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**Workshop 7**

# *Shaping the Gulf National Innovation Systems*

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## Abstract

The economic diversification of Gulf Cooperation Council (GCC) countries is creating a growing need for diverse technologies that allow economic actors to produce energy, materials, products and services locally and move away from hydrocarbon dependence. A number of prevailing conditions, such as geographical location, demographic trends, health and education challenges and rapid expansion and diversification of GCC economies provide important socio-economic rationales for national science and technology (S&T) policies that help build national research, development and innovation (RDI) capacity, and adapt S&T to local concerns. Moreover, the move to more diversified economies will enable GCC youth to contribute to and participate in a more diversified range of employment options, including knowledge based work linked directly to the emerging RDI opportunities. However, to build competitive knowledge based economies requires a number of key ingredients to be in place. These include substantial investment in research and development (R&D), the investment in and employment of highly skilled personnel, ongoing financial support, proper legislation and policy framework, accessibility to scientific and technological information, and the existence of a socio-economic strategy to channel the results of R&D into the various sectors of the diversifying economies and societies. In the context of the globalization of technological knowledge and international flows among corporate innovation units, this workshop will explore the structure of innovation systems in the GCC and try to assess their functions and interactions at the national level. This will help delineate the contribution of different economic specializations to the innovation process, as it is at

this level that some elements of policy and development strategies are planned and implemented.

## Workshop Description and Rationale

### The Concept of National System of Innovation

The concept of a National System of Innovation (NIS) was developed in the middle of the 1980s and has since spread among economists, S&T policy analysts, international organizations and countries as an analytical concept, through the empirical application of which, attempts were made to discuss, understand and compare the factors behind technological change, economic development and international competitiveness in different countries. Exploring the reasons why national growth rates differ and the multiple explanations brought forward taking into consideration the differences in the science and technology research systems of different countries, the innovative capability of their production systems (Lundvall), their management of innovation (Freeman), their culturally embedded business practices, and their home markets led to the recognition of the complexity of elements that define the NSI concept or impact the formation of such a system. Historically, different approaches related to different national contexts and priorities have emerged: from a broad NSI concept that covers all aspects of learning and competence building in socio-economic activities, with emphasis on the division of productive and innovative labor, to a more focused analysis on the role of institutions and organizations involved in the promotion of science and science-based activities (Lundvall 2002). In an attempt to bring together most of the different components of the NSI concept, a synthetic definition was coined by J. Niosi, P. Saviotti, B. Bellon, and M. Crow, stressing the possible linkages among the different public and private institutions that support technical change: A national system of innovation is the system of interacting private and public firms (either large or small), universities and government agencies, aiming at the production of science and technology within national borders. Interaction among those units may be technical, commercial, legal, social and financial, inasmuch as the goal of the interaction is the development, protection, financing or regulation of new science and technology. (Niosi and al 1994 and Niosi and al 1993) The NSI concept was developed mainly in the rich countries - the US, the UK, France and Scandinavia - but interest in its analytical perspective has been growing strongly in Latin America, Asia and Africa and emphasized the idea that for less developed countries, institutions matter in the catching-up process. More research based on the NSI concept is needed in order that its empirical application in those countries affects positively the development strategies and helps stimulate policy learning (Lundvall 2002) In the context of the GCC countries efforts to build knowledge based economies, the NSI concept approach for the present workshop is to put into perspective the role of science and technology in the formation and shaping of their innovation systems. Hence, this workshop will address, as Niosi and Bellon put it, the structures through which countries conduct technological change at the level of their socio-economic institutions - such as industrial firms - and at the level of public policy for promoting innovation, which pertains to industrial and technological policy, universities, and public laboratories (Niosi and Bellon 1994)

### Innovation Processes & Dynamics

According to Cutler (2008), innovation is the conversion of knowledge and ideas into a benefit, which may be in the form of new or improved products, processes or services and may be for commercial use or the public good. Innovation may be described as creating value by doing things differently; or doing something in a novel way. Simply, it is good ideas put to work. Moreover, innovation:

