

The role of research in knowledge economy within GCC countries

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Abstract

The Gulf Cooperation Council (GCC) member states are transitioning into a knowledge-based economy. The methodology use in this paper is secondary data obtained from difference sources. Descriptive and comprehensive approach have been applied. The OECD definition of knowledge economy and the World Bank Knowledge Index (KI) and Knowledge Economy Index (KEI), and Arab Knowledge Economy Index (AKEI) and other indicators are the international literature that is used to examine current and progress made by GCC member states to transition to the knowledge economy. The role of research in the knowledge economy is vital for the transformation process into knowledge economy within GCC member states. According to Dr Mona “no research, no knowledge economy”. Natural resources of which GCC countries are endowed with are abundance especially oil and gas are plumbing typically from \$140 to \$30 or \$40. There is growing effort by all countries globally to move toward green energy technology which is real. These challenges and the move by developed and developing economies toward knowledge economy is influenced by research, innovation, technology, information and entrepreneurship. That is why most of the countries within GCC member state are moving toward a knowledge economy. However, the literature review for this paper shows that there is little or less funding toward research, innovation and technological development compare to GCC member states counterparts in the West, Finland, Switzerland, Korea, Japan, UK, USA and Singapore. Hvit [2] pointed out that there is a lack of funding for research within GCC member states, despite economic resources. They have not even been forced to invent, innovate but been able to base their development on learning, imitation, importing technologies and workers globally. For him, this type of transformation or lack of funding will be long and difficult, and they cannot leapfrog to the knowledge economy as parallel to European evolution process.

The wheel of transformation, diversification into a knowledge economy and the role of research in knowledge economy within GCC member states have left the station, and there is no reverse to the old status quo. Their transformation may take many directions but requires bravery by playmakers within GCC member states. One option could be global talent pool, greater collaboration with great institutions, especially establishment of campuses in GCC countries, naturalisation and attraction of the best mind from abroad if the need be. There are differences from country to country toward the role of research in knowledge economy among GCC member's states as this paper show. Some member states are in the crossroad of diversification of their economy. Nonetheless, one common factor across GCC member states is the mindset toward science culture is still low. Some states are still in their early stage of establishing a research system or ecosystem or research hubs or incubators to drive toward knowledge economy and should be approved.

Key Words: Gulf Cooperation Council (GCC), research, education, innovation, technology knowledge economy.

1. Introduction

The Gulf Cooperation Council (GCC) is a political and economic organisation composed of six nations, namely, Saudi Arabia, United Arab Emirates, Bahrain, Qatar and Oman. The GCC was established in Riyadh, Saudi Arabia in May 1981, to strengthen relationships among its member states and promote cooperation. GCC countries are endowed with natural resources, especially oil and gas with high income among its citizens. However, with recent challenges GCC countries are vying more for higher education, research and knowledge economy. The need for the knowledge economy is base on the understanding that modern economies are created based on scientific foundation whereby scientific research, knowledge and innovation leads to economic development and growth. Countries around the world, countries including GCC countries are trying to diversify their economy to a knowledge economy.

To this effect, Lester Throw [1] argue that “Natural resources have dropped out of the contentious equation. The lack of natural resources may even be an advantage ... because the industries we are competing for, the industries of the future, are all based on brainpower” Thus, the role of research either in science or social science is essential for knowledge economy within GCC member states and the world at large. The drive by GCC countries into the role of research in the knowledge economy is due to changes facing the world and the realities

within GCC member's states. These realities or challenges facing GCC member's states are the fluctuating of oil and gas prices which are the source of government revenue generation. The oil price has slumped from \$140 per barrel to \$ 30 per barrel and has led to the budget deficit within GCC member's states. The other challenges such as the need for human capital building, the creation of jobs for the GCC citizens and diversification of the economy within the region are evidence. All the above requires a shift in perspective by the GCC countries. The shift toward the role of research in knowledge economy should be supported by a policy with a long-term strategy in place to avoid disappointment on a very long journey that requires focuses. To this effect, Hvidt [2] contend that the present collapse of oil price has encouraged new life into the diversification effort, by GCC countries to transform their economies into the knowledge economy.

Scientific research plays an important part in the sustainable economic development of any given nation. Knowledge creation and dissemination has become significant drives to the economic growth of many developed nations especially with the rapid advancement in information and communication technologies (ICT). The greater use of ICT had also lead to speedy advances in research and development especially in the West and developed the world. Knowledge on doughtily is an important ingredient for economic development and transformation within GCC member states.

However, there is a greater recognition that there is a low level of funding for research within GCC members countries although there are differences from country to country. Most institutions or universities of learning do not put emphasis on research which is mostly funded by the government within GCC countries. But rather on teaching which means that many faculty members concentrate on finishing their syllabus or teaching load which deprive them of research initiatives. There is less encouragement for academic staff to present papers at various international conferences around the world although there are an exception for GCC nationals which lead to limited research among institutions of learning, especially by expertise staff who believe their research will yield to nothing if they cannot present them in conferences internally or internationally.

To the above observation, Hvit [2] states very strongly that there is a lack of funding for research within GCC countries. Hvit [3] concluded that GCC countries despite their sufficient economic resources have at no time been forced to invent or to innovate, but been able to base their development on learning, importing technologies, savoir-faire and workforce available globally. He cautions such type of economy which dependent on import and income dependent on oil and gas. He argues very strongly that the current state of affairs about innovation and the educational system, the transformation of knowledge will be difficult and long. He emphasised that the Gulf States are attempting to leapfrog from pearling/fishing/trading economy into the knowledge economy while asserting that Europe started its economy from agriculture as the economy Foundation as a society then to industrialisation, then information society and now knowledge economy.

Al Lawati [4] also noted that the spending by GCC countries on research and development does not exceed 0.2% of GDP data from UNESCO 2010. He also argues that the private sector is near complete absence role in research and development within GCC countries with only one exception of Qatar which has allocated 2.8% of GDP for research and development. Al Lawati [4] went further to compare develop countries spending on scientific research and development with GCC countries and concluded that GCC countries are considerably low.

In this paper, a descriptive and comparative method of analysis are applied. According to Leedy and Ormrod [5], the descriptive approach is a basic research method which analyses situation as it exists in its current state. Comparative research examines how the independence variables are affected by the dependable variables and involves causal and effect relationship between variable. Furthermore, Skocpol [6] argue that a comparative method or approach is a set of rationally based procedures for systematically testing against experimental evidence alternative (or competing) hypotheses about causal relationships between phenomena, and thereby either corroborating or reject them. It's aimed at identifying law-like causal regularities.

The aim of this paper is to analyses current progress in the role of research in knowledge economy within GCC member countries and discusses the challenges and put in some recommendation. Section one of the paper focuses on the introduction. The second section focuses on the brief background of GCC member states; the third section is on conceptual framework and literature reviews. The fourth is reviewing current progress in the role of research in knowledge economy across member states since there are differences in how some have fared toward a knowledge economy.

