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SCIENTIFIC RESERCH IN SAUDI UNIVERSITIES: REALITY AND AMBITION

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ABSTRACT: ***Background:*** *Scientific research is the essential factor for gauging the credibility of their students and faculty members.* ***Purpose:*** *This study addressed the ground realities of scientific research in Saudi universities by analyzing the indicators related to research and development.* ***Method:*** *Descriptive analytical approach was opted to develop a scientific research system in Saudi universities to promote the standards of knowledge based society.* ***Results:*** *The study presented vision that was based on interactive and cooperative learning processes, including interactions and social exchanges among effective parts such as researchers, practitioners and consumers.* ***Conclusion:*** *Saudi Arabia should encourage the research practitioners to actively participate in the scientific research field. Saudi universities can also enhance their research systems by analyzing the international research standards.*

KEYWORDS: Scientific research in Saudi universities; Knowledge-based society, interactive model

INTRODUCTION

The knowledge-based society is an intellectual tool to prescribe new conditions where knowledge and information determine the features and characteristics of relations among communities, organizations, industry and human life (Naidoo & Jamieson, 2005; Valimaa & Hoffman, 2008; Stehr, 1994). The urgent need of reform has emerged a lot of pressure on continuous learning because of the rapid pace of change in industry field and society in general. These pressures were accompanied by renewed attention to issues of scientific research and development because of its important role in guiding policies and practices.

Arab countries are categorized as knowledge-consuming countries. Therefore, disparity in the progress of science and technology between Arab and developed countries is due to the difference in their attention and care about scientific research. The emergence of knowledge-based society has imposed the need to build a system that contributes to form a social, academic, scientific stimulating environment that fosters creativity and innovation. It enhances the need of developing scientific research at universities that contribute to the investment of faculty members' potentials and creative minds in Saudi universities towards more creativity and innovation (Kearns, 2004; Bickel et al., 2002).

Previous studies emphasized the need of development of a strategy for the scientific research that specifically focuses on expenditure proportions, and various infrastructures. Most of these studies expressed the unsatisfactorily reality of Arab world technology and scientific conditions. Some studies referred these bad

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conditions to the absence of a research policy stemmed from specific strategies and plans. Therefore, they all stressed the importance to drawing a general policy for science and technology that focuses on the system of scientific research. It is essential to provide an environment that suits creativity, innovation, and renewal to move towards a future that fulfills the needs and aspirations of an Arab citizen.

Kearns (2004) asserted the fact that expenditure proportions on scientific research in the Arab countries are generally below the required level. Valimaa & Hoffman (2008) mentioned that the total proportion of expenditure on scientific activities in both private and public sectors does not exceed (0.03%) from gross domestic product of Saudi Arabia (Arab Thought Foundation ATF, 2013). In other words, government and other community establishment should contribute in the development of research system in higher educational field.

Kearns (2004) concluded that the needed infrastructure for scientific research is too weak in the Arab world. In addition, Valimaa & Hoffman (2008) emphasized the need to build organizational capabilities and develop research legislations by determining the aims and priorities of scientific research system. Many studies have called for the need to strengthen the technology and information infrastructures and develop appropriate support plans. They linked the urgent research fields for the community and its development in order to have a developed research structure at Saudi Higher Education Institutions.

Statement of the Problem

Preceding literature has found that the absence of national policies, strategies and lack of plans for scientific research is the major reason for the low development of technology. Other obstacles are the lack of required research information, high level of teaching load and weak institutional and administrative structures. Furthermore, the lack of cooperation among researchers at universities; low expenditure on scientific research and the inability of faculty members of foreign languages are also serious obstacles that hinder scientific research process (ATF 2010, 46-47).

The absence of clear strategies for scientific research, except some diligences (efforts) conducted by deanships of scientific research at Saudi universities. Most of the legislations do not allow the development of the research system because of two main reasons. The first is represented in the bureaucracy of these legislations in terms of the financial rewards system or support received by the researchers. The second reason is due to the complicated approval procedures and a long and boring bureaucratic process for an unrewarding financial return.