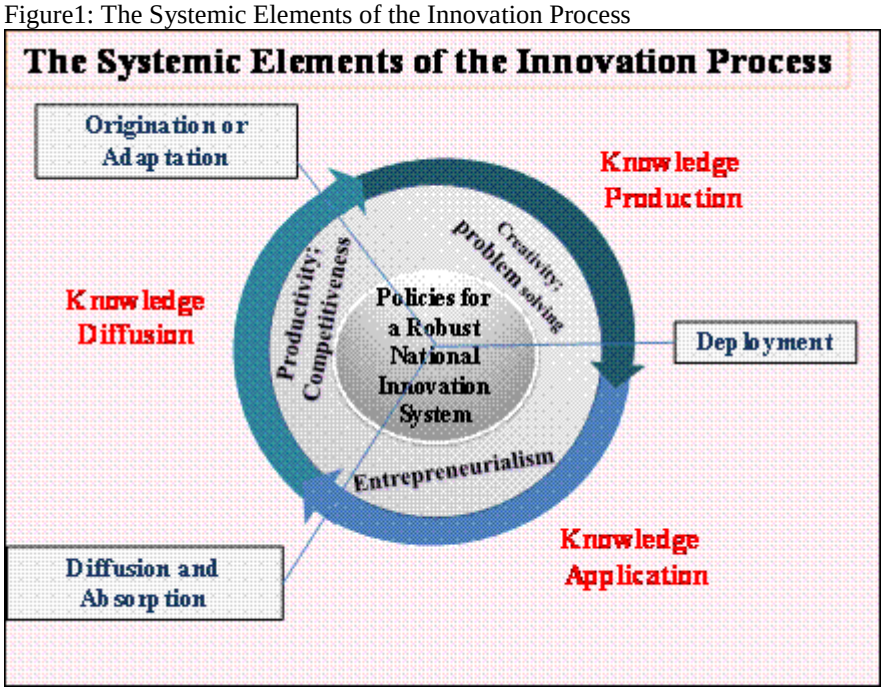
- Is a process of continuously generating and applying new ideas;
- Complements and facilitates the knowledge creation and application process;
- Is one of the key drivers of economic growth;
- Is essential to the competitiveness and sustainability of an economy.

Therefore, innovation is a dynamic, evolving and learning process. There are three highly interdependent components within an innovation system. But the innovation process occurs in various innovation sub-systems and it is common for technology specific innovation systems to overlap various national, regional and sectoral innovation systems (Hekkert et al, 2007, p.416). Hence, if we consider that these consist of the flows and relationships which exist among industry, government and universities in the development of science and technology, three highly interdependent components within an innovation system become evident:

- Knowledge production (the origination of new knowledge and ideas);
- Knowledge application (the deployment of knowledge and ideas in the real world);
- Knowledge diffusion (the absorption of this applied knowledge and its adaptation in use).

The simple virtuous innovation cycle approach presented by Cutler (2008) is a very useful way to look at innovation. Accordingly, the innovation process may be represented graphically as in Figure1.

Figure1: The Systemic Elements of the Innovation Process



However, in reality this process is likely to contain many non-linearities and feedback effects. The link between knowledge and innovation is far from straightforward. Innovation does not occur in isolation but emerges from a system characterized by innovative firms often small and medium sized enterprises (SMEs) often working with government and universities as R&D partners. This has led to the Triple Helix model of innovation (Etzkowitz, 2003) with the university as the SME founder via leveraging off its intellectual property assets generated from research; industry as the incubator through companies that subsequently spin off and governments as the venture capitalist bearing the risk of commercialization. Irrespective of how innovation occurs, it is clear that innovation does not occur in a vacuum. That is, innovative business enterprises interact with the public and private sector including universities and Higher Education Institutions (HEIs). Therefore the NSI may be thought of as embracing all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovation (Fagerberg et al, 2005, p.182), including science and technology development as a result of a complex set of relationships among actors in the technology specific innovation system, namely science-based industries, universities and government R&D institutes (Nelson, 1993). In summary:

- Innovation is built on stocks of knowledge and capability, and the information flows of the innovation capital around these;
- Innovation Policy is a central part of Economic policy;
- A successful NIS invests in each innovation stock component as well as in the flows and linkages between them;
- A NIS incorporates regional (RIS) and sectoral (SIS) clusters of activity; and
- Within a globalized economy, a NIS also needs to be positioned within a global innovation ecosystem.

