

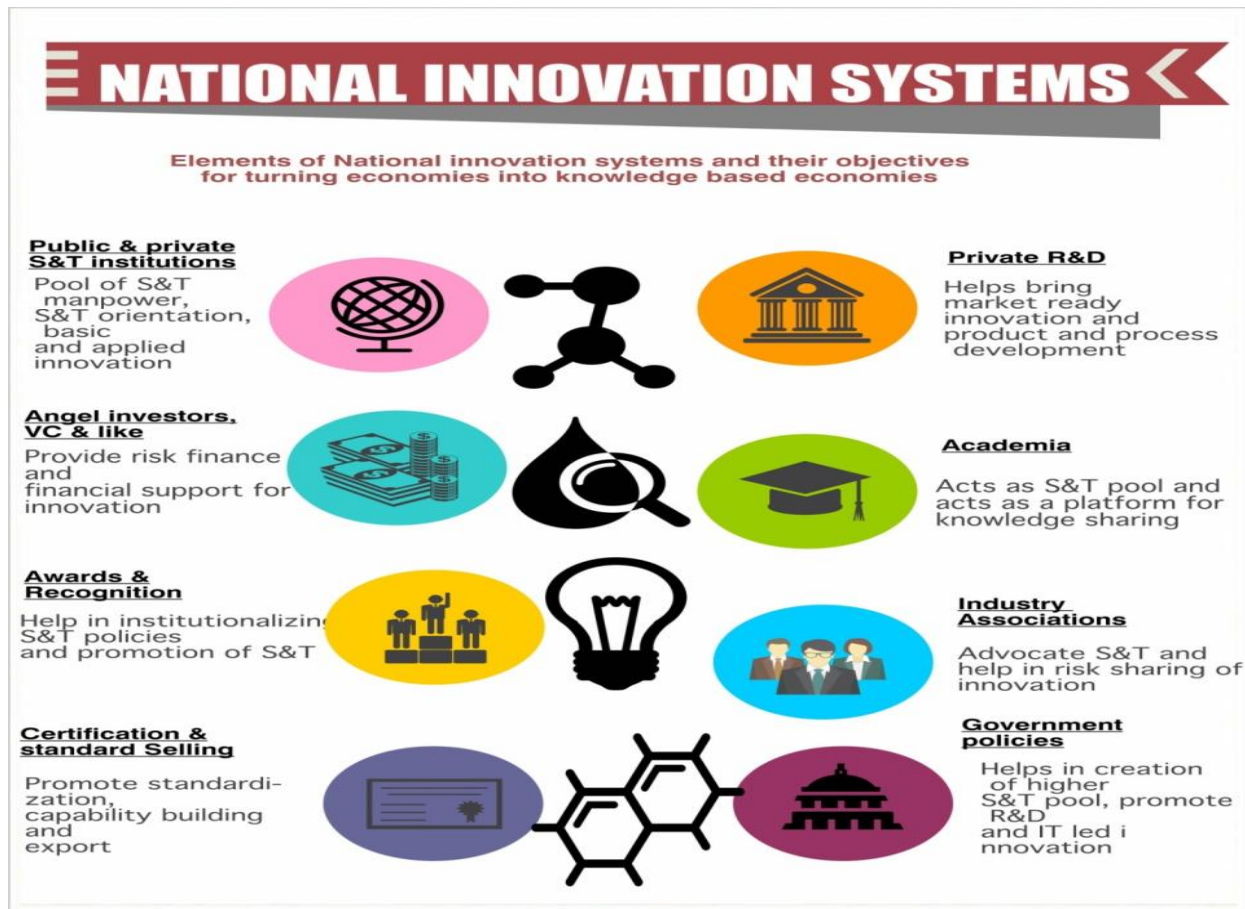
# A study of National Innovation Systems of Gulf Cooperation Council

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**Abstract:** A robust NIS system is a prerequisite for building a successful nation. With huge amount of wealth at their disposal, GCC countries are taking initiatives to transform themselves into knowledge based economies from oil based economies. This paper evaluates the current NIS of GCC countries, shows where they stand when compared to other countries, and how they can learn from countries like Singapore, Brazil, Malaysia, USA and Norway to make their NIS more effective.