2. Background on GCC countries

The GCC countries are made up of Bahrain, Oman, Kuwait, Qatar, Saudi Arabia and United Arab Emirates (UAE). The founding father creation of GCC was to have greater cooperation in all the field. To have free

movement and trade among them. All the GCC countries are rich in natural resources especially oil and gas. The structure of GCC countries is made up of a supreme council, Ministerial Council and the secretary general. The secretary general office is permanent and is in Riyadh Saudi Arabia. The supreme council is composed of the head of states, and they meet once a year, and they can also call on an emergency meeting by any two countries of member states [24]. The Ministerial Council is administered by the Foreign Minister from each member states.

The GCC member state is endowed with natural resources. However, recently these resources that the government dependent upon for revenue collection has collapsed. The oil prices have gone down drastically, and most of the countries in the region are trying to diversify their economy into the knowledge economy. To diversify GCC member states economy into the knowledge economy, there is a need for a certain ingredient to take place. First, the role of research in the transformation process is very important. Knowledge of the citizens is key, and this requires huge funding from both the government and the private sector. There is also a need for entrepreneurship among GCC citizens and at the same time collaboration with big research institutions in the North, East, West and South who are willing to set up R&D centre or universities within the GCC countries. For GCC countries to transform into the knowledge economy, they have to do the unthinkable, reduce some of the subsidies on items like electricity, water, and also to some extent petrol. The second aspect is to encourage entrepreneurship among its citizens and reduces over dependency on government jobs. A government job is considered as a more secure place of employment. The third option is to spur it, citizens, to do more of voluntary activities which help the needy and at the same time create a sense of citizenship. The other aspect which could be helpful is to give citizenship to certain groups of an expatriate in the area of research and development. They will contribute to the economic development and also fast-tracked the transformation of the region into the knowledge economy, but this requires bravery by the policymakers.

3. Conceptual framework and literature review

Have examine the background of GCC countries; it is important to examine the conceptual framework and the literature review for this paper. The world economy today is driven toward a knowledge economy. This shift toward knowledge economy is stimulated by research, innovation, entrepreneurship, and information technology (ICT). Many countries within the GCC member states are also embracing this transformation process as a means of diversifying their economy that was fully relying on their natural resources oil and gas. Knowledge according to Drucker [25] has become the key economic resources and the dominant and perhaps the only source of competitive advantage. The same sentiment is echoed by Lester Throw [1] who argue that Natural resources have dropped out of the competitive equation, and a lack of natural resources may even be an advantage ... because the industries we are competing for, the industries of the future, are all based on brainpower. Thus, the conceptual framework for knowledge economy literature internationally suggests that there is a distinction between knowledge based economy and resource based economy. OECD [26] define knowledge-based economies as economies which are openly based on production, distribution, and use knowledge and information, with the important role of information, technology and learning in performing. In contrast to knowledge-based economy resource based economy is an economy that is base on the natural resources of the country which account heavily on the GDP of the country as we know in the case of GCC countries oil and gas. Have set the conceptual framework it is important also to examine GCC countries R&D expenditure per capita on GDP, and also GCC member's countries ranking regarding research publication. Below, Table 3 show GCC members states expenditure per capita on GDP.

Countries	R&D expenditure funding on GDP per capita	Actual year of spending
Bahrain	0.1%	2014
Kuwait	0.302%	2014
Oman	0.171%	2013
KSA	0.073%	2009
Qatar	0.47%	2012
UAE	0.7%	2014

Table 3. Show the R&D Funding and expenditure on GDP per capita in GCC countries [25].

The spending of GCC countries member state per capita on GDP show how important or serious countries view the importance of the role research towards a knowledge economy.

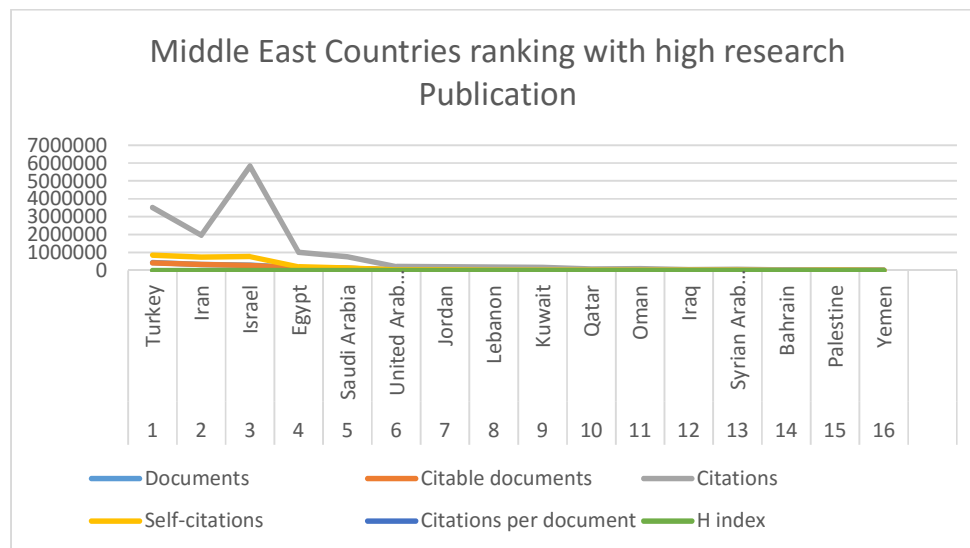


Figure 3. Show the ranking of countries within the Middle East in terms of publications [26]

Fig 3. Show that the highest country within Middle Eastern countries in term of research publication output is Turkey and the least is Yemen. GCC member state, Saudi Arabia is the highest within GCC member state followed by the United Arab Emirates. The least country within the GCC member States is Bahrain. Research publication and R&D funding and expenditure per capita is an indication of how countries are into the transformation process into the knowledge economy. Hvidt [2] had already indicated that the current affairs with regards to innovation and the education systems within the region to transform into knowledge economy would be difficult and long. There is a lack of funding into R&D expenditure per capital within GCC countries as compared to Korea with 4.3%. Tadros [27] also argue that the main drivers of knowledge-based economy are an investment in all levels of education; research and development (R&D) and collaborative research; entrepreneurship; access to finance; Science Park; and business incubators. He warns again that investment alone will not produce the desired result unless the sound macroeconomic framework is established, with an effective innovation environment and business friendly environment with transparent regulations. For him the above environment would encourage private sector investment and also Foreign Direct Investment (FDI), resulting in transferring of technology which leads to knowledge-based development.

Tadros [27] emphasise that GCC states should focus their R&D activities on areas of strategic importance to their countries and the region. Furthermore, that knowledge-based development requires a holistic approach that brings together researchers, entrepreneurs, and policymakers. Connecting scientist and researchers with entrepreneurs in clusters, networks, and regions is an essential ingredient for an innovation ecosystem. Finally that knowledge based development need strong R&D institutions, industrial base, skills and capabilities, cyber infrastructure and business-friendly regulatory framework [27]. This dictates policy shift in all the GCC member state.