**NSIs and Globalization**

NSIs are open systems that relate to domestic and international environments through cooperation and competition. Degrees of NSI's openness differ from one country to another and are indicative of some convergence with other NSIs. In particular, the catching-up process entails that industrializing countries adopt foreign technology and science to foster fast technical change and avoid exclusion from international S&T collaboration and R&D, technology transfer, and flows of S&T personnel. This may lead to global uniformity trends in technology, or diverge into national specificities (Niosi and Bellon 1994). But in general, it is important to know how globalization processes affect the possibilities to build national systems of innovation in the industrializing GCC countries, as local knowledge and challenges could easily be ignored when economies are opened up to international competition and societies restructured accordingly. For economies with a weak specialization in high-technology production, technology specific innovation systems could emerge through the introduction of S&T knowledge into the economy. This primarily requires active learning and competence building to enhance the intellectual capital (learning) of these countries (Lundvall 2002). Especially, since growing knowledge-based-industries have increased the need for highly skilled personnel (HSP) in many countries and are driving global demand for human resources in science and technology, the availability of such a pool of talent will be a critical differentiating element of national development. In the context of increased globalization of

production and R&D activities, and with more open forms of innovation challenging national S&T policies, establishing knowledge infrastructure, intellectual property rights, cluster initiatives, good networking capabilities, and industry- university linkages should constitute a suitable basis for and efficient R&D system in the GCC countries. Subsequently, there is a benefit for national and international companies which have their own in-house R&D department in the region to get involved with the output of the region's universities and academic research centers in order to foster innovation culture and skills that are adapted to both local economic development and the company's particular needs. National Innovation ecosystems can thus emerge which will help localize, and hopefully attract, some R&D activities of multinational companies based in the Gulf.

***Measuring Innovation: Indicators & Rankings***

A close look at GCC countries indicates that currently they lag, substantially, the most competitive knowledge based economies of the world based on important knowledge economy indicators. Innovation is directly related to R&D activities, the performance of which is mainly measured by the public sector contribution, Government R&D expenditure (GERD) and the private sector contribution - Business R&D expenditure (BERD). Investment in R&D is a necessary but not sufficient condition for creating a competitive knowledge based economy and society. One should also look at other innovation indicators which may reflect the degree of dynamism of the NSIs. According to Lundvall, in each NSI, there exist two co-evolving dimensions: the structural aspect of the system that accounts for what is produced and what competences are most developed, and the institutional part that is concerned with how production, innovation and learning take place. So to better appraise how NSIs look in each GCC State, we can also draw on Innovation and Knowledge Economy indices developed by different international organizations.

***•R&D Investment Rankings***

To illustrate the extent to which knowledge based economies invest in R&D it is possible to consider the percentage of a country's Gross Domestic Product (GDP) that is invested in R&D. Figure 1 provides data on the percentage of GDP spent on R&D for a broad sample of Organization for Economic Cooperation & Development (OECD)countries. There is considerable dispersion from below 0.5% for Mexico to above 3.5% for Sweden. However, the OECD average is 2.26% of GDP on R&D. Unfortunately there are no reliable data for any Gulf State. Importantly, Qatar has announced that it plans to spend 2.8% of GDP on R&D going forward. No similar announcements have been made by other Gulf States. Expenditure of GDP on R&D is likely to be below 0.3% in each Gulf State except KSA where it is likely to be about 0.5%. Currently Gulf States lag dramatically behind OECD countries in terms of R&D investment expenditure.

***•Innovation Indices***

To rank countries, the Economist Intelligence Unit (2009) distinguishes between innovation output and innovation inputs. Innovation output is measured by patents granted by the three major government patent offices: European Patent Office; Japanese Patent Office and US Patent and Trademark Office. By contrast Innovation

inputs include direct drivers of innovation such as R&D expenditures, quality of research infrastructure, education and skills of the workforce, ICT infrastructure and Broadband penetration. Indirect drivers of innovation such as the political environment, market opportunities, economic policy environment and the regulatory environment are also included in the Innovation inputs measure.

**Table 1: Innovation Index Rank for Gulf countries among 82 countries**

| Country | 2002-2006 | 2004-2008 | 2009-2013 | Change from 2004-08 to 2009-13 |
|---|---|---|---|---|
| Bahrain | 50 | 60 | 56 | 4 |
| Kuwait | 35 | 37 | 36 | 1 |
| Oman | N/A | N/A | N/A | N/A |
| Qatar | 57 | 51 | 53 | -2 |
| Saudi Arabia | 41 | 42 | 37 | 5 |
| UAE | 43 | 40 | 44 | -4 |

Source: The Economist Intelligence Unit Limited, A new ranking of the world's most innovative countries, 2009. Available at http://graphics.eiu.com/PDF/Cisco_Innovation_Methodology.pdf N/A: not available

The Economist Intelligence Unit is forecasting a fall in both Qatar's and UAE's rank position on the Innovation Index in the period 2009-2013 of two or four places, respectively.