## Introduction

National innovation system (NIS) has emerged as the dominant paradigm used by policy makers and economists to explain how various actors at state and regional level influence the technological innovations that arise from that economy. NIS includes the public and private education systems, industry-academia interactions, support for innovation and risk taking including venture funds, Research & Development (R&D) infrastructure including labs, no. of scientists and national S&T policies. Niosi et al (1993) construes NIS as the complete ecosystem and interrelation amongst knowledge, finance, human skills, regulatory support and commercial flows within a country. The interaction amongst these units may be technological, social, legal, commercial, and financial or anything else as long as the goal of the interaction is the development, protection, financing or regulation of new Science & Technology (S&T). NIS includes major regulations and policies at the national, regional and cluster levels with regard to R&D, innovation and education and training. Incubators, technology parks, business promotion centers etc are also institutions that play a significant role in national innovation development. Fig 1 presents the various components of NIS.

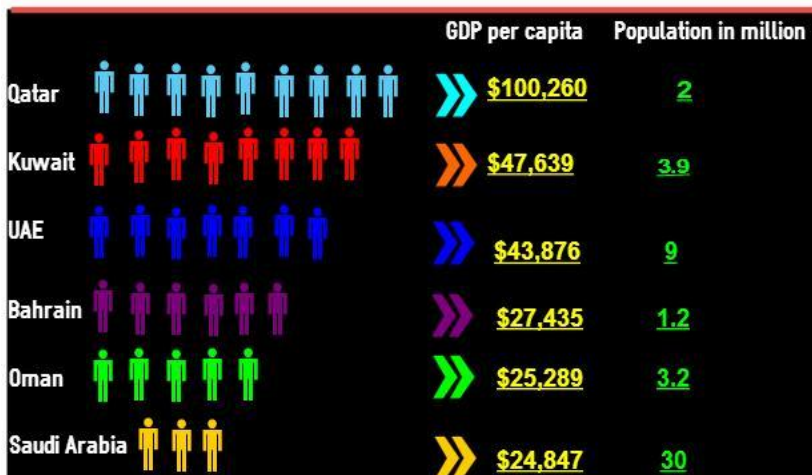


**Figure Number. 1: Elements of NIS**

The roles that a government plays in creating an atmosphere where policies can be implemented to get the desired outcomes have been stressed time and again by various economists. Mariana Mazzucato, in her book “the entrepreneurial state” has advocated the role of the government for creating backbone of NIS. GCC countries have also made efforts to create infrastructure and institutions necessary for NIS. The various business incubation centers, science and technology funds, schemes and policies have been created to facilitate innovation. However, despite of the numerous efforts, the GCC countries have not made much progress. The experiences of Japan, Korea, India and Singapore show that government can play a critical role in the technological capability development process. A well planned national innovation system develops and sustains institutional mechanisms and market behaviors that allude to competitive advantage of the nation. Korea, exemplifies it. It has successfully transitioned itself from a farming led economy to technology led economy. Until 1961, Korea depended mostly on farming and 10% of their GNP came from American aid. It has transformed by acquiring and disseminating technological know-how. For that, Korea did not go by traditional route, i.e. to loosen the import barriers and encourage FDI. Instead it allowed turnkey projects. Intentionally locals were hired as employees in these projects so that even after the completion of the project the knowledge would remain in the country. Slowly with the help of reverse engineering, they were able to be technologically advanced. It clearly shows how well planned and prepared their NIS was. At first they allowed the MNCs to do the projects and meanwhile they also prepared their citizens in terms of education so that they were able to learn from the MNCs. It indicates how important NIS is and how it helps to increase the competitive advantage of the nations.

Similarly, behind the success of Germany as an engineering nation is its robust education system which inculcates a culture of apprenticeship from as early as high school level. USA is home to some of the most innovative companies in the world like Google, Apple and Facebook. Simply because the government has been able to create an environment where entrepreneurship is encouraged and risk capital is available plenty. Most products are outcomes of lab to market programs and commercialization of technologies across different domains.