A study by Poudel and Dolpin [28] acknowledge the effort made by GCC countries to create infrastructure and institutions necessary for National Innovation System (NIS). The many business incubation centres, technology fund, science and policies have been made to facilitate innovation. But despite those efforts, the GCC countries have not made much progress. They ascertain that the government can play an important role in the technological capability development process by giving the example of Japan, Korea, India and Singapore.

Innovation is an important element of the knowledge economy. According to the Global Innovation Index 2016 [29] Switzerland is first globally second by Sweden, third UK, fourth, fifth Finland and with regards to the prominent five Arabs countries on the Innovation Index, the United Arab Emirates is first and rank in the world 41, second by Kingdom of Saudi Arabia, rank in the world 49, third Qatar, ranked in the world 50, fourth Bahrain rank in the world 57, fifth Kuwait rank in the world 67, Oman Six within GCC states but rank in the world 73 [29]. Finally, it is important to discuss country by country since each road to the knowledge economy is different.

The Department of Economic Development in UAE in 2009[30] caution knowledge economy and argue that one of the negative effects of the knowledge economy are many, widespread unemployment, due to the reliance on technology-intensive techniques, which leads to the abolition of some existing posts, and the transfer of some employees to other jobs which they cannot practice; with the exception of those who only have certain qualifications, training or familiarity with modern technology. Thus, the application of the knowledge economy, may lead to the emergence of what is known as cybercrime, and increases stress on individuals and their sense of loneliness and isolation, and threatens their national identity, under the pressure of globalisation.

The positive social impact aspects of the implementation of knowledge economy as the study acknowledge, the return in the economy bigger and faster, greater social development, the acceleration of teleworking (working from home) especially within the region is great especially for women in general. Knowledge economy would also lead to enhancement of renewable technology and create a great impact in the fight against environmental pollution that may be harmful.

A study conducted by Mahesar et al. [5] concluded that GCC countries progressive influence on research is still marginalised. Saudi Arabia was the highest country with numbers of research among GCC countries. McGlennon [6] also argue that the GCC countries have developed world level GDP per capital and yet investment in R&D at developing world level. He also acknowledges the fact that the World Bank Knowledge Economy Index showed GCC countries rated below the world average.

Nordling [7] acknowledge that science is becoming more of a political priority in GCC countries and that with the decline of oil reserves both Qatar and Abu Dhabi have set their target to become a knowledge-based economy by 2030.

The global outlook on research and development (R&D) forecast and the knowledge economy, in general, is very important for this paper. All see education as individuals as well as nations as the key catalyst and connective nerve into the knowledge economy. Research communities such as educational institutions, labs, universities and R&D centre are spires of the economic growths. The day's pre-Industrial age (agricultural economy), the industrial age (Industrial economy), to post-industrial/mass production economy has given a chance to the knowledge economy that is driven by technology/human capital. Weber [8] also argue that some scholars believe that the knowledge economy is the next step of global economic development after an agricultural age (based on land) followed by an industrial age (based on capital and labour) while others demise the term as a jargon and buzzwords. Aubert and Reiffers [9] on World Bank report, noted that countries that fail to become part of this [information] revolution risk becoming even more marginalised than those left aside in the industrial revolution. Many countries would not like to be left behind, and that is why most of the countries within the GCC member states are gearing toward a knowledge economy. However, the key to the knowledge economy hinge on investment in education, innovation, information infrastructure and most importantly on research and development. To address the role of research in knowledge economy within the GCC member's states, it is important to examine the world trend regarding research and development. According to 2016 Global R&D Funding Forecast [10], global R&D investment will increase by 3.5% to a total of 1.948 trillion in Purchasing Power Parity (PPP). Table 1. Shows the forecast for global R&D spending powers. Asian countries (including China, Japan, India and South Korea) now reason to additional 40% of all global R&D investment, with North America investment less than 30% and European R&D only more than 20%. China investment in R&D continues to rise more than 10%

Share of Total Global R&D spending powers

	2014	2015	2016
North America	29.1%	28.5%	28.4%
US	26.9	26.4%	26.4%
Caribbean	0.1%	0.1%	0.1%
All North America	29.2%	28.5%	28.5%
Asia	40.2%	41.8%	41.8%
China	19.1%	19.8%	20.4%
Europe	21.5%	21.3%	21.0%

Russia/CIS	3.1%	2.9%	2.8%
South America	2.8%	2.6%	2.6%
Middle East	2.2%	2.3%	2.3%
Africa	1.0%	1.1%	1.1%
Total	100.0%	100.0%	100.0%

Table. 1. Share of Total Global R&D spending powers (adopted from 6).

The 2016 Global R&D Funding Forecast [10] define R&D as the procedure of generating new products, processes and technologies that can be used to benefit humanity. There is a variation of R&D from industry to industries and from countries to countries something that is established in this paper whereby the GCC countries will examine one by one to know their present progress.

According to OECD [11] Gross, domestic spending on R&D is the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, university and government laboratories, etc., in a country. It includes R&D funded from abroad but excludes domestic funds for R&D performed outside the domestic economy. This indicator is measured in a million USD and as a percentage of GDP. The main indicators of R&D are on Science and Technology with regards to R&D 2015 [12]. Below, see Table 2, are the top twenty countries spending on R&D per capita.

The top twenty countries in the world on R&D expenditure on GDP per capita are shown in table 2 as of 2011-2015 [12]

Countries R&D expenditure funding on GDP per capita Actual year of spending The top twenty countries in the world on R&D expenditure on GDP per capita are shown in the table 2 as of 2011-2015 [12]

Countries	R&D expenditure funding on GDP per capita	Actual year of spending
Korea	4.3%	2014
Israel	4.1%	2014
Japan	3.6%	2014
Finland	3.2%	2014
Sweden	3.2%	2014
Austria	3.1%	2015
Denmark	3.1%	2014
Taiwan	3.0%	2014
Switzerland	3.0%	2012
Germany	2.9%	2014
United States	2.7%	2013
Belgium	2.5%	2014
Slovenia	2.4%	2014
France	2.3%	2014
Singapore	2.2%	2014
Australia	2.1%	2013
China	2.0%	2014

Netherlands	2.0%	2014
Czech Republic	2.0%	2014
Iceland	1.9%	2014

Table 2. Show twenty countries in the world on R&D expenditure on GDP per capita [10].

Knowledge economy within the GCC is also reviewed in this paper based on a country by country. According to the department of industry UK, the knowledge economy is defined as “A knowledge-driven economy is one in which the generation and exploitation of knowledge play the predominant part in the creation of wealth [10]. On the other hand, Knowledge Economy Index Report 2014 [13] define knowledge economy as encompassed of individuals, companies and sectors that generate, develop, hone and commercialise new and emerging ideas, technologies, processes and products and export them around the world. The emergence of the concept of knowledge economy was in the economies of the developed North which come as a recognition that ideas are the cornerstone of economic development. Ideas and innovations drive economic growth moving away from the labour intensive past. Knowledge Economy is a vital element of every developed economy in the world as it contributes to and enhances their global competitiveness, which in turn increases their level of economic growth. Thus, the importance of knowledge economy on any given nation is vital due to many reasons, exportation to other countries, generation of stable employment and high productivity. Subsequently, SciDev.Net [14] define the term knowledge economy as a shift from traditional economics to one where the making and use of use of knowledge are paramount.