An alternative set of international benchmark data are provided by INSEAD, which produces a Global Innovation Index for 130 countries. The rank positions for the six Gulf States according to INSEAD's Global Innovation Index are as follows: UAE (24), Kuwait (33), Qatar (35), Bahrain (40), KSA (54) and Oman (65). One notices apparent contradictions between EIU and INSEAD innovation indexes, which highlight the care that must be taken when using such international benchmark indicators.

***•Knowledge Economy Indices***

Further evidence on the current state of innovation in Gulf States may be obtained from the the World Bank Institute who have developed the Knowledge Economy Index, using its Knowledge Assessment Methodology. According to the World Bank Institute, the Knowledge Economy Index is comprised of four pillars:

Pillar 1: Economic and Institutional Regime The country's economic and institutional regime must provide incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship.

Pillar 2: Education and Skills The country's people need education and skills that enable them to create and share, and to use it well.

Pillar 3: ICT Infrastructure A dynamic information infrastructure is needed to facilitate the effective communication, dissemination, and processing of information.

Pillar 4: Innovation system The country's innovation system firms, research centers, universities, think tanks, consultants, and other organizations must be capable of

tapping the growing stock of global knowledge, assimilating and adapting it to local needs, and creating new technology. The World Bank Institute has calculated the Knowledge Economy Index (KEI) and Knowledge Index (KI) for 146 countries. KEI comprises all four Pillars, whereas, KI comprises Pillars 2 to 4. KEI takes into account whether the environment is conducive for knowledge to be used effectively for economic development and is calculated based on the average of the normalized scores of a country on all four pillars. The KI measures a country's ability to generate, adopt and diffuse knowledge and is a simple average of the normalized scores of a country on the key variables in the three pillars (Education, Innovation and ICT). Table 2 summarizes the rank position for Gulf States. None of the Gulf States is ranked particularly well on KEI and KI. UAE and Qatar are ranked reasonably well in terms of ICT. In contrast to the Economist Intelligence Unit Innovation Index, Kuwait is ranked considerably below UAE and Qatar on Innovation and only just above Oman, Bahrain and KSA. Table 2 is useful in drawing attention to the extent to which Gulf States lag internationally competitive countries in terms of innovation and knowledge economy fundamentals.

Table 2: The Rank of Gulf countries among 146 countries with regard to Knowledge Economy

| Country | Knowledge Economy Index (KEI) | Knowledge Index (KI) | Pillar 1: Economic Incentive Regime | Pillar 2: Education | Pillar 3: ICT | Pillar 4: Innovation |
|---|---|---|---|---|---|---|
| Bahrain | 49 | 56 | 48 | 60 | 40 | 80 |
| Kuwait | 52 | 59 | 51 | 76 | 46 | 70 |
| Oman | 66 | 79 | 40 | 86 | 76 | 71 |
| Qatar | 44 | 45 | 42 | 67 | 27 | 48 |
| Saudi Arabia | 68 | 73 | 58 | 80 | 52 | 86 |
| UAE | 45 | 44 | 47 | 79 | 21 | 46 |

*Source:* The Knowledge Assessment Methodology (KAM) 2009 rankings for 146 countries, The World Bank Institute, available at: *http://info.worldbank.org/etools/kam2/KAM_page5.asp*

UAE and Qatar are ranked reasonably well in terms of ICT. In contrast to the Economist Intelligence Unit Innovation Index, Kuwait is ranked considerably below UAE and Qatar on Innovation and only just above Oman, Bahrain and KSA. Here too one can see contradictions between the different innovation indexes. Notwithstanding these caveats, the various international benchmark data discussed above indicate that currently Gulf States, generally, are not internationally competitive with respect to Knowledge production and innovation.