The objective of this paper is to 1) analyze the status of NIS in GCC countries, 2) identify the policies and initiatives taken by countries like Brazil, Malaysia and Singapore to build NIS and 3) Identify the gaps in the current NIS and areas for improvement in GCC countries 4) identify approaches GCC countries can adopt and customize to grow scientific development from their region.



**Fig.No.2 GDP per capita and population of GCC countries**

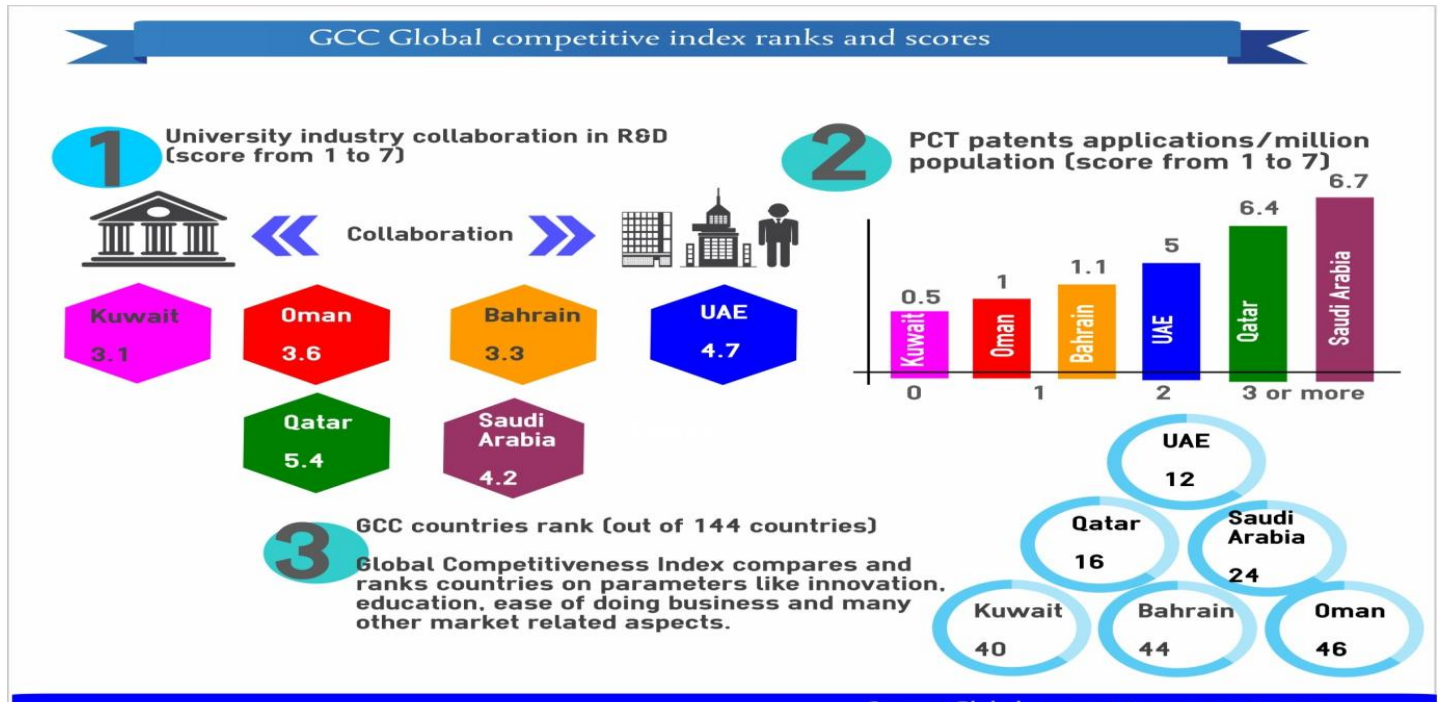
Source: Global Competitiveness Report, 2014

economic philosophy of these countries has been free market and outward market orientation.