Powell and Snellman [15] define knowledge economy as production and services based on knowledge-intensive actions that contribute to a quicker pace of technological and scientific advance, as well as fast obsolescence. They argue that the key factor of a knowledge economy is a better confidence on intellectual capabilities than on physical input or natural resources. However, people like

Brown and lauder [16] argue that an economy focused on knowledge worker benefits only a very small segment of well-educated workers and there is a very little significant advantage to the wider economics.

In reviewing the literature for this paper, it is obvious that any transformation to knowledge economy requires an enormous investment in research and development, education, ICT infrastructure, and a conducive economic environment for business. For knowledge economy to strive it, four pillars should be followed. According to the World Bank [17] the four pillars the Knowledge Economy framework are:

- The labour force should be composed of educated and skilled workers who can continuously upgrade and adapt their skills to create and use knowledge efficiently. Education and training systems encompass primary and secondary education, vocational training, higher education, and lifelong learning.
- A modern and adequate information infrastructure will facilitate the effective communication, dissemination, and processing of information and knowledge. Information and communication technologies (ICTs)—including telephone, television, and radio networks—are the essential infrastructure of the global, information-based economies of our time, as railways, roads, and utilities were in the industrial era.
- An effective innovation system is composed of firms, research centres, universities, consultants, and other organisations that keep up with new knowledge and technology, tap into the growing stock of global knowledge and assimilate and adapt it to local needs. Public support for innovation, science, and technology covers a wide range of infrastructure and institutional functions, from the diffusion of basic technologies to advanced research activities

The country’s institutional regime and the set of economic incentives it creates should allow for the efficient mobilisation and allocation of resources, stimulate entrepreneurship, and induce the creation, dissemination, and efficient use of knowledge. The notion covers a vast array of issues and policy areas, ranging from aspects of the macroeconomic framework, to trade regulations, finance and banking, labour markets, and governance. The latter includes the rule of law and its applications (judicial systems), the quality of the bureaucracy as reflected in measures of government effectiveness, and the level of corruption.

The importance of knowledge economy model or framework is that it offers an effective application and monitoring apparatuses to engage human resources in science technology and innovation in national development strategies and promote economic growth and job creation. Thus, the role of research in knowledge

economy within the GCC member states countries is that it promote innovation, revitalized it human resource capital that will lead to economic diversification, entrepreneurship and economic growth. For all these to happen there is a need for a robust policy strategy with clear roadmap. Chen and Dahlman [18] argue that the transition to knowledge economy requires long-term strategies that focus on developing the four pillars of knowledge economy. To realized these four pillars as Chen and Dahlman [19] argue means that countries need to comprehend their strength and weakness act on them to develop good policies and investment to spring a course to their goals at the same monitor their progress. They attest to the fact that to facilitate the transition process to knowledge economy the World Bank has develop the Knowledge Assessment Methodology (KAM) which is an internet-based tool that provides a basic assessment of countries' and regions' readiness for the knowledge economy. Thus, the GCC member's states can use KAM as a basic regions readiness for knowledge economy with research as a backbone. The World Bank and most economies agrees that knowledge economy rest on four major pillars which are critical requisite for a country to be able to fully participate in the knowledge economy [20]:

- Education & Training
- Information Infrastructure
- Economic Incentive & Institutional Regime
- Innovation Systems

According to the World Bank knowledge economy makes effective use of knowledge for its economic and social development. That include tapping foreign knowledge as well as adapting and creating for its specific needs [21].

Below is the Global Ranks of Arab Countries on each of the Pillar of Knowledge Economic Index (KEI).

Global Ranks of Arab Countries on each Pillar of KEI											
Economic Incentive Regime			Innovation			Education			ICT		
Rank	Country	Score	Rank	Country	Score	Rank	Country	Score	Rank	Country	Score
44	OMAN	6.96	46	UAE	6.6	45	BAHRAIN	6.78	1	BAHRAIN	9.54
45	QATAR	6.87	49	QATAR	6.42	55	UAE	5.8	12	UAE	8.88
48	BAHRAIN	6.69	57	OMAN	5.88	58	KSA	5.65	21	KSA	8.37
50	UAE	6.5	64	KUWAIT	5.22	63	JORDAN	5.55	51	QATAR	6.65
54	KUWAIT	5.86	70	TUNISIA	4.97	64	LEBANON	5.51	54	KUWAIT	6.53
60	KSA	5.68	71	LEBANON	4.86	71	ALGERIA	5.27	55	OMAN	6.49
62	JORDAN	5.65	75	BAHRAIN	4.61	74	OMAN	5.23	79	TUNISIA	4.89
72	MOROCCO	4.66	84	KSA	4.14	89	TUNISIA	4.55	87	JORDAN	4.54
73	EGYPT	4.5	85	EGYPT	4.11	98	KUWAIT	3.7	89	ALGERIA	4.04
79	LEBANON	4.28	88	JORDAN	4.05	101	QATAR	3.41	90	MOROCCO	4.02
96	TUNISIA	3.81	96	MOROCCO	3.67	102	EGYPT	3.37	99	LEBANON	3.58
107	YEMEN	2.91	99	ALGERIA	3.54	109	SYRIA	2.4	100	SYRIA	3.55
115	ALGERIA	2.33	107	SYRIA	3.07	115	MOROCCO	2.07	105	SUDAN	3.16

Table 3. Show the ranks of Arab countries on each pillar of KEI Source: IMF and MRD/Orient Planet [21]

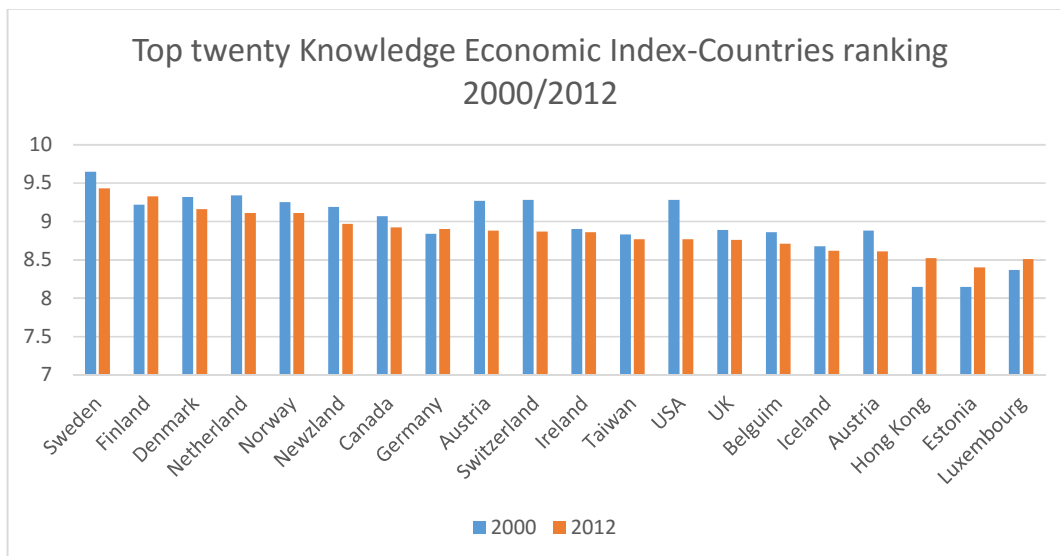


Figure 1. Show the top twenty countries on Knowledge Economy [22]. Figure 1 show top twenty countries in the world ranked by knowledge economy between the year 2000 to 2012 [22]. There are three key variable that serve as a substitutions for each knowledge economy pillar: Economic Incentives, Educational Communications Technologies (ICT) and Institutional Regime.

