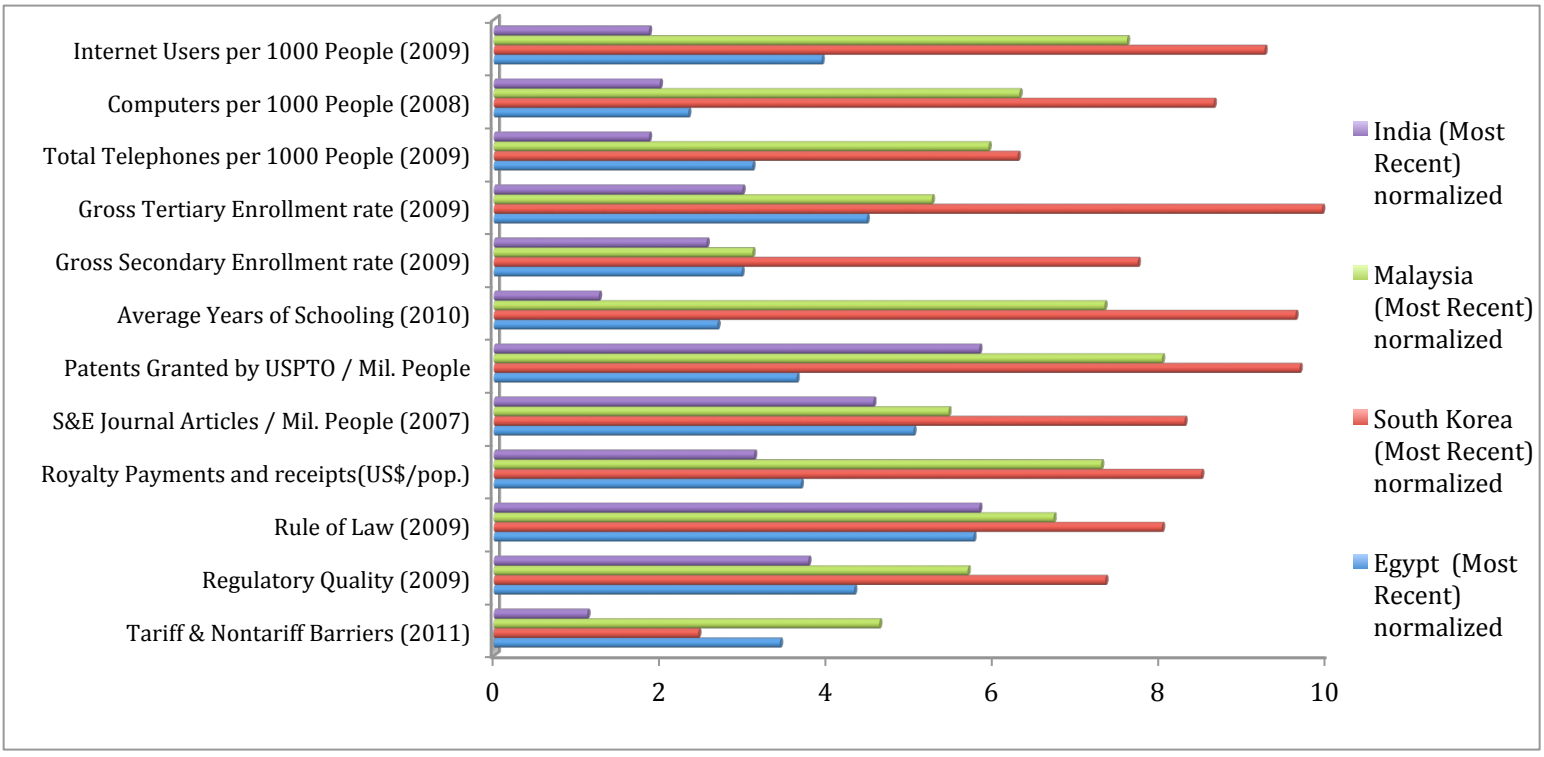
Policy and Regulatory Environments: India's government has identified eight key factors known as the 8 Cs to unlock ICTs for development: Connectivity, Content, Community, Commerce, Capacity, Culture, Capital, and Cooperation. Also, the easing of controls and regulations and the introduction of the "Broadband Policy" of the Indian government has encouraged MNCs and caused high Internet penetration allowing the knowledge capture in the country. (Asian Development Bank, 2007)

Figure 3: Comparison between Egypt, South Korea, Malaysia, and India (1995)



Source: KAM, (World Bank, 2012)

Figure 4: Comparison between Egypt, South Korea, Malaysia and India (Most Recent Years)



Source: KAM, (World Bank, 2012)

South Korea	**Korea ranks 29th in the 2012 knowledge Economy Index, falling five positions since 2000, where it ranked 24th and in 1995, it ranked 25th. (World Bank, 2012) Whereas, Egypt ranks 97th in the 2012 Index, deteriorating nine positions since 2000 where it ranked 88th and in 1995, it ranked 87th. (World Bank, 2012)** **As we can see from the previous comparison between Korea and Egypt, in 1995 and most recent years, we can see that Egypt has performed quite well on improving the Tariff and Nontariff Barriers since 1995 till 2011, where it has outperformed Korea in that indicator to give Egypt a good starting point in improving the Economic and Institutional Regime pillar by capitalizing on this success and focusing on improving Regulatory Quality and Rule of Law, which supposedly has worsened since 2009 (Most recent data) especially after the political unrest that the Arab region has witnessed in 2011.** **Korea's main competitive advantage would lie within its strong Education and Human Resources Pillar with great advancement in Gross Tertiary Enrollment rate, the Average years of schooling and in Patent Applications Granted by the US Patent and Trademark Office in the Innovation Pillar. In the ICT pillar, although Egypt was relatively close to Korea in the number of Internet users in 1995, but Korea however, has managed to breakthrough in 2009, and double the number of Internet users compared to Egypt.**
Malaysia	Malaysia ranks 48th in the 2012 knowledge Economy Index, falling three positions since 2000, where it ranked 45th and in 1995, it ranked 47th. (World Bank, 2012) In 1995, Malaysia and Egypt were equally in the number of Internet Users per 1000 (people) but in 2009, Malaysia managed to double Egypt in this indicator due to Egypt's fall tremendously in this indicator whereas Malaysia remained almost the same. In the ICT pillar, Malaysia also has performed better than Egypt in the number of Computers Per 1000 People. But the major breakthrough for Malaysia over Egypt was in the Innovation Pillar, the Patent Applications Granted by the US Patent and Trademark Office, and Royalty Payments and Receipts. Finally, the Education and Human Resources Pillar, Malaysia has declined in the Gross Secondary Enrollment Rate and so did Egypt and hence, they both were almost equal on that indicator however, Egypt is performing worse than Malaysia as in 1995, Egypt scored higher than Malaysia on that indicator. Malaysia has compensated this poor performance with the great progress it achieved in the Average Years of Schooling, from 1995 to 2010, unlike Egypt; where there was no remarked progress.
INDIA	India ranks 110th in the 2012 knowledge Economy Index, falling six positions since 2000, where it ranked 104th and in 1995, it ranked 106th. (World Bank, 2012) Even though Egypt ranks higher than India in the Knowledge Innovation Index still India outperforms Egypt in two very critical indicators, the Innovation Pillar, in the number of Patents Granted by USPTO/ Mil. People since 1995 till 2009 given India's unique case that we have discussed earlier but still managed to perform very well in Innovation Pillar and the Rule of Law in 1995 and 2009, and again might have increased in 2011 and thus needs to be updated as Egypt has declined tremendously in this particular indicator as per other reports used in this research.

F. Summary of Recommended Government Actions for Egypt from South Korea, Malaysia and India at Four Development Stages

	Education and Training	National Innovation System	Networks and ICT	Institutional and Regulatory Environments
Lower-Middle Income	-Enhance quality and expand access to secondary and vocational education. -Strengthen key higher education institutions by integrating into networks of advanced institutions worldwide.	-Intensify global scanning to find, acquire, and import relevant technologies. -Increase productivity and agricultural extension services. -Strengthen existing public R&D institutions and encourage private R&D.	Expand the use of the Internet to improve governance, logistics, business services, and delivery of social services	-Strengthen financial and labor markets to improve business environment. -Extend SEZs across the economy -Encourage more strategic FDI.

Source: (World Bank Institute, 2007)

Lessons learned from SOUTH KOREA	-Invest in basic and vocational education. - Use ICT to enhance and improve access to education.	- Start by importing ready-made technologies and then strengthen and invest in R&D to develop local technology. - Set a national Innovation plan and engage the important players in the policy making process. Create awareness campaign to ensure the whole nation is aware of the current innovation strategy adopted and where it is heading.	- E-Government. - Use ICT to create educational opportunities and delivery of social services such as Internet for disabled.	- Enact a comprehensive set of legislations and laws to set the stage for KBE.

Lessons learned from **MALAYSIA**	- The promotion of lifelong learning. - Re-orientation of the education and training systems to prioritize science and technology to link the university education with industry requirements. -Applying the "Brain Gain" Program	- The national innovation vision of Malaysia is derived from the aspirations of its people, as reflected in the vision 2020 by its leader, Dr. Mahathir Mohamed. 1. *Vision 2020* 2. *Launching a National Agenda.* 3. *Formulating a KBE Master Plan* 4. *Identifying Seven strategies to achieve the vision* -National Innovation council Chaired by the Prime Minster	-Use ICT as a tool for community, and business development and improve the life of citizens. *Community-Directed Projects: includes TaniNet Project and CyberCare.* *Business-Directed Projects: includes MSC and Flagship Applications Project.* *Government-Directed Projects: E-Government services*	- Establish and build the institutions necessary to allow the transition to a KBE. -Ensure that the incentives, infrastructure, and info structure would allow the application of knowledge in all sectors of the economy and the flourishing of knowledge-enabling, empowering and intensive industries
Lessons learned from **INDIA**	-Amending its constitution in 2002 to make elementary education a fundamental right for every child. -Initiating the National program for Universal Elementary Education, "Education for All" project. Encouraged the private sector to use ICT's in delivering education -The government of India investing in higher education in India	-National vision adopted by the President and re-stated every now and then. -The establishment of the National Knowledge Commission to guide the government of India into a KBE. -Private sector funding R&D activities carried out by educational institutions. -Establishing the National Innovation Foundation to develop S&T in India	- India has developed its IT- related industries to serve a variety of sectors; community e-centers in health care, education, and E-governments services. -Developing programs to serve specific group as women and children, vulnerable and marginalized groups.	-The 8 Cs to unlock ICTs for development: Connectivity, Content, Community, Commerce, Capacity, Culture, Capital, and Cooperation. -The easing of controls and regulations allowing the knowledge capture in the country

The previous section has managed to provide broad definitions for the different concepts introduced in this research, the Knowledge-Based Economy and the Knowledge Society; the Knowledge Assessment Methodology that measures the country's overall potential of knowledge development, its ability to generate, adopt and diffuse knowledge. And its measured through the three Knowledge Economy pillars – education and human resources, the innovation system and information and communication technology (ICT).

This has helped in studying the different successful global experiences of South Korea, Malaysia and India, looking at the different obstacles and challenges facing these countries in transforming to a KBE and the different strategies, policies and actions taken by these countries to overcome these challenges using the three KE pillars.

The research attempts to answer the following central question: How can Egypt transform to a Knowledge-based Economy? The literature review has provided us with guidelines on how to implement the process and what we need to further investigate to be able to come out with policy recommendations that could set Egypt on the right path towards transformation. It highlighted the main challenges and obstacles facing Arab and Developing countries in building an efficient Science and Technology System and transform to a Knowledge-Based Economy to give a general overview of the main obstacles Egypt is facing as an Arab and Third World Country. The comparisons between the different case studies and Egypt was meant to pinpoint the main strengths and weaknesses in Egypt's knowledge infrastructure.

The coming section shall focus entirely on Egypt, providing answers to the Sub-questions that were raised in the research: What are the main obstacles and challenges facing Egypt to enhance its STI system now? What are the effect of the current constitutional and legislative, cultural and political environment in Egypt on the advancement of Science, Technology and Innovation? What is the role of the government, private sector; public and private research centers and civil society in this transformational process? And finally, provide the recommendations for post-revolutionary Egypt to overcome the current challenges and move towards a knowledge-based economy.