It is only in the recent years that GCC countries realized the importance of technological development. Various initiatives have been taken to transform themselves into knowledge based economies from oil based economies. Some of the initiatives taken by GCC countries to foster science and technology development include the King Abdullah Bin Abdulaziz Science Park in Saudi Arabia, the center of excellence for applied research and training (CERT) in the UAE, the knowledge oasis Muscat in Oman, and the Qatar Science and Technology Park. With an exception of Qatar and UAE, all of them rank very low in terms of “capacity for innovation”. Most of the advanced technology used in these countries is imported. With very few applications for the patents per year they have not been able to invent and most importantly commercialize the scientific discoveries. Mainly due to lack of collaboration amongst university, industry and government which is also called the “triple helix”. A strategic collaboration amongst three is a must for technological advancement and scientific discoveries.

**NIS in GCC**

GCC countries have taken measures for the holistic development in terms of productivity, research and education and training. In each of these spheres, numerous efforts have been made but the result has been mixed. The current situation of the GCC countries in terms of innovation and where they stand when compared to other countries is best summarized by the following figures which have been taken from Global competitiveness report 2014.



**Fig.No.3: University-industry collaboration and patents applications of GCC countries**

Source: Global competitiveness report 2014

Parameters	Saudi Arabia		Qatar		Oman		Bahrain		Kuwait		United Arab Emirates	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Capacity for innovation	4	55	5.2	12	3.4	103	3.8	65	3	129	4.7	25
Quality of scientific research institutions	4.2	44	5.4	16	3.4	92	3.2	102	3.2	103	4.8	30
Government procurement of adv. Tech products	4.6	7	5.7	1	4.2	12	4.1	23	2.9	119	5.4	2

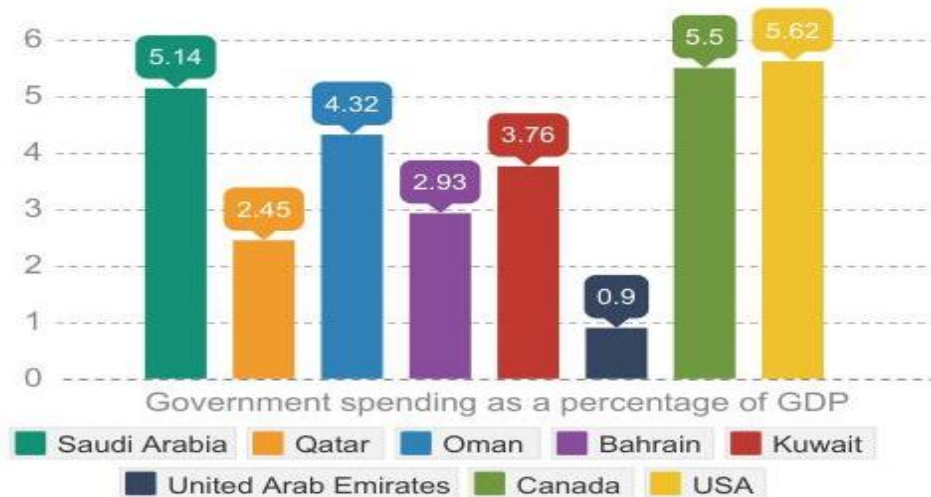
**Table.No.1: Innovation parameters rank and score of GCC countries**

Source: Global Competitiveness report, 2014

Note: rank is out of 144 countries and the score is on a scale of 0 to 7.

In 1985, Konrad & Wahl had classified countries into eight stages of S&T development on the basis of seven quantitative indicators of S&T potential, such as S&T personnel, R&D expenditure, proportion of productive R&D, etc., and five qualitative indicators of development of S&T infrastructure. Countries like USA, Germany, and Japan were listed at 8<sup>th</sup> level, countries like India, Korea, and Brazil were at 6<sup>th</sup> level and most GCC countries including Kuwait, KSA were listed at 3<sup>rd</sup> level. Ever since, GCC countries are continuously adopting policies and measures to raise marketing potential of the local firms. They have started programs to sustain their growth from the vagaries of the international commodity market and in recent years have taken significant steps to raise productive job creation, and improvement in skills and employability of their nationals. GCC countries have been able to achieve huge economic progress but at the science,

technology and innovation front, they have not made significant advancements. According to World Bank, in 2011, the total expenditure of the UAE Kuwait and Oman as a percentage of GDP in research and development was as low as 0.4%, 0.09% and 0.13% respectively.