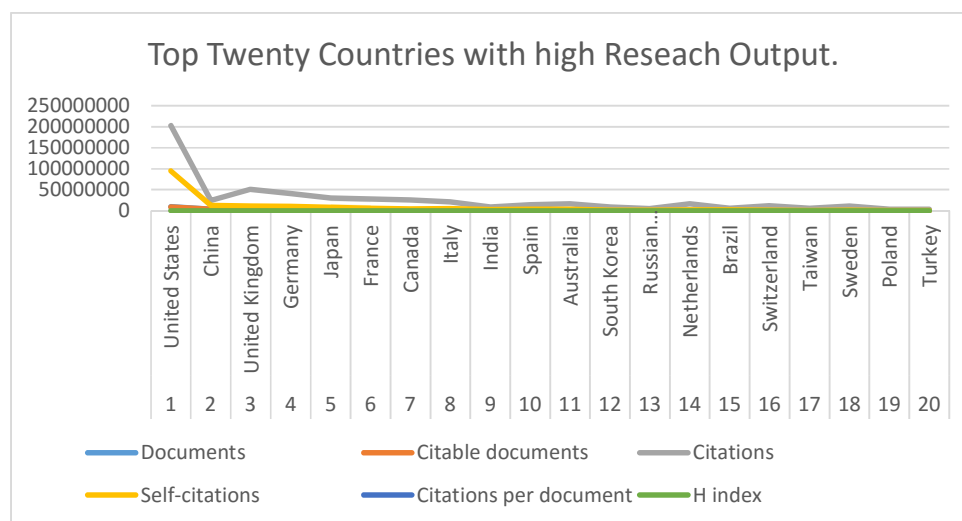


Fig 2. Show top twenty countries with high research publication [23]. Figure 2 show top twenty countries in the world in terms of research publication. Research publication is an indication of how countries are measured globally in relation to research which is the key driver of knowledge economy. In other words, the economy of today is drive by brain power not by the size of natural resources.

4. The role of research in knowledge economy in Bahrain

Bahrain has always been a trading center linking East and West and was the land of the ancient Dilmun Civilization [31]. The word Bahrain means ‘two seas’ in Arabic and the geographical position is a collection of Islands [31]. The capital city of Bahrain is Manama and also its largest city. Bahrain was the first Gulf state to discover oil, in 1932, and in the past 40 years has led the regional transition to a modern economy. Subsequently, as the first Gulf state to move away from dependence on oil, and has striven to become the region’s most diversified economy. Bahrain is one of the leading financial centers within GCC countries and also is moving toward knowledge economy by providing good professional services, communication and real estate sector.

The role of research in knowledge economy for Bahrain is underscored by the Bahrain National Research Strategy 2014-2024. The main objective is improving higher education and research sector by going beyond

teaching to produce knowledge and conducting quality researches. The overall hope is to contribute to the development of Bahrain. Thus, the research strategy for Bahrain is projected to help Bahrain achieve its vision of being a diversified, sustainable, knowledge-based society [32]. Research is acknowledged by the national strategy for Bahrain as one of the main contributors to the development of technology and also solve problems in general. Research is an essential engine of knowledge based economy which requires strong universities. Finally, research is acknowledged by the strategy for Bahrain is that research attract top international faculty members who intern create strong graduate programs [32]

Haven acknowledge the role of research in the knowledge economy in Bahrain, the National Strategy for Bahrain 2014-2024 realized that research funding levels need to expand to be similar to other knowledge economy countries, which have invested 2-3% of their GDP in R&D including 0.5 to 1% of GDP in universities. For investment in research will help to attract and develop qualified human capital, attract investments in technology, improve the Kingdom's capacity to make use of existing global knowledge, and help solve the Kingdom's social and economic needs [32].

4.1 The Current State of Research in Bahrain

The state of research in Bahrain is very low about GCC countries. The National Strategy for Research Bahrain in using SWOT analysis also concluded that Bahrain is at the very early stages of establishing a research system [32]. In examining Bahrain expenditure on R&D funding per capita, the result shows that Bahrain spends less on R&D, see Table 3. Many countries in the West and some developing countries have invested much of their GDP per capita in R&D averaging 2% and above see Table 2 and 1 with the forecast, especially Korea, Finland, Denmark, and Singapore. Bahrain within the GCC countries is 0.1 see Table 3.

According to Schwab and Sala-I-Martin [33] on The Global Competitive Report 2016-2017, Bahrain is ranked 48 out of 138 countries. On Pillar 12 of the Global Competitive Framework on Innovation, Bahrain is ranked 45 with regards to university-industry collaboration in R&D 44 and 57, on companies spending on R&D, quality of scientific research institutions 75, and on the capacity to innovate 65. On pillar five which is Higher education and training is ranked 44. Bahrain is ranked last with the GCC countries about research output per country see fig3. There is a need for Bahrain to put more emphasis on R&D so as to move toward a knowledge economy.



Fig 3. Show Bahrain Technology Park (BTP) adopted from [34]. This Bahrain Technology park is one of the signs that Bahrain is moving toward knowledge economy. This park will help developing the skills of Bahrainis and at the same time provide a fertile hub for industries to further develop their products. This hub will also benefit the private sectors in Bahrain especially small and medium size industries. Thus, the hub will contribute to the Bahrain ongoing effort to create export oriented technology based enterprise and diversify the economy of Bahrain from oil driven income.



Fig 3. Show Bahrain Technology Park (BTP) adopted from [34]. This Fig 4. Show iTeknoCity that CommerceNet Singapor (CNSG) supported by Singapore to be built in Bahrain. This Technology Park is known as iTeknoCity house some of top ICT companies as well as two bio-informatics cluster. Fig 3 and Fig 4, show that Bahrain is aiming toward the transformation of it economy into market economy by creating clusters that enable them to transform to knowledge economy Bahrain Technology park is one of the signs that Bahrain is moving toward knowledge economy. This park will help developing the skills of Bahrainis and at the same time provide a fertile hub for enterprises to further develop their products. This hub will also benefit the private sectors in Bahrain especially small and medium size industries. Thus, the hub will contribute to the Bahrain ongoing effort to create export oriented technology based enterprise and diversify the economy of Bahrain from oil driven income.