IV. The case of Egypt

A. Environment Scanning

An Economic and Political Outlook

Political uncertainty remains high in Egypt after two years of the January 25th revolution. The rise of the Islamists and non-Islamists clash over the direction of policy still persists affecting the political and economic stability of the country causing Egypt to lag behind on all international indicators; and hindering the success of any reform initiatives. (The Economist Intelligence Unit, 2013) Egypt has managed to preserve macroeconomic stability in the period following the revolution, but a broad-based recovery of the economy has yet to set in. Growth has been held back due to political and policy uncertainty, security problems and the global slowdown. Moreover, Egypt has witnessed a major decline in international reserves and an increase in the fiscal deficit and domestic T-bill rates. (International Monetary Fund, 2012)

According to the country report issued by the Economist Intelligence Unit in April 2013, the fiscal deficit widened to 8.2% of GDP in the first eight months of 2012/2013 (July-Feb.) from 6.1% of GDP for the same period of 2010/2011. The EIU report expects the deficit to widen to 12.1% of GDP for the full fiscal year attributing it to the limited progress of government on reforms, the potential for ongoing popular unrest and political bickering. Egypt's business environment global ranking falls to 65th for the forecast period (2013-17) from 60th in the period (2008-2012), and its regional ranking remains unchanged at 9th. The business environment will continue to be affected by the high political and economic instability. (The Economist Intelligence Unit, 2013)

Vital Statistics

Table 2: Egypt's Vital Statistics

Annual Data and Forecast		2008	2009	2010	2011	2012	2013	2014
GDP	Nominal GDP (US$ bn)	164.8	188.0	214.4	231.0	254.4	245.0	276.6
	Real GDP growth (%)	7.2	4.7	5.1	1.8	2.2	2.0	3.5
Origin of GDP	Agriculture	3.3	3.2	3.5	2.7	2.9	3.2	3.2
	Industry	7.1	5.6	4.6	0.5	1.1	3.9	6.4
	Services	8.2	3.8	6.0	2.8	2.9	0.4	1.5
Population and Income	Population (m)	78.3	79.7	81.1	82.5	84.1	85.6	87.2
	GDP per head (US$ at PPP)	5,666	5,878	6,154	6,287	6,418	6,544	6,778
	Recorded unemployment (av; %)	8.7	9.4	9.0	12.0	13.5	14.8	14.1

Source: EIU Country Report April 2013, (The Economist Intelligence Unit, 2013)

- 2008-2012: Actual data
- 2013 and 2014 are EIU Forecasts
- Fiscal year data ending June 30th

Egypt in the Global Democracy Index

The Democracy Index provides a snapshot of the state of democracy worldwide for 165 independent states and two territories. The index assigns each country scores in five categories: political process and pluralism; civil liberties; the functioning of government; political participation; and political culture. Then the index combines these scores to generate an overall score, which places each country within one of four types of regime. Those with the highest score (8 and above on a scale of 0 to 10) constitute "Full Democracies". Next are "Flawed Democracies" (6 to 7.99), followed by "Hybrid regimes" (4 to 5.99) with elements of both democracy and authoritarianism, and finally "Authoritarian Regimes" (below 4). (The Economist Intelligence Unit, 2013)

There were slight developments in the Arab World from previous year to this year, however, democratization prospects remain highly uncertain, as many hopes for democratic transformation as a result of the Arab revolution were overambitious. Egypt's score rose sharply, allowing it to cross the threshold from authoritarian state to hybrid with an overall score of 4.56 and ranks 109 out of 167 countries reported in the Index. (The Economist Intelligence Unit, 2013)

Table 3: Egypt's Rank in the Democracy Index, 2012

	Rank	Overall Score	I. Electro process and pluralism	II. Functioning of government	III. Political Participation	IV. Political Culture	V. Civil Liberties
Hybrid Regimes							
Egypt	**109**	**4.56**	**3.42**	**4.64**	**5.00**	**5.63**	**4.12**

Source: EIU Country Report April 2013, (The Economist Intelligence Unit, 2013)

The transition to more democratic rule has been fought with difficulty in Egypt, underlining the fact that a true transition entails more than just a conceived democracy by holding elections; but requires a wide range of factors than includes the presence of a vibrant political culture, the rule of law, and robust public institutions. (The Economist Intelligence Unit, 2013) Which is the current case of Egypt, that has sparked large protests in the streets and deepened the schism between Islamists on one hand and liberals on the other with President Morsi insistence to continue abusing and extending his substantial power to place himself above the judiciary with his last move in late November ignoring whatever repercussions that may result from such an act. The extent of this polarisation in policy making process was also highlighted by the results of the referendum on the constitution held in December—an estimated 63.8% of voters cast their ballots in favor, but turnout was just 32.9%, meaning that the document was passed with the backing of only 20.9% of eligible voters. (The Economist Intelligence Unit, 2013)

Non-Islamists have questioned the legitimacy of the document on this basis and will continue to voice their concern over the concentration of power in the presidency and the Muslim Brotherhood. And that's what most of the interviewed participants whether from civil society, research centers or government have voiced their concern regarding the process of transition to democracy in Egypt, emphasizing that the strive for democracy is an on-going process and that it is up to the people to change their destinies. They urged that Egyptians must keep fighting for freedom with fierce and strong will because Egyptians are now standing at crossroads and if they don't make a stand and insist on their basic and fundamental rights of freedom and democracy then they have failed their country before failing themselves. We must all believe that every voice counts and therefore, we should not give up and stay away and watch, we should get up

from the back seat to the driver's seat and chose to make a difference no matter what. The EIU report argues that even though the Arab protests remains a brave inspiring example for a strong desire and quest for democracy, still, it is not enough to build a sturdy democracy, democracy can be fragile and thus establishing and sustaining it require persistence and vigilance, and even long-established democracies are vulnerable to corrosion if not nurtured and protected. (The Economist Intelligence Unit, 2013)

The renewed serious violence since the second anniversary of the January 25th, 2011 uprising has further demonstrated the fractured state of Egyptian society and has exposed the failings of key institutions, including the presidency, the judiciary and the forces of law and order. Civil unrest may escalate and sporadic incidents of sectarian violence will continue. (The Economist Intelligence Unit, 2012) What Egyptians currently need from the government is information, confidence and transparency. Transparency and participation are key factors for ensuring broad popular support for any reform policies. This calls the government to adopt a new approach in policymaking, one that is based on openness, disclosure and enhanced communication with the society at large. Government meetings should be open to the press. Free access to information and data (including the state budget) should be everybody's right. New laws and major decisions should be subject to public discussions, keeping those agreed upon behind closed doors to a minimum. There is a need for a freedom of information law, together with updated laws on corruption and conflict of interests. The right to information, and the state duty to provide information on government finances, should be included in the constitution. (Chatham House, 2012)

Moreover, there is the added dilemma that transparency and participation are not part of Egypt's civil service culture. In order to have real participatory processes, a lot of time, political will and effective management is needed. Thus these efforts may sometimes seem futile since decision-making powers remain within few circles, and other groups such as youth and women remained excluded. However, the benefits of getting people to own reforms can be enormous (Ghanem, 2012). Egyptians proactively participating in shaping the future of their country will increase both the feeling of ownership and give incentives for innovation and further development. They need to be able to see the light at the end of the tunnel, and trust their leaders' willingness and ability to finally put the country back on the right track (Youssef, 2012).

Egypt in the African Governance Index

Table 4: Egypt's Rank in the IIAG 2006-2012

Rank in 2012 (Out of 52)	**Egypt Score (Out of 100)**						
14th	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
	58	60	60	61	60	58	58

Source: The Mo Ibrahim Index 2012, (Mo Ibrahim Foundation, 2012)

Table 5: Egypt's Performance in the Four Main IIAG Categories

Egypt	Rank in 2011	Annual Scores						Change since 2006
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	
Safety and Rule of Law	**20th**	59	63	64	65	62	57	**-2**
Sustainable Economic Opportunity	**3rd**	59	62	64	70	71	68	**+10**
Participation and Human Rights	**46th**	35	38	34	36	33	31	**-4**
Human Development	**9th**	77	79	79	74	74	74	**-3**

Source: The Mo Ibrahim Index 2012, (Mo Ibrahim Foundation, 2012)

Egypt has shown unfavorable governance performance since 2006. Over the past six years, Egypt has declined in three of the main IIAG categories- particularly- Safety and Rule of Law, and Participation and Human Rights with great deterioration in the Participation Sub-Category, which assesses the extent to which citizens have the freedom to participate in the political process. (Mo Ibrahim Foundation, 2012)

B. Science, Technology and Innovation: An Overview

Egypt in the Knowledge Economy Indexes

This section tends to shed the light on where Egypt stands in terms of science, technology and innovation on the regional and international rankings, and draw the attention to the pressing need to focus on these issues and try and understand and analyze the reason for such lag.

According the World Bank's Knowledge Assessment Methodology, Egypt ranks 97 from 146 countries in the Knowledge Economy Index (KEI) for 2012 rankings. The following tables illustrate Egypt's ranking in the KE different indexes and KE pillars in 1995, 2000, and 2012.

Table 6: Egypt's Rank in the KEI 1995, 2000 and 2012

Country/ Economy	**2012 Rank**	KEI 2012	**2000 Rank**	KEI 2000	**1995 Rank**	KEI 1995	**Change from 1995 to 2000**	**Change from 2000 to 2012**	**Change from 1995 to 2012**
Egypt	**97**	3.78	**88**	4.29	**87**	4.68	**-1**	**-9**	**-10**

Source, KAM 2012 (www.worldbank.org/kam) (World Bank, 2012)

Table 7: Egypt Knowledge Indexes 1995, 2000 and 2012

Index	2012	2000	1995	Change from 1995 to 2000	Change from 2000 to 2012	Change from 1995 to 2012
Knowledge Economy Index (Average of 3, 4, 5, 6)	3.78	4.29	4.68	-0.39	-0.51	-0.9
Knowledge Index (Average of 4, 5, 6)	3.54	4.49	4.86	-0.37	-0.95	-1.32
Economic Incentive and Institutional Regime	4.50	3.68	4.14	-0.46	+0.82	-0.36
Education	3.37	4.66	4.64	+0.02	-1.29	-1.27
Innovation	4.11	5.03	5.08	-0.05	-0.92	-0.97
ICT	3.12	3.77	4.87	-1.1	-0.65	-1.75

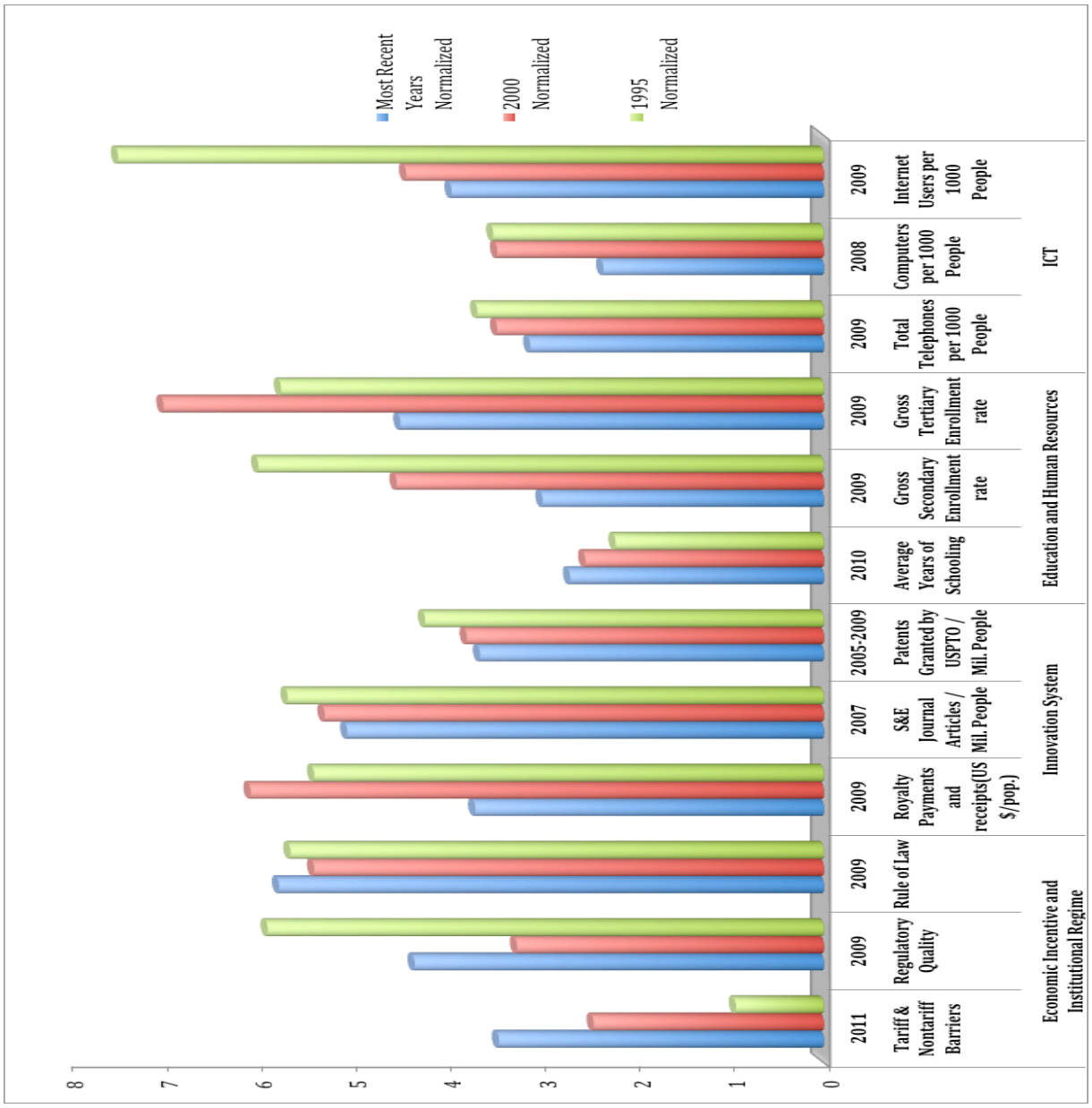
Source, KAM 2012 (World Bank, 2012)

Table 8: Indicators of the KEI for Egypt 1995, 2000 and Most Recent Years

Variable		Egypt, Arab Rep. (Most Recent)			Egypt, Arab Rep. (2000)		Egypt, Arab Rep. (1995)	
			Actual	Normal-ized	Actual	Normal.	Actual	Normal.
Economic Incentive and Institutional Regime	Tariff & Nontariff Barriers	**2011**	74	3.43	55	2.43	25	0.93
	Regulatory Quality	**2009**	-0.14	4.32	-0.28	3.24	0.41	5.87
	Rule of Law	**2009**	-0.03	5.75	-0.04	5.38	0.06	5.63
Innovation System	Royalty Payments and receipts (US$/pop.)	**2009**	3.43	3.68	6.91	6.05	2.35	5.38
	S&E Journal Articles / Mil. People	**2007**	24.16	5.03	21.54	5.27	22.88	5.66
	Patents Granted by USPTO / Mil. People	**2005-2009**	0.07	3.63	0.07	3.77	0.04	4.21
Education and Human Resources	Average Years of Schooling	**2010**	7.08	2.68	5.91	2.52	5.06	2.2
	Gross Secondary Enrollment rate	**2009**	67.2	2.97	75.78	4.51	76.51	5.97
	Gross Tertiary Enrollment rate	**2009**	28.45	4.47	35.18	6.97	20.17	5.73
ICT	Total Telephones per 1000 People	**2009**	790	3.1	100	3.45	40	3.66
	Computers per 1000 People	**2008**	40	2.33	10	3.45	0	3.49
	Internet Users per 1000 People	**2009**	200	3.93	10	4.41	0	7.45