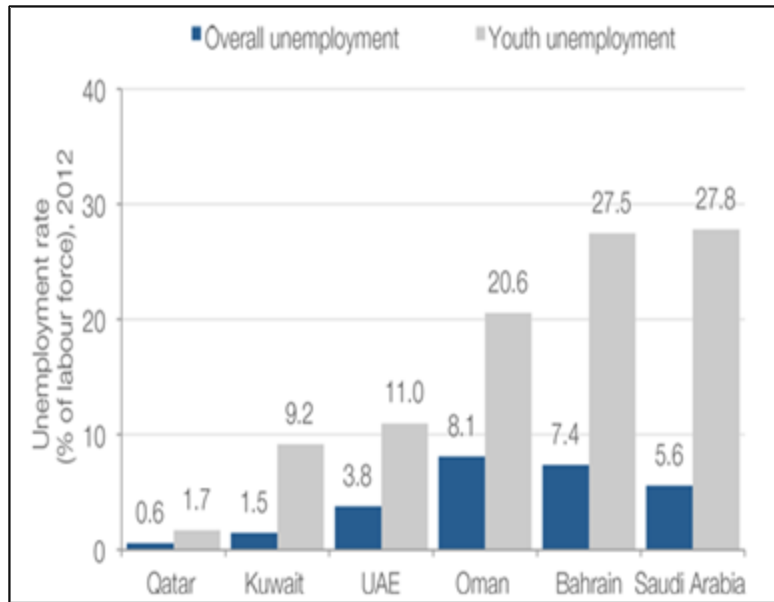


**Fig.No.4: Government spending on education as a % of GDP by GCC countries in 2014**

Source: World Bank

Education and training, another important sphere of NIS, plays a significant implicit role. With a whopping youth population and high unemployment rate amongst them, GCC countries have been spending huge amount in this sector. Countries like Saudi Arabia and Oman have spent as high as 5.14% and 4.32% of their GDP on education and training in 2013. The total number of universities has increased significantly in the last decade from 37 in 2002 to 124 in 2014. Various awards and fellowships programs have been created in GCC countries to encourage the education system and young minds. For example, Hamdan award is given to the outstanding students, teachers, schools and families for their efforts. An alumni association of all the awardees has been created to ensure that the awardees remain on the right track and receive all the support to achieve their goals.

But the industry university collaboration is very low and is acting as a hindrance for knowledge transfer. Despite of the increase in the number of universities and government spending in education, the quality of education is low especially in math and science field. Looking at the Global competitiveness report's parameters, it is evident that the policies have not been effective as the GCC countries still lack behind in all the parameters like quality of education, quality of math and science education and extent of staff training.