5. The role of research in knowledge economy in Kuwait

The knowledge economy is a concept and not a panacea for any successes although there is some strategic framework how to reach it. In other words, it is a means to an end and a framework for reaching a strategic goal. The need for the knowledge economy in Kuwait and the GCC countries had been established in the introduction of this paper, i.e. the over depending on GCC countries on oil and gas without diversification of the economy. The over-relying on oil and gas by Kuwait and other GCC countries for revenues had been hit hard by the slump in the prices of oil and gas. The unsustainable deficit, in the long run, is hurting most of the GCC member states, and Kuwait is one of them even though it tries to diversify its economy. The best way to diversify the economy is to have knowledge economy that does not depend on oil or gas but research and innovation of its knowledge workers. In another word an economy that is stimulated by the brain power not natural resources power which is a blessing.

The role of research in the knowledge economy is then the road taken by Kuwait based on the report prepared by Kuwait Foundation for Advancement of Science (KFAS) [34]. The conference in Kuwait held by KFSA and London School of Economic (LSE) in which the main argument where that the knowledge economy where the central economic future of both developed and developing economy show how serious Kuwait had taken the need for the development of knowledge economy. The recommendation from the London School of Economic was that Kuwait develops its knowledge economy aggressively. That Kuwait should create an ecosystem to upkeep the transition to a knowledge economy, and that innovation and firm growth are trial and error and that there is no single bullet to achieve a result. The findings from the report by Brinkley et al. [35] acknowledge that building a knowledge economy was not an easy task. They outline the roadmap for innovation ecosystem by stressing the role of publicly supported research that supports firm formation and entrepreneurship as a driver of inventive innovation. They stress that a small state like Kuwait needs to open to new ideas which may germinate from abroad. The need for market development and firm creation and that the financial system needs to support firm development and growth. The report [35] emphasise that education system must train people with both hard and soft skills, with cultural zest to learn, work and take the risk. Thus, for knowledge economy to occur all the elements in the ecosystem should work together towards one direction while at the same time valuing Kuwait position, culture and history. The report [35] warn that Kuwait should not expect to leapfrog to the technological frontiers in one leap and that careful investment in the innovation ecosystem is the way forward by building and narrowing the gaps along the way until it reaches critical mass, the result will be disappointing.

The report clearly envisages the role of the ecosystem as the way forward and at the same time recommended that Kuwait can learn from countries like Canada, Taiwan and the USA. Privatisation can generate the impact of

the ecosystem; building up research centres; introducing educational selection; alliances with overseas institutions of equivalent standing; joint ventures; creating reforms; greater professionalism in the public sector; and making business start-ups easier.

5.1 The Current State of Research in Kuwait

Kuwait Foundation for the Advancement of Science (KFAS), is a private non-profit funding Institution plays a leading role in the role of research in the knowledge economy in Kuwait. They have organised many conferences and research report in Kuwait about knowledge economy in Kuwait. KFAS has played a leading part in the state of research in Kuwait. In 2013 KFAS share of total funding of research in Kuwait was 15% totalling 18 million Dinar Kuwaiti [36]. Kuwait is third in the ranks of countries within GCC countries regarding publications, see figure 3. Regarding R&D funding and expenditure per capita, Kuwait is doing well among GCC countries, see Table 3. R&D funding for Kuwait on GDP per capita is 0.302 in 2014. The literature on knowledge economy point to the direction of research and innovation, and that no country can leapfrog and overnight become a knowledge economic country. From the reviews as it is shown in Table 1 to 3 and figure 1 to 3 most of the countries in Asia that have spent more R&D are South Korea, Israel, Japan and Singapore and to some extent Qatar Turkey Iran and Saudi Arabia [37]. However, many countries like Kuwait is also spending more on R&D. Let hope that this trend continues and Kuwait move toward a more stable knowledge economy.

Kuwait is commissioning a study on the knowledge economy and innovation-based development “Kuwait and the Knowledge Economy” shows how Kuwait and the other GCC member’s states are serious about transforming their economy which was whole dependent of oil and gas into knowledge economy [38].

Kuwait Technology Park (KTP) is one of such parks to support innovation. The Kuwait Institute for Scientific Research (KISR) is also very importance for innovation.



Fig .5. Show Kuwait Institute for Scientific Research (KISR); KISR is a pioneering, independent, national institute of scientific excellence. Set up in 1967, KISR’s initial role was dedicated to developing three fields of national importance: petroleum, desert agriculture, and marine biology. The current role of KISR has expanded greatly to the preservation of the environment, sustainable management of Kuwait’s natural resources, responsible management of water and energy, and development of innovative methods of agriculture.

6. The role of research in knowledge economy in Oman

Oman is one of the GCC member countries that relies seriously on oil and gas. Oman like any other countries within the GCC member state is seeking to develop a knowledge economy which is profoundly dependent research and innovation. Technology is a driver of development as we have seen in the West and other developing centuries. Many countries have adopted technology as the way to diversify their economy and have worked favorably for them like Korea, Japan and Singapore. Natural resources alone are not enough for countries to develop, the case be of the GCC countries, and Africa countries blessed with natural resources but poor in the area of greater impotence which is research and innovation. Thus, the engine of modern economy is driven by strong scientific based and the way forward for Oman is to embrace research and innovation.

6.1 The Current State of Research in Oman.

The Research Council of Oman is Oman’s sole research funding body which spearheads R&D in Oman. Ahiddabi [28] argue that the research council has identified the hurdles facing Oman namely, complex administrative processes, little funding, research of poor quality, and lack of relevance R&D for social, economic

needs. He also acknowledges that the Oman research council has developed an incentive scheme to foster research excellence, by rewarding researchers through an open grant tied to their output.

Oman has developed their Vision 2020 Development Plan. This Vision 2020 is a long-term plan to diversify the Oman economy beyond hydrocarbon revenue driven economy. The core pillars of the vision are; the diversification of the economy, human resource development and the private sector development [39]. In other for the vision 2020 to happen there is a need for research council Oman to play an important part in realising such a vision. Research will play an important part in achieving those key pillars of the vision 2020, United Nations Conference on Trade and Development Science Technological and Innovation Policy Review on Oman [40] concluded that to boost innovation capabilities; Oman should, first and foremost, try to bring about a change in mindset. In other words, the government should guide its actions on three keywords: communicate, inspire and lead. The government should use the media to reach the young people, academic sphere, civil society should be provided with the opportunities to express their creativities and a sense of entrepreneurship, and all should be given the voice to participate from those at the top to those at a village level.