## Objectives of the Workshop

The workshop aims to explore the region's capabilities and practices in its efforts to acquire and adapt technology to national conditions and priorities and to identify local synergies and obstacles occurring in such processes of catching-up. Studies could address for example: GCC S&T national policies, strategies and priorities; R&D funding mechanisms; technical networks; industry-university collaboration; or key institutions linked to the absorption, creation and diffusion of technology. This workshop invites participation from academic experts, government policy makers and

other researchers interested in issues, challenges and opportunities related to the building of competitive knowledge based economies in the Gulf region. Of particular interest are NSI concept related themes that highlight the role that S&T and R&D can play in achieving knowledge based economic diversification. We welcome case studies, comparative studies, conceptual papers and empirical studies that include, but are not limited to:

- The design of GCC NSIs and the necessary and sufficient conditions for building them
- The role of international benchmarking in the development of GCC NSIs
- Reciprocity between GCC NSIs and economic structures
- Management of Innovation: key institutions and processes
- Interplay between innovation policy and industrial policy
- Public sector reform and innovation
- The role of government procurement in national innovation systems
- Intellectual Property protection and commercialization
- S&T strategy as integral/coherent component of national social and economic development strategy
- Finance and innovation
- R&D base as national resource to inform and enhance GCC national policy-making across a range of domains, e.g.: sustainability, transport, health, telecoms, etc
- The GCC national R&D bases and investments underpinning strategic industrial and economic diversification priorities, addressing national social and economic challenges, supporting innovation & entrepreneurship
- Industry-university linkages, University R&D versus industry R&D-competitors or collaborators
- Integration of R&D, and education & training
- R&D human resource requirements and local labor market impacts, or the global competition for S&T talent and its impact on the Gulf States
- GCC FDI inflows, inward international technology transfer, R&D and integration into global innovation networks
- The viability of a GCC regional system of innovation

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## Workshop Director Profiles

**Dr. Kenneth Wilson** is Director of the National Research Foundation (NRF) of UAE. Prior to joining NRF, Dr Wilson was Professor of Economics and Director of the Economic & Policy Research Unit, Zayed University, UAE. Originally from Australia, Dr. Wilson has undertaken research in a wide range of applied economic areas and has published more than 50 refereed publications including books, book chapters and international peer reviewed journal articles on topics such as international competitiveness, contingent protection, dumping and anti-dumping, trade, tourism economics, productivity and labor market issues. His current research focuses upon the knowledge economy fundamentals of Gulf countries. Dr. Wilson also has considerable experience in research project management, research training, research capacity building and developing innovation capacity. Dr. Wilson received his undergraduate education in Economics from La Trobe University in Australia and his Ph.D. from the University of Wisconsin-Milwaukee, USA.

**Imen Jeridi Bachellerie (MSc)** coordinates the Science & Technology program at the Gulf Research Center. She holds a degree in Electro-Mechanical Engineering from Ecole Nationale d'Ingenieurs of Tunis (Tunisia), a Master of Science in Mechanics from Ecole Normale Superieure de Cachan (France) and a Master of Science in Epistemology and History of Science and Scientific Institutions from Universite Denis Diderot-Paris VII (France). From 2005 till 2008, she was a project manager in the Arab Science and Technology Foundation (ASTF), where she took part in the design and coordination of many science development initiatives. For

instance, she coordinated the first Pan-Arab Industry University Linkage Competition Made in the Arab World and was in charge of ASTF affiliate Networks. Prior to that, from 2002 till 2004, she was a consultant researcher and contributed to reports for UNDP and UNOPS on the Arab world. From 1996 till 2000, she was a project manager at Association Nationale les Petits Debrouillards (ANPD) and MILSET, French NGOs for Science Education where she developed training programs for science instructors in France and Lebanon. She coordinated the planning and implementation of the Lebanese ANPD sister organization.

**Dr. Eoin O'Sullivan** joined the Centre for Industry and Government as a Senior Policy Fellow in 2007. He is also a Programme Director at the Cambridge-MIT Institute which he joined at the end of 2006. Before joining CMI, Eoin was Special Advisor to the Director General of Science Foundation Ireland. At SFI, Eoin managed several university-industry initiatives including the national Centres for Science, Engineering & Technology (CSET) programme. Eoin was part of the original team that set up SFI. He was both a Senior Policy Advisor at Forfas, The Irish National Policy & Advisory Board for Enterprise, Trade, Science, Technology & Innovation and a Senior Programme Officer for Information & Communications Technologies at the Foundation. Before moving back to Ireland, Eoin spent a couple of years as a Physics Editor at the Cambridge University Press. He has a BSc from University College Cork and a D.Phil. from the Physics Department of Oxford University.