**Fig.No.5: Youth unemployment rates in GCC, 2012**

Source: World Bank, World Development Indicators

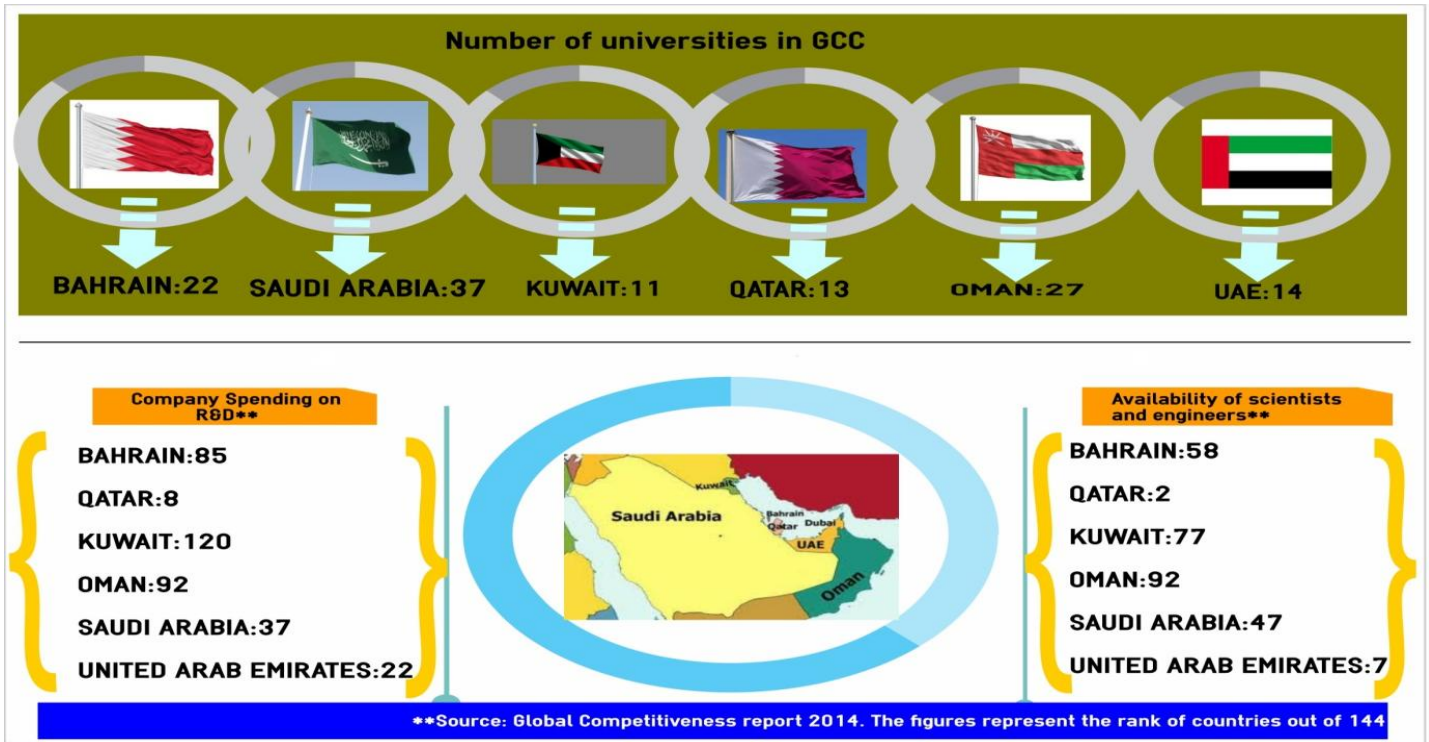
In 2012, according to World Bank, the youth unemployment in Saudi Arabia, Bahrain and Oman was as high as 27.8%, 27.5% and 20.6%. As all the GCC countries have huge number of highly educated expats from affluent countries, the white collar jobs which the Arab youth aspire to get are taken up by expats. In a recent 2014 survey conducted by E and Y, most of the companies indicated that the education system of GCC does not prepare them for the challenges of the corporate world. Despite of the companies and the government making significant spending for research and development, the number of patents registered by the GCC countries is extremely low compared to the countries like Germany and USA.

Parameters	Saudi Arabia		Qatar		Oman		Bahrain		Kuwait		United Arab Emirates	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Quality of education system	4.1	47	5.8	3	3.5	81	4.3	38	3.1	105	5.3	9
Quality of math and science education	4.1	73	5.5	6	3.6	95	4.3	58	3.4	102	5.3	11
Quality of management schools	4.2	78	5.6	10	3.6	113	4.4	59	3.9	87	5.3	18
Availability of research and training services	4.1	73	5.3	19	3.8	94	4.5	42	3.6	100	5.4	11
Extent of staff training	4.1	60	5.3	6	4.3	49	4.5	29	3.7	97	5.1	11

**Table.No.2: Education parameters rank and score of GCC countries**

Source: Global Competitiveness report, 2014

Note: rank is out of 144 countries and the score is on a scale of 0 to 7.



**Fig.No.6: Number of universities, company spending on R&D and availability of scientists and engineers in GCC**

Despite significant investment in S&T infrastructure, a cohesive and coordinated approach is required to ensure the outcomes. Industry university collaboration needs to move beyond supply of graduates. Formal and informal flows of information, ideas and projects need more support and platforms. R&D by companies is limited, as the market in most places is trading. However, a Made in GCC approach can kick start innovations that are local specific with a global impact. There is a need to create policies and programs to encourage R&D. Market making mechanisms that can drive lab to market ideas and channels to distribute innovation and knowledge required. The educational curriculum that has largely aped British education needs to embrace effective education that encourages innovation, research and development from a young age

**Approaches to fortify GCC NIS systems?**

GCC can emulate the strategies and approaches adopted by several countries to strengthen their NIS. In this section we briefly cover the specific policies pursued by different country and how GCC countries can imitative these strategies to

broaden and improve the efficiency of their NIS. Our recommendations are broadly grouped into four categories, namely, research and development in science and technology, SMEs and entrepreneurs, strengthening institutional frameworks and education and training. These four form the pillars on which NIS is built and developed. They affect not just the input part of NIS, but also in defining the behavior of the various elements of NIS system including the risk taking, support for innovation etc.