Source, KAM 2012 (World Bank, 2012)

Figure 5: Egypt Performance in the KE Indicators 1995, 2000 and Most Recent Years



Egypt in the Global Competitiveness Index

Table 9: Egypt's Performance in the GCI 2008-2009 to 2012-2013

Country	Pillars	Egypt's ranking (Out of 134) Countries 2008-2009	Egypt's ranking (Out of 133) Countries 2009-2010	Egypt's ranking (Out of 139) Countries 2010-2011	Egypt's ranking (Out of 142) Countries 2011-2012	Egypt's ranking (Out of 144) Countries 2012-2013
Egypt Overall Ranking		**81**	**70**	**81**	**94**	**107**
Basic Requirements		**83**	**78**	**89**	**99**	**110**
1st Pillar	Institutions	**52**	**56**	**57**	**74**	**96**
2nd Pillar	Infrastructure	**60**	**55**	**64**	**75**	**83**
3rd Pillar	Macroeconomic Stability	**125**	**120**	**129**	**132**	**138**
4th Pillar	Health and Primary Education	**88**	**84**	**91**	**96**	**94**
Efficiency Enhancers		**88**	**80**	**82**	**94**	**101**
5th Pillar	Higher Education and Training	**91**	**88**	**97**	**107**	**109**
6th Pillar	Goods Market Efficiency	**87**	**87**	**90**	**118**	**125**
7th Pillar	Labor Market Efficiency	**134**	**126**	**133**	**141**	**142**
8th Pillar	Financial Market Sophistication	**106**	**84**	**82**	**92**	**102**
9th Pillar	Technological Readiness	**84**	**82**	**87**	**95**	**91**
10th Pillar	Market Size	**27**	**26**	**26**	**27**	**29**
Innovation and Sophistication Factors		**74**	**71**	**68**	**86**	**96**
11th Pillar	Business Sophistication	**77**	**72**	**63**	**72**	**83**
12th Pillar	Innovation	**67**	**74**	**83**	**103**	**109**

Source: The Global Competitiveness Report (World Economic Forum, 2009, 2010, 2011, 2012)

Egypt remains between stage 1 and stage 2 of development, which is the transition stage from a Factor-driven Economy to an Efficiency-driven economy. The GCR identifies 5 different stages of developments and indicates the position of each country in these stages.

1. Stage 1: Factor-driven Economy.
2. Transition from Stage 1 to Stage 2
3. Stage 2: Efficiency-driven Economy.
4. Transition from Stage 2 to Stage 3.
5. Stage 3: Innovation-driven Economy.

Egypt has declined drastically in the GCI 2012-2013, to reach 107th place, this was mainly attributed to the high uncertainty caused by the political transition the country has been going through since the Jan. 25th revolution. According to the report, government efficiency has deteriorated by 22 positions to 106th and the security situation, which was particularly affected by the events, has dropped 40 ranks to 128th. Many challenges lie ahead for the new government to put Egypt on a sustainable and equitable growth path. (World Economic Forum, 2011)

The great deterioration witnessed in the Efficiency Enhancers particularly labor market efficiency pillar and the Innovation pillar is a result of years of negligence by the government in addressing these fundamental issues. The quest to move towards a knowledge-based economy won't be possible if these cornerstones issues are not addressed and given serious attention by policy makers and government. The coming table links the KE pillars with the GCI pillars, highlighting Egypt's competitive advantages and disadvantages in the KE pillars.

Table 10: Egypt's Competitive Advantages and Disadvantages in the KE Pillars

GC Index In the KE Pillars	Egypt's ranking (Out of 134) Countries 2008-2009	Egypt's ranking (Out of 133) Countries 2009-2010	Egypt's ranking (Out of 139) Countries 2010-2011	Egypt's ranking (Out of 142) Countries 2011-2012	Egypt's ranking (Out of 144) Countries 2012-2013
Economic Incentive and Institutional Regime					
Intellectual Property Protection	60	67	67	80	83
Favoritism in decisions of government officials	61	81	95	105	74
Wastefulness of Gov. Spending	86	61	51	87	113
Burden of government regulation	55	70	79	95	113
Efficiency of legal framework in setting disputes	55	39	40	60	86
Efficiency of legal framework in challenging regs.	-	63	69	86	100
Transparency of government policy making	67	57	68	108	113
Gov't services for improved business performance	-	-	-	-	80
Business cost of crime and violence	23	53	97	109	133
Reliability of policy services	52	54	81	83	106
Ethical behavior of firms	53	52	59	90	73
Strength of auditing and reporting standards	66	50	58	99	104
Strength of investor protection	-	-	59	60	65
Extent and effect of taxation	34	52	75	64	87
Total tax. Rate, % of profits	80	79	78	83	87
No. Procedures to start a business	34	26	34	34	47
No. Days to start a business	16	15	21	21	25
Prevalence of trade barriers	118	114	114	104	124
Trade tariffs, % duty	132	131	123	132	133
Prevalence of foreign ownership	78	66	100	112	112
Business impact of rules on FDI	83	63	75	98	110
Burden of customs procedures	77	68	50	75	90
Import as a percentage of GDP	-	-	-	113	116
Availability of financial services	-	-	60	79	88
Ease of access to loans	79	44	49	74	84
Venture capital availability	46	34	41	41	40

Information and Communication Technologies Infrastructure					
Quality of overall infrastructure	57	56	68	80	88
Quality of electricity supply	53	51	53	74	82
Mobile telephone subscription/100 pop.	106	97	102	90	84
Fixed telephone lines/100 pop.	79	73	87	87	90
Internet access in schools	99	95	96	107	116
Individual using internet, %	92	78	90	86	78
Broadband Internet subscriptions/100 pop.	86	82	91	91	90
Int'l internet bandwidth, kb/s per user	-	-	72	86	97
Mobile broadband subscriptions/100 pop.	-	-	-	-	46
Education and Training					
Quality of primary education	129	124	126	131	137
Primary education enrollment, net%	63	45	73	66	59
Secondary education enrol, gross%	65	68	90	92	101
Tertiary education enroll., gross%	59	63	78	77	73
Quality of the education system	126	123	131	135	139
Quality of math and science education	128	124	125	132	139
Quality of management schools	116	114	122	133	137
Availability of research and training services	92	78	64	83	99
Extent of staff training	96	106	112	131	129
Cooperation in Labor-employer relations	50	46	99	121	128
Flexibility of wage determination	62	56	60	71	55
Hiring and firing practices	92	72	76	71	116
Redundancy costs, weeks of salary	119	121	128	87	132
Pay and productivity	114	93	76	96	112
Reliance on professional management	124	106	86	121	134
Brain drain	129	123	114	122	132
Women in labor force, ratio to men	133	127	130	138	139

Innovation and Technological Adoption					
Availability of latest technologies	60	66	91	110	115
Firm-level technology absorption	63	48	58	78	86
FDI and technology transfer	55	30	53	67	75
Capacity for innovation	85	96	109	83	80
Quality of scientific research inst.	96	101	110	113	114
Company spending on R&D	57	54	74	106	116
University industry collaboration in R&D	79	96	120	128	128
Gov't procurement of advanced tech products	57	72	86	104	95
Availability of scientists and engineers	47	53	25	40	61
PCT patents, applications/million pop.	70	86	84	74	73

Source: (World Economic Forum, 2009, 2010, 2011, 2012)

There are a lot of challenges ahead of Egypt as we can see from the table above; the government should initiate a complete reform in the labor market and the education system. The concept of freedom is closely related with Egypt's chronic problem of education. The education system in Egypt lacks all kind of creativity and freethinking, an education system that was built in an oppressive environment that did not allow any kind of questioning and does not give any attention to talents and exceptional individuals. Egypt needs to address the pronounced skill mismatch between educational outcomes and business community needs, which has been the prime factor for unemployment in Egypt. Arab World Competitiveness Report 2012 calls Egypt for enhancing its competitiveness through addressing the quality of scientific and research institutions, their twinning with business needs, the intensity of research and development, and its implications for product and process innovations." (WEF, 2011-2012).

The education system in Egypt's needs a revamp to gear educational outcomes more strongly towards the business community and ensure high enrollment. On the other side, the labor market in Egypt suffers from an inefficient use of available talents, rigid labor regulations, low women participation and little cooperation between labor and employers. Creating more job opportunities will require boosting demand for labor by establishing a framework that would allow for more vibrant domestic competition and greater openness to trade and FDI. "Going forward, providing Egypt's population with opportunities and prosperity in the future will require putting the country on a higher and more sustainable growth path. This can be achieved only by resisting pressures against the reform process in these challenging times and focusing on a competitiveness-enhancing agenda that will raise the economy's productivity levels." (World Economic Forum, 2011)

Egypt in the Global Innovation Index

Table 11: Egypt Rank in the GII 2012

Country/Economy	Score in the GII (0-100)	Rank (Out of 141 Countries)	Income	Rank	Region	Rank
Egypt	**27.9**	**103**	**LM**	**21**	**NAWA**	**17**

Source: The Global Innovation Index, (INSEAD & WIPO, 2012)
-Country's classification:
LI: Low Income/ LM: Lower-Middle Income/ UM: Upper-Middle Income/ and HI: High Income
-Region's Classification:
EUR: Europe/ NAC: Northern America/ LCN: Latin America and the Caribbean/ CSA: Central and Southern Asia/ SEAO: South East Asia and Oceania/ NAWA: Northern Africa and Western Asia/ and SSF: Sub-Saharan Africa

Table 12: Egypt's Performance in the GI Indexes

	Rank
Global Innovation Index 2012	103
Innovation Output Sub-Index	99
Innovation Input Sub-Index	104
Innovation Efficiency Index	78
Global Innovation Index 2011 (Out of 125)	87

Source: The Global Innovation Index, (INSEAD & WIPO, 2012)

Table 13: Egypt Innovation Index- Country Economy Profile 2012 imbedded in the KE Pillars

GII Indicators in the KE Pillars	Rank (Out of 141)
Economic Incentive and Institutional Regime	
Institutions	**116**
Political Environment	**130**
Political stability	115
Government effectiveness	91
Press freedom	132
Regulatory Environment	**126**
Regulatory quality	84
Rule of Law	64
Cost of redundancy dismissal, salary weeks	131
Business Environment	**86**
Ease of starting a business	17
Ease of resolving insolvency	118
Ease of paying taxes	104
Market Sophistication	**108**
Credit	**105**
Ease of getting credit	72
Domestic credit to private sector, % GDP	89
Microfinance gross loans, % GDP	71
Investment	**71**
Ease of protecting investors	60
Venture capital deals/ tr PPP$ GDP	58
Trade and Competition	**121**
Applied tariff rate, weighted mean, %	108
Imports of goods and services, % GDP	122
Exports of goods and services, %GDP	122
Intensity of local competition	110
Education and Training	
Human Capital and Research	**108**
Education	**86**
Current expenditure on education, %GNI	58
Public expenditure/pupil, %GDP/cap	77

School life expectancy, years	92
PISA scales in reading, math, and science	n/a
Pupil-teacher ratio, secondary	81
Tertiary Education	**113**
Tertiary enrolment, % gross	72
Graduates in science and engineering, %	n/a
Tertiary inbound mobility, %	67
Gross tertiary outbound enrolment, %	136
Research and Development (R&D)	**110**
Researchers, headcounts/mn pop.	55
Gross expenditure on R&D, % GDP	83
Quality of Scientific research institutions	110
Business Sophistication	**114**
Knowledge workers	**75**
Knowledge-intensive employment, %	41
Firms offering formal training, % of firms	87
R&D performed by business, %	n/a
R&D financed by business, %	n/a
GMAT mean score	96
GMAT test takers/mn pop. 20-34	82
Information and Communication Technologies Infrastructure	
Infrastructure	**70**
ICT	**49**
ICT access	73
ICT use	84
Government's on-line service	42
E-participation	15
General Infrastructure	**122**
Creative Outputs	**106**
Creative Intangibles	**106**
ICT and business model creation	70
ICT and organizational model creation	92
Online Creativity	**104**
Generic top-level domains (TLDs)/th pop. 15-69	108
Country-code LTDs/th pop. 15-69	120
Wikipedia monthly edits/mn pop. 15-69	94
Video uploads on YouTube/pop. 15-69	88

Innovation and Technological Adoption	
Knowledge and Technology Outputs	**92**
Knowledge Creation	**72**
Domestic resident patent ap/bn PPP$ GDP	65
PCT resident patent ap/bn PPP$ GDP	82
Scientific and Technical articles/bn PPP$ GDP	58
Knowledge Impact	**97**
Growth rate of PPP$ GDP/worker, %	52
New businesses/th pop. 15-64	93
Computer software spending, %GDP	56
ISO 9001 quality certificates/bn PPP$ GDP	71
Knowledge Diffusion	**104**
Royalty and License fees receipts/th GDP	33
High-tech exports less re-exports, %	92
Computer and comm. Service exports, %	100
FDI net outflows, % GDP	52
Knowledge Absorption	**119**
Royalty and License fees payments/th GDP	71
High-tech imports less re-imports, %	95
Computer and comm. Service imports, %	87
FDI net inflows, % GDP	61
Innovation Linkages	**116**
University/industry research collaboration	122
State of cluster development	77
R&D financed by abroad, %	n/a
JV-strategic alliance deals/tr PPP$ GDP	68
PCT patent filings with foreign inventor, %	77
Creative Goods and Services	**68**
Recreation and culture consumption, %	83
Creative goods exports, %	17
Creative services exports, %	71

Source: (INSEAD & WIPO, 2012)

Egypt in the World Science and World Intellectual Property Indexes

The coming section shall indicate the current status of Science in Egypt compared to the rest of the world. Highlighting where Egypt stands in terms of science, scientific research publications and patents applied for on the international arena.