Knowledge Oasis Muscat. Opened in 2003, Knowledge Oasis Muscat (KOM) is the Sultanate of Oman's flagship technology park, and KOM symbolises successful public-private partnership in nurturing knowledge-based businesses. KOM is established to create an environment for entrepreneurs in both small and medium-sized enterprises, and established multi-nationals can coexist, innovate and flourish within the setting in the Middle East. The aims of KOM are to enhance Oman's position as the region's leading Centre of business excellence, innovation and entrepreneurship. KOM provides its tenants with innovative real estate solutions and excellent service. Building and nurturing strong relationships with our tenants is at the heart of everything we do.

7. The role of research in knowledge economy in Qatar

Qatar is one of the GCC countries member state. Qatar as a nation recognises that knowledge economy is a central feature of its development. The role of research in knowledge economy for Qatar become the important driving force for growth and economic development. R&D president of The Qatar Foundation specified that Qatar aims to increase its R&D expenditure to 2.8 percent of GDP per capita [41]. In 2007 the Government of Qatar Planning Council did a project of turning Qatar into a complete knowledge-based economy. They concluded that Qatar needs a vision to concretized detailed plans promoting economic incentives and government frameworks that support a knowledge-based economy in key pillars for the knowledge-based economy namely: education and learning, innovation, and information technologies [42].

7.1 The Current State of Research in Qatar

Qatar has move step forward by increasing its R&D expenditure to 2.8% per capita. R&D funding is critical for knowledge economy and Qatar is in the forefront among GCC member states that made a conscious to move away from total dependent on oil and gas into the knowledge economy. The Qatar Education City and Qatar Science and Technology Park are some of the indication of the seriousness Qatar has taken to transform its economy into the knowledge economy.

Qatar and all the GCC member states understand very clearly that for them to move toward knowledge economy, they require strong R&D institutions of learning, business friendly environment with good regulatory framework, a good cyber infrastructure, vibrant entrepreneurship and high skill and competence workforce to support the shift and Qatar have taken all the above seriously.

Alsuwaidi contended that real challenge for Qatar Foundation is changing the general culture. In other words having a mindset of science culture which is absent [43]. Qatar Vision 2030 in 2008 suggest that it was one of the first countries within GCC member states that based its vision on the concept of a knowledge economy which has the view that education and research are the foundations of building human capital [44]. In other to create in read into research, The Qatar Foundation is encouraging high ranking international universities to establish their branches in Qatar, for example, Georgetown, Cornell and Carnegie Mellon. These institutions can bring in excitement for science culture in Qatar. Qatar is also encouraging the local institution to do a collaboration with others institutions to build up the capacity for research. For Qatar to be successful in harnessing the role of research in knowledge economy there is a need to attract global talent and retain them. In other words give them citizens so that they remain one of the track to attain such an ambition, a knowledge economy. The West have done it, and it is not new. Above all it is a win, win situation, especially in the area of critical need. The Qatar Science and Technology Park Education City is one of the innovation centers in Qatar. The vision of Qatar Science and Technology Park Education City is to be an international hub for scientific and technology innovation, tech-based entrepreneurship and high-tech businesses.

8. The role of research in knowledge economy in Saudi Arabia

The role of research in the knowledge economy in Saudi Arabia. The need for transformation of knowledge in Saudi Arabia has been acknowledged very seriously. This aspect of education and training as an important pillar of the knowledge economy is recognised by The World Bank and many countries including Saudi Arabia. University education and research centres are the means through which Saudi Arabia is pinning its hope to transform its economy from oil and gas dependency into the knowledge-based economy as many countries within the GCC council are doing. Saudi Arabia has invested tremendously in education and promotion of science and innovation in various universities and research centres, especially King Abdullah who laid this strong foundation for the kingdom to move toward a knowledge economy. The move toward knowledge economy needs to be supported by a long-term policy and reward system in place to reward research and innovation. At the same time create a collaborative approach higher institutions in the Kingdom and other scientific institutions abroad and if possible why not draw a strategy how to attract global talent in specialised skill and give them citizenship as one of the tracks of attaining knowledge economy on the win, win situation.

8.1 Current State of Research in Saudi Arabia

The Kingdom of Saudi Arabia has taken a bold step toward diversification of its economy into the knowledge economy. However, the road part of the knowledge economy is long and requires patience along the way. The role of research in the knowledge economy is great and requires sacrifices because the science culture is still at a low level and may require global talent attraction and retention especially in areas deemed critical. Strong universities with strong research incrimination will always attract the brightest around the world, and there is a need to select and retain the best brain as done others in the world.

Khorsheed [45] while examining Saudi Arabia, from oil Kingdom to knowledge-based economy concluded that notwithstanding the external and internal challenges facing Saudi Arabia a declining global economy, division and uncertainty in neighboring countries, the recent plunge in oil prices, and internal challenges such as a shortage of qualified engineers and scientists and low female labor participation rates, the biggest challenge is to orchestrate activities among various National Innovation Ecosystem (NIE) components in order to strengthen competitiveness. Having strong components inside the ecosystem does not solely serve this target; all the apparatuses must be developed, and the connections among those apparatuses have to be fully developed. To this end, the country has proposed a framework for its NIE and developed a roadmap to link the gap of the invention across various mechanisms through certain key strategic interferences. And also that extra funding in promoting an increase in incentive for researchers and innovators and enhancing the communication and transportation infrastructure.

There are many innovation centres in Saudi Arabia. King Abdulaziz City for Science & Technology, Riyadh Techno-Valley, Dhahran Techno-Valley, Prince Abdullah Bin Abdulaziz Science Park (PASP), Jubail Research and Innovation ClusterHub (JRICH) in Jubail Industrial College (JIC).



JRICH is a partnership with Technical University of Munich (TUM), InSITE BAVARIA and VDI/VDE-IT Germany. The initiative of JRICH is focused on bringing industries, academia, and public and private sector

partners in the Kingdom of Saudi Arabia to act in union to achieve the Kingdom's Vision 2030 that foresees a thriving economy by,

- Increasing the SMEs contribution to GDP from 20% to 30%
- Increasing the private sector's contribution from 40% to 65% of GDP
- Leveraging its unique position by integrating regionally & Internationally
- Increasing the competitiveness of the energy sector (industry)

JRICH is going to be a vital pillar of cluster development in Jubail Industrial City and the central service hub for cluster organizations from the entire KSA. Its implementation is strongly supported by the Royal Commission for Jubail and Yanbu.

King Abdulaziz City for Science and Technology (KACST), is a scientific government institution that supports and enhances scientific applied research. It coordinates activities of government institutions and scientific research centres by the requirements of the development of the Kingdom. KACST interacts with the relevant officials in identifying national priorities and policies in technology and science so as to build a scientific and technological basis that serves development in agriculture, industry, mining, etc. It also aims at developing national capabilities and recruiting highly qualified specialists to help develop and control modern technology to serve development in the Kingdom. KACST comprises all the requirements of scientific research, such as laboratories, means of communications, information sources and all necessary facilities.

The vision of KACST speaks for itself, to be a world-class organisation in science and technology. Fostering innovation and promoting a knowledge-based society in the Kingdom of Saudi Arabia.