### Research and Development in Science and Technology

Sl.No	Country	Policy
1	Malaysia	<p><b>Demonstrator Application Grant Scheme (DAGS):</b> It is intended to facilitate the growth of bottom up innovations which are indigenous in design, contain local content and culturally relevant to meet the demands of the Malaysian community. Priority is given to IT and multimedia technology based proposals that have local content and services.</p> <p><b>Commercialization of R&amp;D Fund (CRFD):</b> CRFD was established to provide partial grants to qualified R&amp;D projects for commercialization purpose. The amount of grant received under this is to be used only for the following tasks:-</p> <ul style="list-style-type: none"> <li>• Market Survey and research</li> <li>• Product/Process Design and Development</li> <li>• Standard and regulatory compliance and intellectual property protection</li> <li>• Demonstration of technology</li> </ul>
2	Brazil	<p><b>SwB (Science without Borders)</b> is a large-scale, nationwide scholarship program that is primarily funded by the Brazilian federal government. The program seeks to strengthen and expand Brazilian education in the areas of science, technology, innovation and competitiveness; by providing opportunities for international studying to undergraduate, graduate students and researchers. The overall goal of this program is to qualify 100,000 Brazilian students and researchers in top universities worldwide through 2014. The program's areas of interest are STEM fields.</p>

GCC countries can adopt similar strategies as above to encourage research and development. They should create sector specific funds and grants to support innovation from the inception of the idea till the commercialization of it. Similarly, innovation with regard to indigenous products needs to be given more priority so that more local nationals are involved. But most importantly, creation of a central government body which is responsible for regulation, allocation and distribution of the funds is essential. Also, only the creation of the funds and policies is not sufficient. Targeted groups need to be informed about it. Ease of access to the information is required.

### SMEs, Entrepreneurs

Sl.No	Country	Policy
1	Singapore	<p><b>Business Angel Scheme</b> – Aggregate pre-approved angel investors and organize for startups to reach out to them.</p> <p><b>Sector Specific Accelerators</b> - the government has approved the establishment of Sector Specific Accelerators (SSA) to identify, invest and grow start-ups in strategic but nascent sectors, such as medical and clean technology.</p>



2	<b>Costa Rica</b>	Costa Rica’s Government has developed a National Entrepreneurship Policy 2010–2014, an overall strategy for entrepreneurship development. It identifies national priorities that the Government seeks to contribute to through entrepreneurship including the preservation of the environment, intercultural integration and regional brand development. Key areas of action are also identified, taking into account the existing barriers to entrepreneurship. The areas include promoting entrepreneurship, institutional articulation, information and monitoring, financial instruments for entrepreneurs, guidance to entrepreneurs, innovation and technological development for entrepreneurs and encouraging entrepreneurs to export.

Small firms not only provide employment opportunities but also create a lot of innovative products and services. The innovation giants of today like GE, Apple and Google were once a small company. It is because the environment that they were established in were favourable for entrepreneurs, these companies reached the pinnacle of success. GCC countries can also foster entrepreneurship by establishing various incubation centres which provide help with regard to business planning, idea testing, finance required and feasibility study of the project. Since entrepreneurship requires a lot of risk taking, the GCC countries government should be able to create a cushion, so that the fear of failure is eliminated to some extent as it is one of the biggest impediments after the availability of finance. Similarly, to create a culture of entrepreneurship, the school and college curriculums also need to be adjusted. The habit of risk taking needs to be imbedded in the students mind from an early age to create future entrepreneurs.