Table 14: Egypt's Performance on World Researchers Indicators, 2002 and 2007

	Researchers (Thousands)		World Share of Researchers (%)		Researchers/ Million inhabitants		GERD/ Researcher (PPP$ 000s)	
	2002	2007	2002	2007	2002	2007	2002	2007
World	**5,810.7**	**7,209.7**	**100.0**	**100.0**	**926.1**	**1080.8**	**136.0**	**158.9**
Developed Countries	4,047.5	4,478.3	69.7	62.1	3,363.5	3,655.8	161.3	195.0
Developing Countries	1,734.4	2,696.7	29.8	37.4	397.8	580.3	78.5	100.5
Least Dev. Countries	28.7	34.7	0.5	0.5	40.5	43.4	37.6	43.8
Americas	**1,628.4**	**1,831.9**	**28.0**	**25.4**	**1,890.9**	**2,1010.1**	**196.4**	**236.9**
Europe	**1,870.7**	**2,123.6**	**32.2**	**29.5**	**2,348.5**	**2.638.7**	**127.5**	**147.9**
Africa	**129.0**	**158.5**	**2.2**	**2.2**	**150.2**	**164.3**	**53.1**	**64.6**
Arab States in Africa	84.1	98.4	1.4	1.4	444.1	477.1	30.2	33.3
Asia	**2,064.6**	**2,950.6**	**35.5**	**40.9**	**554.2**	**745.9**	**103.6**	**125.2**
Oceania	**118.0**	**145.1**	**2.0**	**2.0**	**3,677.6**	**4,208.7**	**95.1**	**125.9**
Arab States All	105.2	122.8	1.8	1.7	354.9	373.2	34.3	38.4
Commonwealth of Independent States all	**621.0**	**591.2**	**10.7**	**8.2**	**2,221.1**	**2,133.8**	**30.4**	**47.7**
OECD	**3,588.1**	**4,152.9**	**61.7**	**57.6**	**3,121.2**	**3,492.8**	**184.3**	**215.5**
European Free Trade Association	**48.3**	**52.9**	**0.8**	**0.7**	**3,976.6**	**4,209.1**	**202.3**	**257.3**
Sub-Saharan Africa	**45.0**	**60.1**	**0.8**	**0.8**	**67.1**	**79.2**	**96.0**	**115.8**
Egypt	**-**	**49.4**	**-**	**0.7**	**-**	**616.6**	**-**	**18.5**

Source: World Science Report 2010, (UNESCO, 2010)

Table 15: Egypt's Share in World Scientific Publications 2002 and 2008

	Total Publications		Change (%) 2002-2008	World Publications (%)	
	2002	2008		2002	2008
World	**733,305**	**986,099**	**34.5**	**100.0**	**100.0**
Developed Countries	617,879	742,256	20.1	84.3	75.3
Developing Countries	153,367	315,742	105.9	20.9	32.0
Least Dev. Countries	2,069	3,766	82.0	0.3	0.4
Americas	**274,209**	**348,180**	**27.0**	**37.4**	**35.3**
Europe	**333,317**	**419,454**	**25.8**	**45.5**	**42.5**
Africa	**11,776**	**19,650**	**66.9**	**1.6**	**2.0**
Arab States in Africa	4,988	8,607	72.6	0.7	0.9
Asia	**177,743**	**303,147**	**70.6**	**24.2**	**30.7**
Oceania	**23,246**	**33,060**	**42.2**	**3.2**	**3.4**
Arab States All	8,186	13,574	65.8	1.1	1.4
Commonwealth of Independent States all	**31,294**	**34,217**	**9.3**	**4.3**	**3.5**
OECD	**616,214**	**753,619**	**22.3**	**84.0**	**76.4**
European Free Trade Association	**18,223**	**25,380**	**39.3**	**2.5**	**2.6**
Sub-Saharan Africa	**6,819**	**11,142**	**63.4**	**0.9**	**1.1**
Egypt	**2,569**	**3,963**	**54.3**	**0.4**	**0.4**

Source: World Science Report 2010, (UNESCO, 2010)

Table 16: Scientific Publications Per Million in Egypt and Selected Countries 2010

Finland	2645	Iran	377	**Egypt**	**102**
South Korea	1141	Kuwait	375	Algeria	82
Malaysia	524	Jordan	344	Libya	73
Qatar	495	Lebanon	300	Morocco	71
UAE	448	Oman	278	Iraq	23
Tunisia	425	Saudi	226	Syria	19
Turkey	409	Brazil	233		

Source: (Bond, Maram, Soliman, & Khattab, 2012)

Table 17: Patents Applied for in Egypt and Selected Countries 2010

Country	Residents	Non-Residents	Total
Brazil	2705	19981	806
Egypt	605	1625	2230
Finland	1731	102	1833
Jordan	45	429	474
South Korea	131805	38296	170101
Malaysia	1233	5230	6463

Source: (Bond, Maram, Soliman, & Khattab, 2012)

Table 18: No. of Patents Granted to Egypt and Selected Countries by the US Patent and Trademark Office

Country	2006	2007	2008	2010
Egypt	**6**	**13**	**10**	**20**
Turkey	77	49	139	-
Malaysia	147	234	226	-
China	1215	1460	2224	-
India	871	1013	1275	-
Brazil	352	334	386	-

Source: World Intellectual Property Indicators 2009, (WIPO, 2011)

C. Challenges and Obstacles Facing Egypt in enhancing its STI System

The coming section, shall elaborate in details the obstacles and challenges facing Egypt in enhancing its STI system and transform to a KBE based on the interviews conducted with the experts in the filed, and incorporated within the knowledge economy main pillars (Education and the Skilled Workforce, National Innovation System, Networks and ICT, Policy and Regulatory Environments) as with the case of South Korea, Malaysia and India.

Most of the experts interviewed summarized the main challenges facing Egypt in transforming to a KBE as follows:

- **First: Culture**
- **Second: National Vision and Strategy**
- **Third: Human Resources, Education and Training**
- **Fourth: Institutional and Regulatory Framework**
- **Fifth: Role of Different Players in [Funding, Marketing, Monitoring and Evaluation].**

Culture

People interest in science in general in Egypt appears to be very low. The problem is that people don't see science as an integral part of our culture and as a solution to our societal problems. And scientists and researchers fail to engage scientific research in the pressing issues of our time, abolish hunger and reduce poverty, promote scientific outlook and the values of science which are: rationality, creativity, and the search for truth. (Serageldin, 2007)

> *"It is obvious through many international indicators for STI, that we are lagging behind. We have certainly lost this environment over decades of consistent downgrading of science and scientists. More seriously, we are at a point where researchers' and academicians themselves do not believe in science as the remedy for our economic and social challenges. Also, the general environment of freedom and rights of the citizen in Egypt over the past 6 decades, which could be described, as both oppressive and repressive, talents don't survive in such atmosphere"* Dr. Alaa Adris, Chief Knowledge Officer.

Civil society representative, Dr. Alaa Adris explains the effect of culture on enhancing Egypt STI system highlighting the importance of having an environment that fosters innovation and creativity, supports freedom and questioning. According to the democracy index, Egypt has just moved from an authoritarian regime to a hybrid regime; a mix of democracy and authoritarianism after the revolution, so it's our duty now to protect this democracy that we strived for, nourish it and spread its values in society until it prevails, and we should start by building a culture that is open and tolerant to change and embraces the new.

The fear that the ruling party, the Muslim Brotherhood's ambitions for an Islamic State might contradict with the pursuit of Egypt towards a culture that protects freedoms, should make Egypt prepared to fight for the values of science and reject bigotry, fanaticism, and xenophobia. "The defense against extremist is not by censorship or autocracy; it is by pluralism and defeating ideas

with ideas" Ismail Serageldin through Science and Innovation in Egypt Report (Bond, Maram, Soliman, & Khattab, 2012)

Historically and as argued in the Arab Human Development Report, Arab culture did not constitute a closed system, but rather displayed, at major historical junctures, a profound ability to open up, develop and transcend itself. It welcomed the experiences of other nations and incorporated them in its knowledge systems and way of life, regardless of the differences and variations that distinguished Arab societies from those nations and their experiences. (UNDP & RBAS, 2003)

Dr. Magdi Ishak, Orthopedic Surgeon and the President of the Egyptian Medical Society UK tackled the same point regarding the Arab culture, he says:

> *"Creativity is vital because if you cannot have creative environment, you will oppress scientific research. Scientific research is challenging the status quo so it has to be free and creative. And to be creative, we should not have any fears from freethinking. Because what the history (the Arab history) tells us since Ibn Rushd, who has thought very broadly and very freely. From Ibn Rushd, the west has adopted his writings and his translations and his thoughts since the middle century, when the west was in the Balkans and progressed. The Arab decided to reject what he said, and we know what happened to the Arab from the middle century 50 and 60th century till now. This is a real example of really how people adopting freethinking shall progress and when you translate all the different writings and transfer all the knowledge to the people, you learn a lot and you develop and add to these thoughts, you progress and that what the west France, UK, and Rome did. They took these thoughts and advanced because of this man. The Arabs however, has not contributed from the 60th century till now anything of a value. "*

Ibn Rushd is not the only example of the Arab legacy of tolerance and open-minded inquiry. Contemporary to Ibn Rush and Ibn Al-Haytham in Egypt, Abul Alaa' Al Ma'ari (973-1057) lived in Syria. Al-Ma'ari, a giant of Arabic literature, wrote poetry attacking religion, God and the prophets, and he was not punished for it, even though a certain amount of opprobrium attached to his name. His work was not only published and known in his own time, it has passed down to us in the 21st century without loss.

Moreover, even those who totally rejected his heretical writings appreciated him for his talents as a poet and a linguist. (Egyptian National Competitiveness Council , 2006)

The current political situation in Egypt today does not live up to the Arab legacy of freedom of thoughts and expression, as the current environment now is characterized by a lack of press freedom, as reflected in the Press Freedom Index produced by Reporters Without Borders (2010). Independent media outlets have been closed down, whilst journalists and bloggers have been subjected to attacks, police harassment, and imprisonment. (Transparency International, 2012) Egypt ranked 46th from 52 countries in the MO Ibrahim Index for Governance in the Participation and Human Rights Category, with lowest regional average in Rights Sub-category which include "Freedom of Expression" as an indicator. And ranked 132 out of 141 countries in Global Innovation index for Press Freedom.

Science, research, and innovation could never flourish in an oppressive environment as explained by interviewed participants. They can't grow when fear exists, when people cannot speak or think freely or creatively. We need to guarantee independence, through guaranteeing freedom of all kinds i.e. intellectual freedom, freedom of expression, freedom of thoughts, freedom of creativity, and freedom of questioning. As it is well established that effective pursuit of science requires the protection of independence. "Without independence of inquiry, there can be no true scientific research". (Serageldin, 2007)

The role of Media would have been pivotal at this critical time to increase people awareness about the value and importance of science and scientific research, have not been affected by the restrictions imposed on them by the political system and also, the lack of science journalism training.

National Vision and Strategy

One of the most urging and critical issues tackled by most participants whether from government, research centers or civil society is the absence of a clear vision and a well-defined national STI strategy.

> *"The lack of an owner for the national interest in STI is a fundamental issue; the absence of a national STI Policy and strategy for Egypt is another critical shortcoming. Basically, all three key elements of STI are in disparate need to be re-established, the Researcher, the Research Topic and the Research Resources."* Dr. Alaa Adris

As explained further by participants, the existence of such a strategy is necessary to define a plan of action that:

- Indicate the roles of the various R&D institutes;
- Define the R&D priorities;
- Indicate how the funding is allocated and focused on strategically important research priorities, to ensure effectiveness of the utilization of the funds available;
- Mobilize the existing uncoordinated S&T capabilities towards effectively serving the national development needs of Egypt;
- Create capabilities and an environment conductive to acquiring, diffusing, and improving foreign technology, as well as developing local technology.
- Develop mechanisms to technology assessment for sustainable development with an emphasis on environmental considerations.
- Ensure effective integration of S&T policy with other socio-economic policies such as economic, educational, industrial, agricultural and health.

Human Resources, Education and Training

Egypt expenditure on education in 2008 was 3.8% of GDP and 11.9% of total government expenditure. (Bond, Maram, Soliman, & Khattab, 2012). As seen from the successful cases discussed earlier of South Korea and Malaysia, investing in education should become the number one priority of the government. Government should increase the education budget to overcome many of the current deficiencies that exist in the system including:

- Poor quality of educational inputs and processes;
- Limited access to educational opportunities especially in the poor and deprived areas;
- Under-developed university research capability and linkages to the national innovation system

The number of students entering universities or higher technical colleges has nearly doubled in the last 25 years. There are now around 2.5 million students in higher education, nearly 30% of the 18 to 23 year old age group (Cairo University alone has some 265,000 students, according to the Ministry of Higher Education). The ministry predicts that this figure could rise to 40% by 2021, which would amount to 3.9 million students and with just 34 universities, No part of Egypt's Pre-university or higher education apparatus was designed to cope with such numbers, and inevitably quality has taken a plunge." (Bond, Maram, Soliman, & Khattab, 2012) Reforming the education system should start by adjusting the environment where this system operates, since the current political system does notguarantee full freedoms as one aspired and the policies designed before were affected by the general autocratic environment that prevailed which created this dysfunctional educational system that lacks all kind of creativity and freethinking.