Prince Abdullah bin Abdul Aziz Science Park (PASP) was established in 2002 in affiliation with the King Fahd University of Petroleum and Minerals. The first of its kind in the Middle East, its purpose is the creation and growth of a highly collaborative research and learning environment between the industry and university through the shared utilisation of resources, joint research programs, and the exchange and transfer of technology. Besides this mutual relationship between the university and established companies, the science park will promote local and regional private startup enterprises and entrepreneurs through its incubation program. In addition to providing land and infrastructure, PASP provides unique opportunities and growth incentives for these start-up companies through specialised growth environments. At present, the Park houses firms mainly involved in the regional petroleum and chemical industry as well as in the IT industry, both of which are major strengths of KFUPM.

9. The role of research in knowledge economy in United Arab Emirates (UAE)

Al Hallam [46] cited Dr Mona Al Bahar a member from Dubai and the chairwoman of the education committee and The Federal National Council (FNC) made an accurate assessment that "No research, no knowledge-based economy". The role of research in a knowledge-based economy is taken very seriously in UAE, and that is revealed in the statement of Dr Mona Al Bahar. Al Hallam [46] strongly argue that UAE needs a train or prepare high-quality researchers with a funding mechanism that ensures that the funds bring in a good outcome. The UAE Vision 2021 National agenda aims to transition to a knowledge economy by promoting innovation and research and developing, strengthening the regulatory framework for key sectors, and encouraging high value-adding sector [47].

The president of UAE His Highness Shaikh Khalifa Bin Zayed Al Nahyan in moving toward tuning UAE into knowledge economy affirm the need for the adoption of Science, Technology and innovation's higher policy. He announces 100 national initiatives in the education sector, health, energy, transportation, water and space [48]. Shaikh Khalifa Bin Zayed Al Nahyan also acknowledge that "Creating sustainable wealth for the coming generation will depend on science, knowledge, technology and innovation. The Science, Technology and Innovation Higher Policy adopted today is a turning point in our journey to develop the UAE economically and socially." [49]. The views of the president of UAE Shaikh Khalifa Bin Zayed Al Nahyan are also shared by His Highness Sheikh Mohammed bin Rashid Al Maktoum, UAE Vice President, Prime Minister, and Ruler of Dubai, that "The Science, Technology and Innovation Policy is our roadmap to building a better future for generations to come. We have the human capital, effective governance and financial resources to accomplish a transformation of scientific progress in the UAE [50].

9.1 The Current State of Research in United Arab Emirates (UAE)

Projects like the eFada project (meaning benefit in Arabic) will help enhance the ambition of UAE into the knowledge economy. The eFada project will enhance education and researchers resources to information and

will stimulate the way forward toward knowledge economy and continuously enhance the development of UAE as a whole [51]. Ankabut the UAE's Advanced National Research and Education Network is also an excellent way forward toward achieving knowledge-based economy for UAE [39]. The Department of Economic Development in UAE in 2009 [51] conducted a study on the importance of transferring into a knowledge economy and anticipated social effect and concluded that the challenges that are encountered by UAE in transferring into knowledge economy are the ability to develop human capital and citizens to lead the process of transition. How to cultivate the science culture, inventive, and innovative culture on the citizens so that they can be the driving forces toward a knowledge economy.

Hatherley-Greene [52] argue very strongly for the case of UAE that building a knowledge economy now on current social base will simply not work. He draws back to the time when Arabs societies produced new knowledge in science, mathematics, philosophy, culture, engineering, astronomy, etc., while the Western Europe was in the Dark Ages. The cities of Bagdad and Damascus were intellectual capital. He argues some factors were in play, the instructions from the Quran and Prophet Mohammad (PBUH), a unified empire facilitating easy communication through a common language Arabic. The translation of text from ancient Greek, Roman and Chinese into Arabic and which is often referred to as the Golden Age of Islam. He, therefore, ask a question "What can the UAE learn from those times to assist in developing its knowledge economy?"

He argues that "the top and the bottom of the social hierarchy. Political patronage, financial support and encouragement through initiatives such as the science, technology and innovation policy set the goals that the leadership encourages the country to pursue. The human capital should be in a position to assist in achieving those goals through the possession of knowledge, skills, emotional awareness, soft-skills in communication and self-management, curiosity, intrinsic motivation, grit and resilience. He asserts that Knowledge today is built upon the knowledge of yesterday. It is imperative that wide dissemination and discussion of all knowledge takes place in an atmosphere of reasoned debate and openness. And those model exist in the region today. For example, King Abdulla University of Science and Technology (KAUST) north of Jeddah is the first mixed-gender university campus in Saudi Arabia. It attracts bright students from around the world, notably from China, India and Saudi Arabia. High academic entry standards and rigorous examination criteria, backed by some of the most gifted and smartest teachers from around the world. KAUST climb over 100 points in just three years in global university rankings (in 2015, it was 350th out of 500).

The UAE needs to create its knowledge hub to attract students from around the world. Hosting foreign universities on its soil, but it has the capacity right now to offer its own unique and extraordinary learning experience to the world [53]. The way forward toward knowledge economy is to recognise this global talent that is out there and attack them with good incentive even if it lead to naturalisation. There are great Muslims and non-Muslim scholars out there in the North, East, West and South who will jump to such an opportunity. Policymakers should be brave toward such an endeavours because they are difficult but doable. It is a win, win situation.

10. Challenges of GCC countries on the role of research in knowledge economy are many.

There is a need for a policy framework on how to fund research in each member state within GCC states. i.e., each member state should have a policy on how GDP should be allocated for research.

- There should be a way forward on encourage entrepreneurship by removing the barriers on startup enterprise by establishing e-government and e-commerce to reduce the time of approving a startup business.
- Liberalise the education sector so that foreign institutions can create campuses within GCC member states. There should be a strong emphasis on institutional foundations of the knowledge economy.
- Create an atmosphere conducive to science culture and at the same time try to bring in some foreign direct investment (FDI). Use global talent to help enhance the drive toward knowledge economy within GCC member state.
- Create an audit organisation to audit all state-owned enterprises for potential self-standing, and this body could be extended inside GCC member states to make sure that state enterprise is functioning well.
- Create apprenticeships programs to enhance learning by doing, other words apprenticeship.

11. Conclusion

The role of research in knowledge economy within GCC countries is taking shape. There is a great deal of effort by those in authorities within GCC member's states to transform into the knowledge economy. Some member states have already gone far, but some are at their early stage. However, one thing that is needed by all member state is to have a keen interest in knowledge culture, something which is lacking for some. There is yearning ambition by all GCC members' states to transform their economy into the knowledge economy. They all need a sound policy in place to help them transition into the knowledge economy. Funding for research and development should be double guided a policy. There is a need for greater collaboration with great institutions in the West or East with good research output and the same time finding ways how to utilize the human capital which is already in the region, for example, the expert or importing global talent which is a win, win situation. There is no magic bullet prove to transition to knowledge economy but rather a careful strategy for the way forward spearheaded by the government and the private sector and the citizens at large.

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