### Strengthening Institutional Framework

Sl.No	Country	Policy
1	<b>Malaysia</b>	The Ministry of Works has a division devoted to the development of Bumiputera entrepreneurs in the construction sector. The Bumiputera Development Division has adopted a client charter to efficiently serve and provide guidance to Bumiputera contractors. The charter includes commitments to process applications for specific programmes within 30 days and, to provide feedback to complaints in 3 working days, among other measures.
2	<b>Singapore</b>	The Ministry of Trade and Industry is also the coordinating entity in charge of entrepreneurship, The Research and Enterprise Division within the Ministry focuses on creating a conducive business environment for Singapore based enterprises to form, compete and grow. It works closely with the Competition Commission of Singapore, the Entrepreneurship Development Agency SPRING Singapore, International Enterprise Singapore and the Agency for Science, Technology and Research as well as various other public and private sector entities.
3	<b>Barbados</b>	The Barbados Entrepreneurship Foundation formed in 2010, was born from a vision to make Barbados “The #1 Entrepreneurship Hub in the World”. Led by a prominent local business leader and a group of local and international entrepreneurs, the goal of the Foundation is to support developing businesses. Its focus is growing sustainable entrepreneurship through finance, government policy, education and skills, mentorship and business facilitation. The Foundation has broad political support.

Institutional framework is the infrastructure required for NIS. Like the countries mentioned above, GCC countries should also work towards strengthening their infrastructure. Infrastructure here is not only confined to physical infrastructure but instead comprises of policies, regulatory bodies, rules and regulations which have a direct or indirect impact on the NIS. Like mentioned before, GCC countries need to have a central regulatory body which is solely responsible for driving all the innovation related activities.

### Education and training

Sl.No	Country	Policy
1	<b>Sweden</b>	Adult education initiative (or knowledge lift) (1997 to 2002), aimed to foster adult education as cornerstone of a renewed labor market policy which would promote inclusive economic growth. It targeted unemployed adults who had not completed the last three years of upper secondary school and employees with low levels of education who were at risk of unemployment. Participation was voluntary and involved counselling and orientation courses, various forms of education and additional sources (e.g. financing for studies). Special education grants were given to the people of age 25 to 55 years. Municipalities, who were responsible for running local job centers, were, for the first time, given overall responsibility for providing adult education for which they received state funding. The initiative was a huge success, in which 20% of the Swedish labor force participated in the initiative. The budget allocated for the initiative was 8 billion Euros. It led to higher participation rates in adult education, increased personal income, better cooperation between the education system and trade union
2	<b>Finland</b>	NOSTE PROGRAMME (Lifting up) which ran from 2003 – 2009, aimed to raise the competences of the low skilled labor force in Finland. It targeted 30 to 59 years old citizens who lacked post compulsory formal education. Free trainings for skill development. Implementation was based on tripartite coordination, close cooperation with local and regional institutions, local trade unions and education providers.
3	<b>Denmark</b>	Strategy for lifelong learning adopted in 2007. Effort were made to track each student till the age of 25 and to propose concrete education or training options if they are at risk of dropping out of study or work.
4	<b>Germany</b>	Dual system – apprenticeship accompanied by part-time classroom tuition in vocational and general subjects. Apprenticeships are open to all the students who have completed lower secondary education (Age 15) and last from 2 to 3 and half years.

GCC countries can learn from countries like Denmark, Finland, Germany and Norway which have the best education and training programs in the world. Like Germany, GCC countries can inculcate the culture of apprenticeship from an early age in students. Similarly, various options should be given to the youth apart from the studies. For example, in Denmark, the youths are tracked till the age of 25 to make sure that either they are engaged in studies, vocational training or correctional programs. Not all the youth want to pursue studies, so the GCC need to come up with policies which include even those who are not interested in studies.

In totality, GCC countries have taken big strides in terms of economic development and have huge amount of wealth at their disposal derived mainly from oil and natural gas reserves. Since these reserves are non-renewable and are bound

to perish in future, it is high time for GCC countries to transform themselves into knowledge based economies. As a robust NIS is a prerequisite for any knowledge and innovation led economy, GCC countries need to make provide significant attention to it. The transformation itself cannot happen overnight as it is a paradigm shift. However, with small initiatives and policies changes at the time, the goal is not unattainable.

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