With so few opportunities for graduates and so little money for research, it is of no surprise that Egypt has lost so many scientists abroad, especially in engineering and IT. Brain drain is a major challenge for Egypt in building knowledge economy since the human capital is the most significant building block of the knowledge economy. Egypt scored (2.1) on the Human Capital Flight Index 2009, which measures the extent to which Egypt loses its "Knowledge Workers" abroad on a scale of (1-7). (Bond, Maram, Soliman, & Khattab, 2012)

Institutional and Regulatory Framework

The regulatory framework or legal environment in Egypt tends to be restrictive as pointed out by different participants. They explained that laws and regulations are shaped in accordance with the control and containment environment that prevails. Whereas, Science, Technology and Innovation needs freedom, flexibility and some degree of informality, and an environment that supports the view that to try hard and fail is perfectly fine.

The scientific environment that helps people and society as a whole is referred to as vibrant environment, highly dynamic and highly productive and if that does notexist then there is some sort of deficiency in the policy making process in Egypt as explained by civil society representative, Dr. Adris, he points out to the point that even when the government develop policies, it end up developing *"Seyasat Samaa"* or Deaf policies that *"does not understand, realize and reflect what is needed."*

The main problems in Egypt's Institutional and Political infrastructure can be summarized based on the different views of the interviewed participants and supplementary research as follows:

- Strong executives controlling the judicial and legislative branches;
- Relatively weak formal systems of checks and balances, internal and external accountability mechanisms;
- Lack of truly independent institutions to hold public officials accountable;
- Lack of fair and competitive electoral processes;
- Government structures infiltrated by ruling elites and informal patronage;
- Low level of civil liberties, political rights and independence of the media;
- Limited public transparency and disclosure of public information. (Transparency International, 2012)
- Intellectual Property Rights Laws: Administrative and financial burden of coping with an intrusive patenting system that inhibits the conduct of research, since a large part of intermediate outputs that serve as research inputs are covered by IPR protection. (Egyptian National Competitiveness Council , 2006)
- The Egyptian Accounting system is criticized as inadequate and failing to keep pace with the vast changes taking place in the knowledge society. Financial statements fail to measure and reflect the value of intangibles i.e. intellectual capital.
- People in charge of drafting policies lack the required education, skills and training to perform such task.

Role of Different Players in [Funding, Marketing, Monitoring and Evaluation]

Government

Table 19: R&D Spent by Government as % of GDP

Year	Percentage	Annual Change
2004/2005	0.24	-0.03
2005/2006	0.26	0.02
2006/2007	0.26	0.0
2007/2008	0.27	0.01
2008/2009	0.21	-0.06
2009/2010	0.24	0.03
2010/2011	0.40	0.16

Source: ASRT 2011 through **(Bond, Maram, Soliman, & Khattab, 2012)**

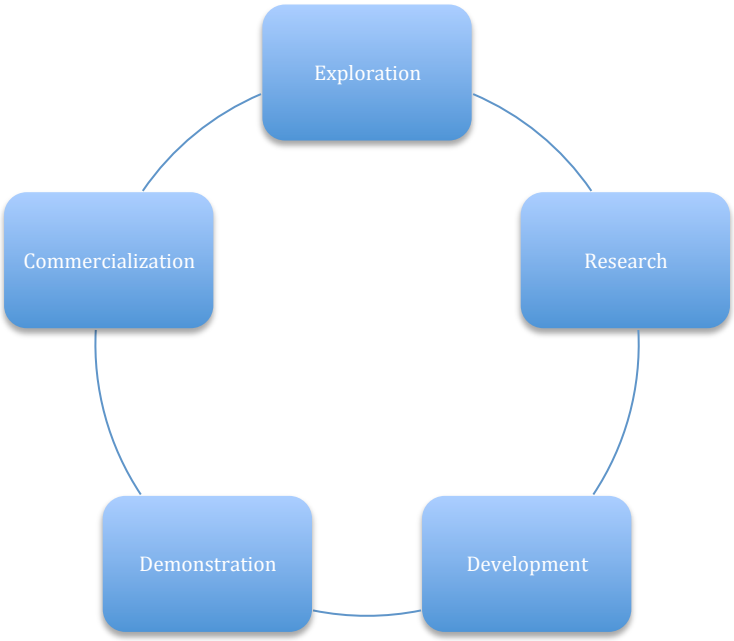
Even though the R&D spending has increased in 2010/2011 from L.E 2.4 billion to some L.E 3 billion, which represents 0.4% of GDP (up from 0.24% for the previous year), we have not seen any significant progress as explained by Dr. Hany El Nazer, Former President of NRC

> "*The increase was mainly reflected in the increase in staff salaries and not in any core activities as investment in infrastructure development, acquisition of new technologies, materials, supplies or knowledge resources"* says Dr. Hany El Nazer.

Again, this loss of confidence in the government is due to the lack of transparency and the weak system of checks and balances, where people are unaware of where the money is spent and thus any slight or substantial progress is not felt in the environment of opaqueness and constrained access to information.

Apart from the misallocation of funds, we have another problem pertaining the funding mechanism, which is completing the cycle of innovation.

Figure 6: The Innovation Cycle



The innovation cycle is compromised of five main processes as described by civil society, research centers and private sector representatives, they explain the mechanism of the cycle and the role of each player in the cycle.

Each process is financed separately through a different party. Usually the government funds the first two steps in the cycle (the exploration and the research) the remaining steps (development, demonstration and commercialization) are usually financed through other mechanisms such as private sector. The main problem is the lack of coordination between these parties that usually results in lack of funding for the remaining steps in the cycle causing the break of the cycle. Completing the cycle of innovation should be among the roles of government, to establish strong linkages between academia, research and industry. Since only 5% of Egypt's total investment in R&D comes from non-governmental sources. This is among the lowest contribution anywhere. (Bond, Maram, Soliman, & Khattab, 2012)

The main challenges the government is facing in enhancing its research, development and innovation system lies within the following points summarized by the participants as follows:

- The inability of the government to create means of collaborations and promote partnerships among the different players.
- The lack of entrepreneurial culture that links basic and new sciences and their conversion into wealth. (Egypt is among the worst countries in education of entrepreneurship skills- Understanding how ideas in the lab can translate into market opportunities. (Bond, Maram, Soliman, & Khattab, 2012)
- The lack of trust and understanding between academia and industry that makes it almost impossible for them to serve each other's needs.
- Most of the university research is not geared towards public and community needs.
- The lack of money for research, and the low salary scale for scientists and researchers.
- The rigid academic culture that holds back creativity and innovation such as the seniority system for promotion.
- Women underrepresentation in the scientific community in Egypt.

Private Sector

As described in the previous section, the role of different players in the innovation cycle; the role of the private sector is to get involved once the research stage is over in the innovation cycle and the private sector role is divided into two parts: Financial and Technical. The Financial part should include the different funding tools and mechanisms like venture capital and matching funds. The Technical part would first include overcoming the challenge of finding someone in charge as the researcher or scientist who produced this output believes that his/her role is done once the product is out of the lab as criticized by representative of research centers and industry.

> *"Any product of scientific research needs two things: finance and entrepreneurship for the cycle to complete with the commercialization step. We need the private sector for that, to close the loop."* Dr. Alaa Adris, MEK

The problem is that the financial support for R&D and the acquisition of new technologies is low; the transfer of knowledge from universities and research centers to new enterprises is "extremely weak"; and that education in entrepreneurship skills is worse in Egypt with the assertion that most nascent entrepreneurial activity is in the retail and service sectors rather than research-based industries. (Bond, Maram, Soliman, & Khattab, 2012) Just 1% of Egypt's manufactured exports are high technology goods, on a par with the world's least developed countries.

The fundamental challenge here is to restore the faith of Egyptian businessmen to invest in local technology and support R&D activities.

> *"The Private sector contribution is a very important source of funding. And therefore we need to develop innovative methods and tools to attract investors and businessmen to invest and fund scientific research and local technology and that's a major challenge Egypt is facing"* Dr. Hany El Nazer (NRC)

He further argues, that government and research centers should give businessmen and industry people reasons to invest in research whether through tax exemptions privileges or other similar privileges. He emphasized, the importance of linking the industry with scientific research.

> "*If one wants to start a factory; the government should ensure there is a unit in the factory designed for research and development before granting the factory the license. It should be one of the pre-requisites for obtaining an industrial licenses same as meeting environmental regulations. We need to start installing the culture of manufacturing and production of local technology. The private public partnership is not just for funding or investing money but also for encouraging local industry. And through these different initiatives we could raise money for scientific research not just through the government but through private sector as well. "* Dr. Hany El Nazer (NRC)

Civil Society

The government of Egypt has long tried to suppress the role of civil society through imposing constrains on their anti-corruption programmes and activities. The revolution has tried to mark a change in how much space civil society is granted. However, after the initial euphoria, some government have resorted to their former "strong" arm tactics. In Egypt for example, the emergency law has been tightened further, turning some basic actions into criminal offences. (Transparency International, 2012) The role of civil society is crucial at this stage to influence public policies, empower people with information, hold the government accountable, push for a more transparent government and execute the function of "Monitoring and Evaluation" since the government has long been playing both roles, the executive body and the regulatory body as explained by civil society representative.

According to the MO Ibrahim Index for African governance 2012, Egypt has shown unfavorable governance performance since 2006. Egypt has declined tremendously in the Safety and Rule of Law category that include Accountability, Transparency and Corruption in the Public Sector as one of the indicators. We need to empower the civil society in Egypt to perform these tasks.

There have been some successful projects implemented by civil society foundations to fill these institutional gaps such as establishing a separate entity called ECASTI- The Egyptian Center for Advancement of Science, Technology and Innovation to monitor the work of government in the STI sector. This initiative has been under the patronage of MEK foundation, they're still at the beginning of the process and are currently advocating for it. Check the website and Facebook page on [https://www.facebook.com/ecasti.org] and [http://www.ecasti.org].

Another project also adopted by MEK foundation is the establishment of a "Scientific Media Association" to enhance the skills and training of journalists in science media, so that the media can perform its role in reaching people and spreading the awareness of the importance of science and scientific research and create a culture that value science, technology and innovation.

D. Windows of Opportunity: A quick overview of some of the exemplary initiatives to enhance Egypt's STI system

Aswan Heart Center

Founded by HE Sir Prof. Magdi Yacoub, Professor of Cardiothoracic Surgery at Imperial College London, for the purpose of serving Humanity and Science. The center opened in 2009 in Upper Egypt to treat patients who are suffering complex cardiac diseases and who usually don't have access to such advanced treatment. The center mission statement is "Offering state-of-the-art free-of-charge medical service to the Egyptian people, particularly the underprivileged; training a generation of young Egyptian Doctors, Nurses and Scientists at the highest international standards; advancing basic science and applied research as an integral component of the program". (Magdi Yacoub Heart Foundation, 2012)

This year has witnessed two major events, the completion of the first and second phase buildings, with a new-state-of-the art Cardiovascular Imaging Suite and Pediatric Intensive Care Units as well as fully upgraded Operating rooms and Cardiac Cath-Labs, the quality of the buildings meets the highest international standards. And the continued progress in all the research projects, as well as knowledge dissemination and staff publications in peer review journals. All the epidemiological (population science), clinical, translational and basic science research projects are designed to address clinically relevant issues with the aim of changing practice as soon as possible. (Magdi Yacoub Heart Foundation, 2012)

Misr El Kheir Knowledge

Misr El Kheir Foundation is a non-profit organization established in 2007 with the vision of becoming a leading international role model that develops a self-sustainable society through empowering and serving human beings in different fields: Social Solidarity, Health, Education, Scientific Research, Life Aspects in fighting Poverty, Illness, Illiteracy, and Unemployment. (Misr El Kheir Foundation, 2011)
"Misr El Kheir Knowledge" is the knowledge sector in MEK foundation in charge of scientific research and education. IDRAK is the technical and vocational university and institutes as explained by Dr. Alaa-Eldin Adris, Chief Knowledge Officer and Head of Scientific Research Committee at MEK Foundation.

In MEK, there is the scientific research program and the education program that holds two programs: The scholarship program and the technical and vocational institutes.
The main objectives of the scientific research program are funding world-class scientific research with high societal impact; capacity building; help in completing the cycle of innovation; promoting a culture of scientific research and innovation and mobilizing NGOs to support S&T. (Misr El Kheir Foundation, 2011)

The Scientific research program at MEK as Dr. Adris explains, aims at fostering a culture of STI in Egypt through announcing call for papers in the different fields (Agriculture/Water dissemination/ Renewable energy/…etc.) and in social sciences as well and it's all for the purpose of attracting and funding proposals and researches directed towards better understanding of societal needs and problems. MEK aims to contribute in finding solutions and satisfying some of the societal basic needs. Also through the annual prize ceremony that MEK holds for best researches, most cited publications, international publications awards, it hopes that through identifying and honoring those scientists and researchers this would boost the environment for science, technology and innovation and push more people towards research and invention, knowing they will get the needed support, funding, recognition and appreciation.

There is also the structural role that MEK as a civil society plays through working with influential research institutions in Egypt as the NRC and the STDF. It tries locating the problems that exist whether administrative or technical or chronic problems that existed for long within their systems and try to fix or eliminate these problems and provide them with the help needed for that. In the National Research Center, MEK has established a technology transfer office; to help unleash the research and innovation capabilities in the NRC and this is done through selecting from each department a group of doctors or researchers to send them on study missions abroad and when done, they acquire a professional diploma from the technology transfer office.

MEK works with prominent scientists in funding world-class scientific research, at the NRC; MEK is working on developing vaccine for Virus "C" with a team of scientists from the NRC, with Prof. Dr. Mostafa El- Sayed in his research on cancer therapy and diagnosis using Nano gold particles, and with Prof. Dr. Mohamed Ghoneim, in his center in Mansoura in his research on curing diabetes using stem cells.

ICT for Inclusion

The "ICT for Social Services" is a newly established unit at the Ministry of ICT in Egypt with the aim of utilizing ICT to improve the quality of life for people with disabilities (PWD) by providing them access to information and knowledge, new employment and social opportunities, its vision is that "ICT becomes the tool for an inclusive, equitable, open and participatory knowledge society" (Ministry of Communications and Information Technology, 2013)

The goal of the "ICT for Social Services" unit is to find a way for bridging the gap between society and PWDs, and to create an environment where they can enhance their abilities and develop their capabilities in order to participate and serve society. "PWDs are a full power resource that needs to be utilized to be able to participate in the society efficiently and effectively," says Dr. Abeer Shakweer, Advisor to the Minister of ICT for Social Services.
A strategy was developed to help utilize and empower this significant group through working on enhancing the services provided and their accessibility, building the knowledge infrastructure for PWDs, enhancing ICT research, development and innovation to serve PWDs then tackle the issue of participation and empowerment through education, training and employment.

Projects that have been implemented so far include working with schools as well as the Ministry of Higher Education to support the inclusion of students with disabilities. The project was implemented in 35 schools across three governorates (Al Fayoum, Aswan, and Bany Suef) whether through providing training courses and psychological rehabilitation for teachers to be able to deal with the students or whether through equipping schools. Another project was initiated in 26 special governmental education schools for the blinds to develop and enhance these school technologies to better serve the students. And last but not least, developing a highly accessible portal for PWDs through the Ministry of ICT website.

One of the main objectives of the strategy is promoting ICT research, development and innovation to empower PWDs. And in order to achieve this objective, the Ministry has initiated an innovation contest for software and mobile applications called "Tamkeen" which aims mainly at encouraging the creation of ICT industry targeted to serve PWDs in Egypt through providing the different customized and affordable ICT applications to empower PWDs through the competition.

"Inclusion through providing better employment opportunities for PWDs" This program aims at training PWDs to use the different computer applications whether through ICDL certificate that the Ministry provide for free or other specialized training on certain IT applications that is required for the job as per IT companies. This project was collaboration between government, private sector and civil society to encourage inclusion and empowerment of PWDs in the community through fair employment opportunities.

E. Strengths, Weaknesses, Opportunities, and Challenges: A Summary [1]

Strengths	Weaknesses
- *Tremendous Human resources with large pool of researchers and science students with great talents.* - *Egypt has a well-established RDI institutional infrastructure developed over the years and has separated the scientific research from the system of higher education.* - *Many shinning examples of success, particularly in agricultural research and in some well focused industrial R&D* - *Centers of Excellence* - *Fast growing ICT sector in Egypt, with new projects directed towards inclusion and enhancing the community's quality of life.* - *Egypt exceeds the world average in citation impact for mathematics papers, and Alexandria University ranked 147th in the Times Higher Education World Universities Rankings 2010 for the quality of its research in mathematics and theoretical physics.* - *The solar radiation in Egypt is among the highest in the world, making it a prime site for the production of solar energy.*	- *Lack of a National Vision and explicit S&T policy* - *Lack of research funding: Lack of money to fund research, and low salary scale for scientists and researcher.* - *No strong financial incentive encouraging researchers to excel and most researchers select their own topics; which is usually continuation of existing research.* - *Lack of transparency from the government side, which make people unaware of how money is spent as no accurate data exist, 70-80% of the budget of R&D is devoted to salaries.* - *Inefficient and complex organizational structure for the Egyptian S&T system causing conflicts rather than promoting harmony.* - *Most R&D Institutions function as academic units rather than as technology centers.* - *Most of the scientific and technological equipment, instruments and other hardware tools are obsolete.* - *The deteriorating education system that desires obedience rather than nurture questioning, demands memorization rather than enhance creativity and imagination. Students are not taught to think like researchers or scientists- to question orthodoxy, ta analyze critically. Instead, rote learning dominates.* - *Weak business and entrepreneurial skills among university graduates. Scientists and researchers lack the understanding of how ideas in the lab can translate into market opportunities.* - *Weak Policies and Procedures.* - *Lack of Monitoring and Evaluation.* - *Stifled freedom of expression.* - *Weak formal systems of checks and balances, internal and external accountability mechanisms.*

[1] This SWOC Analysis is based on the interviews findings.

Opportunities	Challenges
- *Transfer of Technology* - *"Brain Gain" programs* - *Science Parks* "A Science Park is an Organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated business and knowledge-based institutions. To enable these goals to be met, a science park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities." (UNESCO, 2007) - *International Collaboration in science and technology will help support local scientists and the industry.* - *Foreign Investment* - *Partnerships between government, private sector and NGOs.* - *Capitalize on successful initiatives such as centers of excellence and ICT projects to accelerate leapfrogging developments.*	- *Culture change: creating a culture that truly enhances innovation by supporting the view that to try hard and fail is perfectly fine.* - *The government must engage all stakeholders in developing its national S&T vision.* - *Little appetite for Science, people does not see science and scientific research as playing a pivotal role in development or in improving their lives.* - *Gearing science and scientific research towards solving societal problems.* - *Establishing link between R&D institutions and industry to promote new knowledge products.* - *Establishing clear funding mechanisms for S&T that particularly support innovation.* - *Private sector has little faith in R&D as a business model.* - *Media role in creating S&T awareness in the Egyptian society and emphasizing its importance as a national priority.* - *Freedom of Press.* - *Freedom of information.* - *Rule of Law.* - *Government transparency and accountability* - *Access to Knowledge: the right to claim knowledge comes with certain obligations; to participate in the creation and sharing of this knowledge, and if Egypt won't take drastic actions to become part of the knowledge society, it shall be marginalized.* - *Egypt's current political& economic situation.* - *Sound strong articles regarding STI and education in the constitution.* - *Brain Drain: Egypt has a harder job holding onto its skilled researchers than any other Arab country, according to the Knowledge for development Indicators.*

V. Towards the Knowledge-Economy

A. The Road Ahead for Egypt: Policy Recommendations

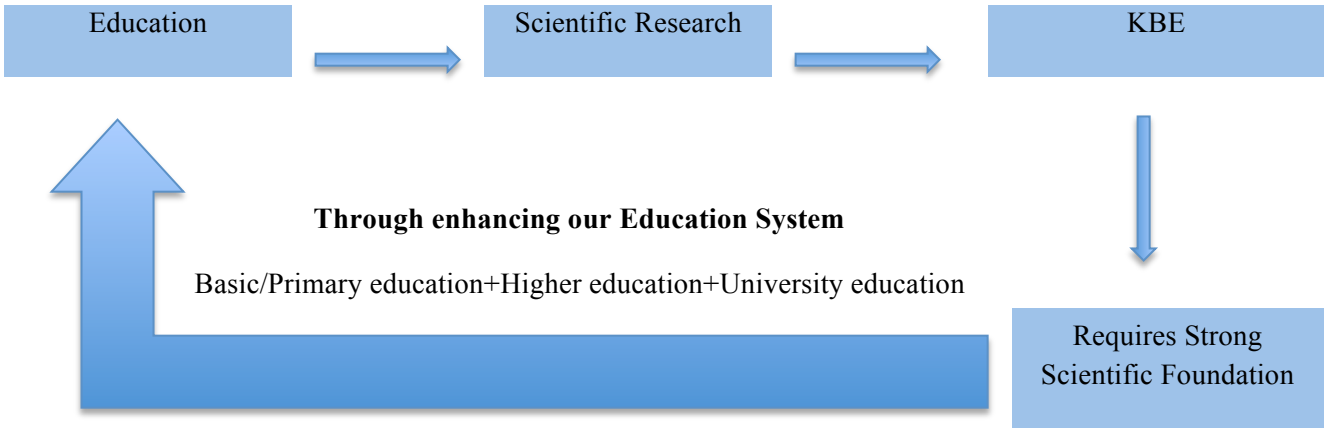
In order to induce change and move forward, we first need to acknowledge our weaknesses, become aware of the challenges ahead of us, and be able to utilize our strengths to overcome these challenges and create opportunities to integrate into the global economy.

Dr. Venice Gouda, the former Minister of State for Scientific Research explains that Egypt's transformation to a knowledge-based economy is like preparing an army for a battle, you need to exploit all your options, use all your strengths and give it all you can in order to get the army ready for the battle, this is Egypt's battle against technological retardation, Egypt's fight for inclusion into the global world and becoming part of the global change that is happening right now. However, Dr. Gouda argues that no successful transformation could occur without Egypt going through a complete bottom-up reform and restructuring process.

> "*We shouldn't just expect Egypt to jump from its current state to a knowledge-based economy without building the foundation. First we need to get people to understand what is science, technology and innovation, we need to build the foundation and systems that could seriously make this transformation realistically possible. We need to build a competitive and motivated scientific-based systems and institutions. Create the environment that enables and enhances scientific research and fosters innovation. And above all, we need well-educated and trained people who understand what is technology, how to develop technology, what is forward engineering and how to implement it. "* Dr. Venice Gouda

Prof. Shaaban Khalil, Director of the Center for theoretical physics at Zewail City of Science and Technology, summarizes the steps Egypt should go through in order to enhance its STI system and enable a successful transition to the knowledge society in the following figure:

Figure 7: Summary of the Transformation Process



He further explains that that knowledge now has a great impact on our economic and social life and that we're living in the era science and technology revolution. A fast changing and developing technology in all the various fields: electronic, nuclear, physics, biomedical and aerospace. And what distinguishes this new economy is its dependence on science and knowledge.

> *"The world today is dealing with knowledge industries where ideas and creativity are the input for production. The human minds are the capital asset and for that, knowledge has become the prime factor for the modern knowledge society.* Dr. Shabaan Khalil, ZCST

This technological revolution has created the need to increase spending on education starting from primary to university education along with spending on scientific research to enhance society's knowledge and enable its transformation as explained by research center representative.

As argued by Dr. Gouda, Prof. Khalil and most of the experts consulted, the knowledge economy requires a strong comprehensive infrastructure, a human resource investment plan, better education and training opportunities, a culture than enhances and fosters creativity and innovation. A society that is suffering social, political and economic fissures like Egypt at this critical stage must think carefully about the path it needs to pursue to achieve economic, social and technological advancement to transform to a KBE. The formulation of national policy for Egypt should be guided by the notion that knowledge is the path to societal development and growth.

The following is a summary of recommendations for how Egypt can build a strong efficient STI system to pave the way towards the knowledge economy:

Culture

The challenge for Egypt today is to create an overall climate that is open and tolerant and ensure that its children and young people are brought up with these values. The bulk of the new scientific breakthroughs and revolutionary ideas come from the young same as the Egyptian revolution that was sparked by the young who went out in the streets calling for freedom and dignity. Those young revolutionist will not tolerate any more abiding to the old environment of obedience, conformity and submission without any rights to freedom of thinking or questioning. The situation in Egypt requires nothing less than a major revolution in the education system. We must move from demanding rote memorization to appreciating creativity and imagination, from desiring obedience to nurturing questioning as explicitly pointed out by all participants and supported by secondary data. (Egyptian National Competitiveness Council , 2006).

Vision and National S&T Strategy

A national vision is derived from faith and conviction, as explained by civil society and government representatives

> *"We need to have faith and conviction that the primary enabler for development is knowledge and people need to enhance and utilize this knowledge to manufacture and produce local technology that could serve our society."* Dr. Alaa Adris, MEK

Egypt needs a coherent national framework for actions that directly affect the promotion of science and technology. The government in consultation with the different parties, the scientific community and academies, the business and industry sector, and civil society should develop such a national S&T strategy and this strategy should benefit from the experiences of other countries. The strategy should be prepared with great transparency and should indicate clearly the government's commitments to funding, standards of excellence, openness to innovation, dissemination of knowledge, and local regional consortia and networks, and entry into partnerships with others-locally, regionally and globally. (Serageldin, 2007)

For such a policy to be effective, strong political and commitment at the highest level is necessary, this was strongly highlighted by government representative, Dr. Venice K. Gouda. She further elaborated that the S&T strategy must be submitted to the Cabinet of Ministers for approval then to the President for winning sustained support for the entire cause of S&T development in Egypt as a national priority.

In order to make the S&T policy more effective, she explains, the government should first: formulate a clear vision of the socio-economic development of Egypt for the next 20 years. Second: an effective integration of S&T policy with other socio-economic policies such as

economic, education, industrial, agricultural and health. And third: an assurance that the greater part of the Egyptian people is actively involved and adhering to the major thrust of the proposed S&T policy. Furthermore, the fruits of development need to be shared among the different classes of society.

Institutional and Regulatory Framework: Laws, Policies and Procedures

We need to harmonize the legal environment. That was a major demand by participants from government, research centers and civil society. They stated the fact that we have laws that govern and influence scientific research, R&D, technology and innovation, which need to be reviewed and amended as appropriate. Our current institutional framework as they explained needs to keep pace with the global changes and be reviewed and updated accordingly.

There is no doubt that the twenty-first century most important asset and resource is knowledge, where investment in intellectual capital has become the driving force for economic growth and development. The existing legislative instruments for protection of IP rights (patents, trademarks, and copy rights) needs to be reviewed, as the old notion was that the existence of strong patents, trademarks, and copy right protection systems, and the prompt enforcement of the relevant laws, is necessarily better for innovation and development. A recent study on "Access to Knowledge in Egypt: New research on Intellectual Property, Innovation and Development" argues that "maximal protection of intellectual property is not only the silver bullet to innovation and development promised by its promoters, but may actually stand in the way of these public aims". When adjusting our legal system, we can't ignore the vast global

movements, what used to work before has become obsolete now and might require deeper understanding of the global trends. We need to shape public policies that would ensure that the potential of knowledge is maximized through programs, technologies and business models that enable knowledge to be shared widely and to flourish in conditions of freedom." (Rizk & Shaver, 2010)

Further, we need to concentrate on the urgently needed legislative reforms directly affecting the performance of S&T in Egypt which the participants has summarized as follows:

- The constitution, the Laws, presidential decrees, and by-laws governing the function and performance of R&D and technology institutes.
- Alter the tax system, to encourage people to change their behavior and culture. Through the tax system, we can encourage people to invest in scientific research.
- Adjust and update the Egyptian Accounting System.
- Establishing a clear and transparent budgetary document that presents the detailed financial requirements for Egypt's S&T system.
- We need to revise the vision, mission, and mandates for all Egyptian Universities and make sure they are consistent with the overall strategy of the state. Including:
    - Laws regulating the number of students accepted in the different faculties in universities to prevent the overcrowding of students in classes to increase their chances for better education.
    - Adjust the hierarchical academic culture for faculty appointment that restricts the mobility of faculty members within and between universities and inhibit innovation.
    - The salaries, allowances, and incentives for faculty members and researchers need to be adjusted.

- Change the merit system by which university officials and d faculty members are evaluated so that it takes into account not only published work but also the extent to which they are involved with the industry, so that building links with the industry becomes integral to researcher's role.
- Review the study mission abroad s system in Egypt. Every year we spend millions sending people abroad to obtain masters and PhDs in different disciplines, these missions needs to be reviewed and monitored and it should be directed towards programs that is related to societal needs at least at the current time.

Human Resources, Education and Training

The people are Egypt's biggest strength and challenge at the same time. We need to develop mechanisms to make Egyptians participate in the value creation cycle by creating and harnessing knowledge.

The government needs to develop new ways and mechanisms that coordinate between S&T policy and educational policy as explained by government representative, Dr. Venice Gouda. Along with research center representative and private sector. They all stressed the need to gear the educational policy to target development of S&T manpower by ensuring adequate supply of highly educated researchers, scientists and engineers to meet the demand for them in various sectors of the national economy. Increase the number of science, engineering and technology graduates. And the number of well-trained technicians with advanced skills and this can be done through different educational reform policies as per the recommendations of the report on "Science and Innovation in Egypt":

- "Upgrade school and university curricula and teaching methodology to ensure they reflect the needs of the marketplace, with greater emphasis on problem-solving, critical thinking and communications skills. Revise science curricula to make them more interdisciplinary and to incorporate knowledge about new technologies;
- Increase the emphasis on vocational and technical education, whose critical role is too often downplayed or considered socially inferior to that of higher education;
- Introduce entrepreneurship courses into university degrees and vocational and technical training courses, and encourage more students at universities and research centers to start up their own businesses." (Bond, Maram, Soliman, & Khattab, 2012)

Finally, the government should develop "Brain Drain" programs like Malaysia to attract its talents abroad from scientists, researchers, engineers through improving the status and working conditions of scientists and engineers involved in S&T development, provide them with state-of-the art research and technology centers to tempt them to return back and work in them.

R&D, Technology and Innovation Policies and Institutes

Universities and R&D institutes affiliated to the different ministries are a national asset that has long been neglected by the government as explained by government representative Dr. Venice Gouda. She argued that their effectiveness must be continuously improved as an integral and key element of the socio-economic development of the country. In this regard, she offers the following policies:

- Establishing a national innovation system through promoting systematic linkages among the key actors of technological development and ensuring that research funding is used more efficiently and in line with national research priorities.
- Increase the national R&D expenditure by government while at the same time diversify the sources of R&D funds. We need to attract investors and beneficiaries to fund local technology and invest in Science and Technology products to be able the complete the cycle of innovation, where the state usually funds the first two steps in the cycle (the exploration and the research) the remaining steps (development, demonstration and commercialization) are usually financed through other mechanism and the private sector which is usually where the cycle stops due to the lack of funding.
- Transformation of the institutes into technology centers capable of serving the national need of strengthening technological capabilities. The focus of their activities will be on:
    i. Providing technical services aimed at solving immediate and urgent problems of production.
    ii. Accelerating technology transfer from advanced nations through understanding, absorption, adaptation and diffusion to local firms.
    iii. Facilitating technology transfer to local companies and institutions in all stages of negotiations, installation, operation, maintenance, and upgrade.
    iv. Enhancing local technology development by introducing some innovations, which may be known elsewhere.
    v. Performing conventional R&D to create knowledge and technology.
- Assessing the socio-economic impact of technology adopted on society. It is important to link the technology with societal needs. The government should support the growth

of physical-asset intensive industries at the current period, as they typically employ large numbers of workers with minimal training, education and skills. These ventures have the potential to uplift large sections of the population and create large employment opportunities.

According to an OECD study on higher education in Egypt, it offers several recommendations for strengthening the capacity for research, development and innovation, among which are the following: the government should first start an industry performance and foresight project, and an associated mapping of Egyptian R&D capacity to serve identified development needs and opportunities; Gross expenditure on R&D should be directed on areas of internationally benchmarked research strength and national research priorities and the government should provide incentives for linking centers of research excellence with leading universities and develop different means of partnership and collaboration as supervising doctoral and post-doctoral students and joint participation in research projects. And finally, the government should produce an annual report on the state of Egypt's RDI system, comparing Egypt's capacity and performance with international comparators. (OECD, IBRD, & The World Bank, 2010)

Business and Industry

Most of the interviewed participants whether from government, private sector or research center have stated the importance of creating incentives to attract and encourage the private sector to invest in R&D in areas that will benefit the country through providing matching funds, infrastructure or tax incentives by the government.

They highly emphasized the importance of establishing strong links and partnerships between academic, R&D and technology institutes and the production sector so that research output more effectively meets the needs of the community and industry. They recommended that the government should work on improving the environment in Egypt, making it more business friendly to attract FDI, enhance the spirit of entrepreneurship, encourage more venture capital and private equity funds and invest in young innovative enterprises.

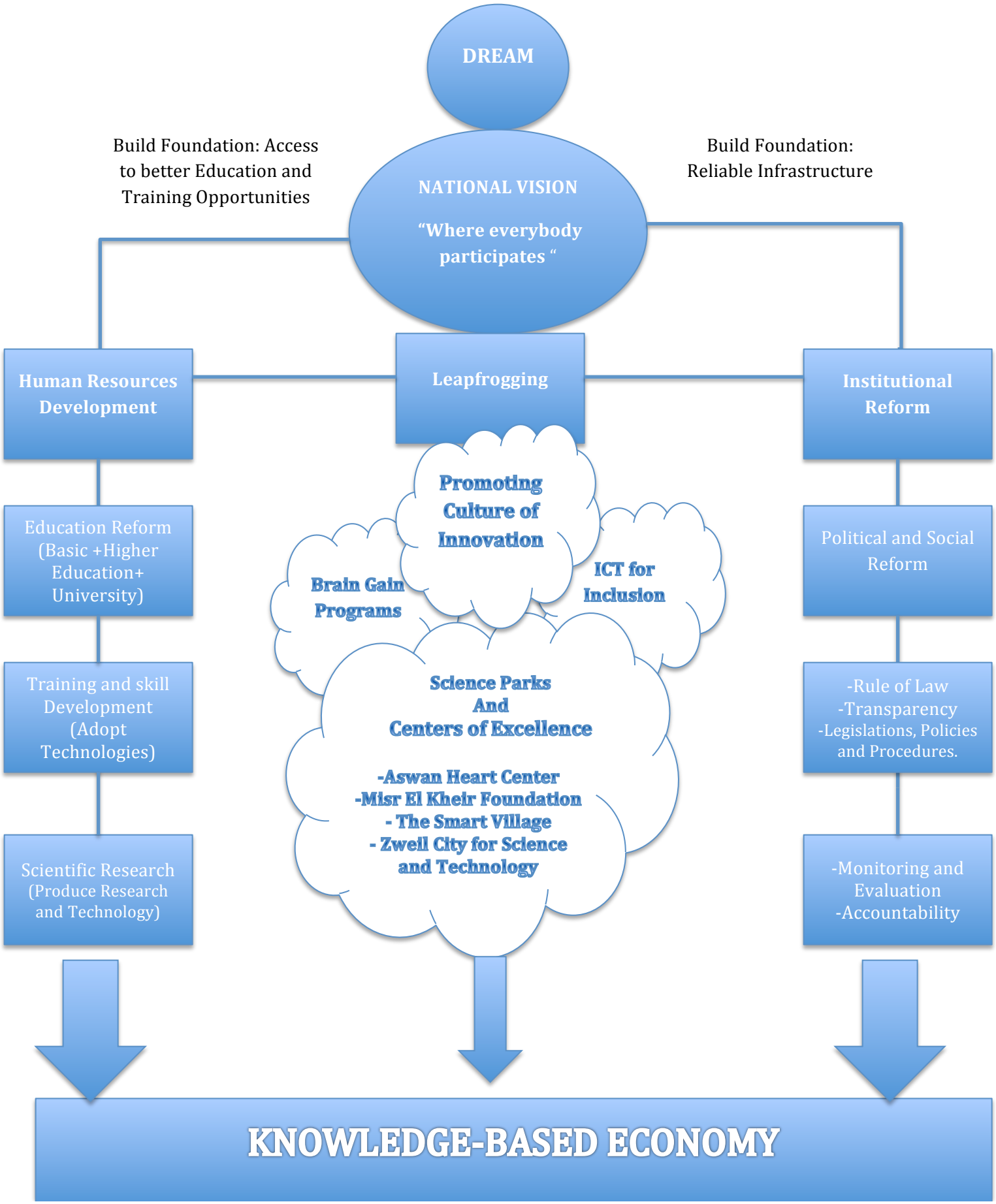
ICT Sector

This is one of the areas that Egypt is performing well and has made considerable success at encouraging research-based business: information and communication technology (ICT). The number of ICT companies in Egypt has grown from 1,716 in 2005 to 3,972 at the beginning of 2011 and the number is increasing at a rate of around 13.5% a year. (Bond, Maram, Soliman, & Khattab, 2012)

Egypt's potential for vast development in the ICT sector needs to be enhanced and steered towards socio-economic development, promoting growth and strengthening competitiveness. We need to capitalize on this opportunity to accelerate the process of transition by using ICT as a catalyst for economic and social development. We should fully understand that ICT is not an end in itself, it has potential to make existing processes more effective and efficient, but cannot substitute building the infrastructure that support a successful economy i.e. reliable infrastructure core, and widespread access to education and training.

Egypt should further develop its ICT policies and programs within an overall ecosystem that encourage knowledge sharing and collaborative work, and which is guided by the notion that access to knowledge is the path to societal development and growth. (Kamel, 2010)

Figure 8: Suggested Framework for Egypt's Transformation to a KBE



B. Conclusion

Egypt has a long way ahead to reach a knowledge-based economy. This research does not indicate a specific duration. However, it is meant to draw the attention of the government and policy makers to the importance of placing knowledge, science, technology and innovation on Egypt's priority agenda. The environment scanning conducted for Egypt and positioning it among all the international indicators was meant to emphasize how Egypt is lagging behind on many aspects. The sad reality is that only a simple step of having a consolidated vision would easily amend this situation and help pave the road from where we stand today, to where we want to be and how to get there. This was the ultimate purpose behind this research- to plant a vision and provide directions of how to reach it.

Egypt has been given a chance for rebuilding, renewal and renaissance after the revolution. The main problem however, as mentioned previously, is the lack of a vision. Egypt has been struggling for two years now with no signs of improvement, which is reflected in its deteriorating performance on all the international indicators. Also, unfortunately, any successful models within the country are diminished due to the turbulence and high instability the country is going through, as well as the perceived inability to unite all these efforts and direct them to achieve a certain goal. Setting a national vision should thus be at the forefront of the public agenda no matter the obstacles and challenges that exist. It seems as though the government continues to fail to understand the growing role of knowledge in the global economy; ways on how to capitalize on the knowledge revolution to improve competitiveness and welfare; planning appropriate investments in human capital, effective institutions, and relevant technologies, as well as promoting innovative and competitive enterprises.

Emerging countries such as South Korea, Malaysia, and India selected as case studies in this research, illustrates the rapid progress that can result on capitalizing on knowledge for development strategies. Behind every success story, there exist many struggles and obstacles, but each of these countries managed to challenge the status quo and move forward with a vision in mind. The Republic of Korea (ROK) has come a long way from the 1960s, when it had one of the lowest per capita incomes in the world, to the present vibrant economy that has undertaken reforms in financial, corporate, and government sectors. Malaysia a similar Muslim country with an economy dependent on agriculture and natural resources, with a non-existent tertiary education, low skilled labor force and many political and social challenges; managed to turn into an upper middle industrial and production-based economy through investing in knowledge; providing world-class infrastructure, attractive incentives and a sound education system. India's pursuit to the KE was not halted by the socio-economic challenges the country was and is still facing, with high rates of poverty and illiteracy among its population. India still managed to position itself among the giant economies by capitalizing on its strengths and opportunities rather than surrendering to its weaknesses and challenges.

On the other hand, some may counter argue the success of India in terms of sustainability given the fact that India's success was attributed to the technological break-through in the ICT sector, which ultimately caused its giant leap. Yet India could have pursued the traditional bottom-up approach in building a robust industrial economy that can be made more efficient and productive with IT and yield the greatest returns at the societal level (Konana & Balasubramanian, 2001).

As such, the research recommendations indicate that Egypt should start the rebuilding process from the ground up and including bottom-up approaches, in addition to capitalizing on the successful leapfrog initiatives.

Despite the different approaches each country has pursed to embark on the journey towards the knowledge economy; they all shared one common characteristic- having an encompassing, holistic and national vision. They all had different starting points but they knew that their destination was one "A Knowledge-Based Economy" and each country developed its own tailored means and methods to get there, successfully managing to set examples for the rest of the world. Thus these examples have proven that political will believing in intangible dream can be realized through a real consolidation of efforts.

Moving towards a knowledge-based economy is one of many other dreams and aspirations we have for Egypt, but the choice of which dream to pursue at this critical stage is the real challenge. Setting a national vision towards a KBE would set Egypt on the path towards development and become part of the advanced global economy. This is since it would stipulate that real widespread reform rebuilding and renovating the whole country, which includes the culture, the institutions, the policies and regulations, the education system and the people. By uniting all successful efforts that stand alone into one strong quantum leap, this will forcefully move efforts towards faster development. Egypt will simply gain in every way by paving the way towards the KBE and in this case; the path is more important than the outcome.

C. Future Research Recommendations

1. Strategies to develop the role of media in promoting science, technology and innovation in Egypt.
2. The relationship between maximizing access to knowledge and fostering development.
3. Future research can explore new methods other than the KAM methodology that adopt bottom-up approach in measuring innovation and knowledge to amore holistic approach.
4. Develop national STI database for Egypt.
5. Proposals for national R&D network and technology oversight programs.
6. Ensuring equitable geographical distribution of R&D institutes to optimally serve all segments of society according to their specific needs.
7. Promote the establishment of technical and vocational institutes in Egypt.
8. Introduce flexible learning programmes in school and universities such as on-line and distant learning.
9. Develop export strategies and create a market abroad for Egypt's competitive industries such as textiles and agriculture products.
10. Increase spending on agricultural R&D and desert reclamation projects to promote sustainable development.
11. Develop a master plan for preserving natural resources and promoting sustainability: Water from the River Nile, Solar Energy and Climate change adaptation strategies for best crop yields.
12. Incorporating environmental protection awareness and efficient use of resources and their protection from pollution in formal school and university education.
13. Enhance international cooperation.

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VII. Appendix

A. The KAM Basic Scorecard (Data of Comparisons between Egypt and Global Experiences)

Table 20: Comparison between South Korea and Egypt, 1995 and Most Recent Years

Variable	Egypt, Arab Rep. (Most Recent)		Egypt, Arab Rep. (1995)		South Korea, Rep. (Most Recent)		South Korea, Rep. (1995)	
	Actual	**Normal - ized**	**Actual**	**Normal.**	**Actual**	**Normal.**	**Actual**	**Norm.**
Tariff & Nontariff Barriers (2011)	**74**	**3.43**	**25**	**0.93**	**70.8**	**2.45**	**69.2**	**7.01**
Regulatory Quality (2009)	**-0.14**	**4.32**	**0.41**	**5.87**	**0.85**	**7.33**	**0.47**	**6.08**
Rule of Law (2009)	**-0.03**	**5.75**	**0.06**	**5.63**	**1**	**8.01**	**0.85**	**7.71**
Royalty Payments and receipts (US$/pop.) (2009)	**3.43**	**3.68**	**2.35**	**5.38**	**209.94**	**8.48**	**59.52**	**8.46**
S&E Journal Articles / Mil. People (2007)	**24.16**	**5.03**	**22.88**	**5.66**	**381.15**	**8.28**	**84.34**	**7.52**
Patents Granted by USPTO / Mil. People (2005-2009)	**0.07**	**3.63**	**0.04**	**4.21**	**151.18**	**9.66**	**29.22**	**8.69**
Average Years of Schooling (2010)	**7.08**	**2.68**	**5.06**	**2.2**	**11.85**	**9.61**	**10.57**	**9.21**
Gross Secondary Enrollment rate (2009)	**67.2**	**2.97**	**76.51**	**5.97**	**97.22**	**7.72**	**100.87**	**8.68**
Gross Tertiary Enrollment rate (2009)	**28.45**	**4.47**	**20.17**	**5.73**	**100.02**	**9.93**	**52.03**	**9.51**
Total Telephones per 1000 People (2009)	**790**	**3.1**	**40**	**3.66**	**1.380.00**	**6.28**	**450**	**8.21**
Computers per 1000 People (2008)	**40**	**2.33**	**0**	**3.49**	**580**	**8.63**	**110**	**8.25**
Internet Users per 1000 People (2009)	**200**	**3.93**	**0**	**7.45**	**810**	**9.24**	**10**	**8.55**

Source: KAM, (World Bank, 2012)

Table 21: The KAM Basic Scorecard, Comparison between Malaysia and Egypt, 1995 and Most Recent Years

Variable	Egypt, Arab Rep. (Most Recent)		Egypt, Arab Rep. (1995)		Malaysia (Most Recent)		Malaysia (1995)	
	Actual	Normal-ized	Actual	Normal.	Actual	Normal.	Actual	Normal.
Tariff & Nontariff Barriers (2011)	74	3.43	25	0.93	78.7	4.62	67	6.91
Regulatory Quality (2009)	-0.14	4.32	0.41	5.87	0.33	5.68	0.66	7.06
Rule of Law (2009)	-0.03	5.75	0.06	5.63	0.55	6.71	0.79	7.5
Royalty Payments and receipts (US$/pop.) (2009)	3.43	3.68	2.35	5.38	50.93	7.28	n/a	n/a
S&E Journal Articles / Mil. People (2007)	24.16	5.03	22.88	5.66	30.43	5.45	17.76	5.17
Patents Granted by USPTO / Mil. People (2005-2009)	0.07	3.63	0.04	4.21	5.63	8.01	0.94	7.38
Average Years of Schooling (2010)	7.08	2.68	5.06	2.2	10.14	7.32	8.41	5.98
Gross Secondary Enrollment rate (2009)	67.2	2.97	76.51	5.97	68.71	3.1	58.7	4.03
Gross Tertiary Enrollment rate (2009)	28.45	4.47	20.17	5.73	36.46	5.25	11.68	3.85
Total Telephones per 1000 People (2009)	790	3.1	40	3.66	1.270.00	5.93	210	6.83
Computers per 1000 People (2008)	40	2.33	0	3.49	230	6.3	30	6.67
Internet Users per 1000 People (2009)	200	3.93	0	7.45	580	7.59	0	7.45

Source: KAM, (World Bank, 2012)

Table 22: The KAM Basic Scorecard, Comparison between India and Egypt, 1995 and Most Recent Years

Variable	Egypt, Arab Rep. (Most Recent)		Egypt, Arab Rep. (1995)		India (Most recent)		India (1995)	
	Actual	Normali-zed	Actual	Normal.	Actual	Normal.	Actual	Normal.
Tariff & Nontariff Barriers (2011)	74	3.43	25	0.93	64.2	1.12	0	0.21
Regulatory Quality (2009)	-0.14	4.32	0.41	5.87	-0.28	3.77	0.06	3.99
Rule of Law (2009)	-0.03	5.75	0.06	5.63	0.05	5.82	0.35	6.53
Royalty Payments and receipts (US$/pop.) (2009)	3.43	3.68	2.35	5.38	1.78	3.12	0.1	2.4
S&E Journal Articles / Mil. People (2007)	24.16	5.03	22.88	5.66	16.18	4.55	10.05	4.55
Patents Granted by USPTO / Mil. People (2005-2009)	0.07	3.63	0.04	4.21	0.51	5.82	0.04	4.14
Average Years of Schooling (2010)	7.08	2.68	5.06	2.2	5.12	1.26	3.8	1.34
Gross Secondary Enrollment rate (2009)	67.2	2.97	76.51	5.97	60.02	2.55	48.81	3.33
Gross Tertiary Enrollment rate (2009)	28.45	4.47	20.17	5.73	13.48	2.98	6.58	2.87
Total Telephones per 1000 People (2009)	790	3.1	40	3.66	480	1.86	10	2.55
Computers per 1000 People (2008)	40	2.33	0	3.49	30	1.99	0	3.49
Internet Users per 1000 People (2009)	200	3.93	0	7.45	50	1.86	0	7.45

Source: KAM, (World Bank, 2012)

B. Interviewed Participants

Entity		Title	Name
Government	**Ministry of Scientific Research**	1. The Former Minister of Scientific Research	**Dr. Venice Gouda**
	Ministry of Communication and Information Technology	2. Advisor to the Minister of Communications and Information Technology for Social Services	**Dr. Abeer Shakweer**
Non-Profit Organizations and Private Research Centers	**Misr El Kheir Foundation**	3. Chief Knowledge Officer and Head of Scientific Research Committee	**Dr. Alaa-Eldin Adris**
	Magdi Yacoub Heart Foundation – "Aswan Heart Center"	4. Chairman of the Board	**Prof. Sir Magdi Yacoub**
		5. Member of the Board	**Dr. Magdi Ishak**
	Zewail City of Science and Technology	6. Director, Center for Theoretical Physics	**Prof. Shaaban Khalil**
Public Research Centers	**NRC [National Research Center]**	7. The Former President of the National Research Centre	**Prof. Dr. Hany El Nazer**

C. IRB Approval

CASE #2012-2013-071

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

To: Salma Khaled El Tanany

cc: Enas Abdel Azim

From: Atta Gebril, Chair of the IRB

Date: February 19, 2013

Re: Approval of study

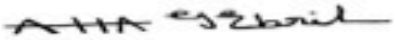
This is to inform you that I reviewed your revised research proposal entitled "**Moving towards a Knowledge-Based Economy: What is needed to enable Science, Technology and Innovation in Post-Revolutionary Egypt**"," and determined that it required consultation with the IRB under the "expedited" heading. As you are aware, the members of the IRB suggested certain revisions to the original proposal, but your new version addresses these concerns successfully. The revised proposal used appropriate procedures to minimize risks to human subjects and that adequate provision was made for confidentiality and data anonymity of participants in any published record. I believe you will also make adequate provision for obtaining informed consent of the participants.

Please note that IRB approval does not automatically ensure approval by CAPMAS, an Egyptian government agency responsible for approving much off-campus research involving surveys and interviews. CAPMAS issues are handled at AUC by the office of the University Counsellor, Dr. Amr Salama. The IRB is not in a position to offer any opinion on CAPMAS issues, and takes no responsibility for obtaining CAPMAS approval.

This approval is valid for only one year. In case you have not finished data collection within a year, you need to apply for an extension.

Thank you and good luck.

Atta Gebril



IRB chair, The American University in Cairo
2046 HUSS Building
T: 02-26151919
Email: agebril@aucegypt.edu

Institutional Review Board
The American University in Cairo
AUC Avenue, P.O. Box 74
New Cairo 11835, Egypt.
tel 20.2.2615.1000
fax 20.2.27957565
Email: aucirb@aucegypt.edu

D. Consent Forms of Interviewed Participants

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

Documentation of Informed Consent for Participation in Research Study

Project Title: Moving towards a Knowledge-Based Economy: What is needed to enable Science, Technology and Innovation in Post-Revolutionary Egypt.

Principal Investigator: Salma Khaled El Tanany

E-mail: stanany@aucegypt.edu/ Mob: +2 01223766464

You are being asked to participate in an interview for 20-30 minutes for a research study. The purpose of the research is to clarify what are the current obstacles Egypt is facing in the fields of Science, Technology and Innovation and how this is hindering Egypt's transformation to a Knowledge-based economy.

The results and findings of this study will be published and presented as a thesis at the American University in Cairo

The procedures of the research will be as follows: The interview shall take place for 20-30 minutes and there shall be an audio recording device, which will be used during the interview upon your consent. Your participation will be on a voluntary basis and you may feel free to withdraw from the interview at any time.

There will not be certain risks or discomforts associated with this research.

There will not be benefits to you from this research.

The information you provide for purposes of this research is confidential.

Questions about the research, my rights, or research-related injuries should be directed to Salma El-Tanany at +2 0122 3766464.

Participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or the loss of benefits to which you are otherwise entitled.

Signature Venice K. Gouda

Printed Name Dr. Venice Kamel Gouda

Date March 24th, 2013

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

Documentation of Informed Consent for Participation in Research Study

Project Title: Moving towards a Knowledge-Based Economy: What is needed to enable Science, Technology and Innovation in Post-Revolutionary Egypt.

Principal Investigator: Salma Khaled El Tanany

E-mail: stanany@aucegypt.edu/ Mob: +2 01223766464

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Signature 

Printed Name Dr. Abeer Shakweer

Date March 5th, 2013

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

Documentation of Informed Consent for Participation in Research Study

Project Title: Moving towards a Knowledge-Based Economy: What is needed to enable Science, Technology and Innovation in Post-Revolutionary Egypt.

Principal Investigator: Salma Khaled El Tanany

E-mail: stanany@aucegypt.edu/ Mob: +2 01223766464

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Signature 

Printed Name Dr. Hany El Nazer

Date March 4th, 2013

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

Documentation of Informed Consent for Participation in Research Study

Project Title: Moving towards a Knowledge-Based Economy: What is needed to enable Science, Technology and Innovation in Post-Revolutionary Egypt.

Principal Investigator: Salma Khaled El Tanany

E-mail: stanany@aucegypt.edu/ Mob: +2 01223766464

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Signature 

Printed Name Dr. Alaa-Eldin M. Adris

Date March 3rd, 2013

THE AMERICAN UNIVERSITY IN CAIRO
INSTITUTIONAL REVIEW BOARD

Documentation of Informed Consent for Participation in Research Study

Project Title: Moving towards a Knowledge-Based Economy: What is needed to enable Science, Technology and Innovation in Post-Revolutionary Egypt.

Principal Investigator: Salma Khaled El Tanany

E-mail: stanany@aucegypt.edu/ Mob: +2 01223766464

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Signature 

Printed Name Dr. Shaaban Khalil

Date March 3rd, 2013