In light of what has been mentioned before, the present study aims to identify the reality of scientific research system in Saudi Arabia and the ways to develop it in the context of knowledge-based society by answering the following questions:

1. What is the reality of scientific research in Saudi universities and research centers?
2. What is the proposed perception for the development of scientific research in Saudi universities in light of the requirements of a knowledge-based society?

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Aims of the study

The present study aims to:

1. Monitor and analyze the reality of scientific research in Saudi universities and research centers through monitoring some indicators related to research and development inputs and outputs.
2. Provide proposed perception to develop the scientific research system in Saudi universities to conform to the standards and elements of a knowledge-based society.

METHODOLOGY

The present study adopted the descriptive and analytical approach, which aims to describe the studied phenomenon and analyze, information obtained from various sources. In order to collect the data, the investigator has thoroughly reviewed the local, regional and global documents. The present study tackles these topics:

1. Reality of scientific research at Saudi universities.
2. A proposed perception for the development of scientific research system at Saudi universities in light of the standards and elements of knowledge-based society.

FINDINGS

Reality of scientific research at Saudi universities

The researcher tackled a set of indicators that describe the reality of institutionalism and scientific research infrastructure in Saudi universities and research institutions. The indicators include research policies, universities growth, research centers and institutes, faculty members, research groups at universities, and expenditure on scientific research. After that, there was a discussion of indicators related to the outputs of research and development through which the product of Saudi can be analyzed. Then, this product is compared with the Arabic and international product via a set of indicators.

The researcher of the present study has referred the number of well-known reports such as cultural development reports issued by the Arab Thought Foundation (ATF), United Nations Educational, Scientific and Cultural Organization (UNESCO), Saudi Ministry of Education, international journals' data bases such as Thomson Reuters, Scopus, Shanghai and QS and US News for universities classification.

Inputs of research and development

Research policies

Technical developments in recent decades have brought about, a shift in the economies of industrialized nations. It also forced to plan strategies and general policies that guide scientific research towards achieving the aims of development, and consequently achieve an advanced position within global leadership road map (ATF, 2013, 216). Thus, Saudi Arabia has rushed to develop a national policy for science and technology that stemmed from two main things, i.e. the importance to be aware of the challenges inherent in the global transformations, and the need to make available national capabilities to confront them. In 2011 the "Extended Plan for Science Technology and Innovation" was prepared in coincidence with the "Ninth

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Development Plan". The plan involved eight these great national projects, (ATF, 2013: 219-20; OECD, 1995a, OECD, 1995b):

1. Strategic Technologies Program
2. Research capabilities, technical development and innovation program
3. Technology and innovation transference and localization program
4. Knowledge-based main structures program
5. Human resources development program for science and technology
6. Financial support diversification, development, and enhancement program such as endowments (Awqaf) and other software
7. Development of science systems, technology and innovation program
8. Development of institutional structures for science, technology and innovation program

Universities and research institutions

A significant movement occurred because of these policies in the growth of universities and their centers, institutes, chairs, research groups, and technical valleys.

Universities growth index

Saudi Arabia has witnessed a significant increase in the number of universities in the past few decades. Table (1) indicates the number of universities evolution in the Kingdom from (2005 to 2014). It reveals that this number has nearly doubled within the last ten years. The total growth rate was (187%). The total number of public and private universities in 2015 was reached to 43; whereas, in 2005 there was only 15 universities in Saudi Arabia among which 11 were public. The number of universities index has risen from (0.7) to (1.27) per million inhabitants in a short time. The total growth rate was (6%) per million of the population during the period from 2010-2014. This rise is due to the increase in the number of universities that exceeded the growth rate of population (Ministry deputy for planning & information, 2015, 60; OECD, 2000).

[Insert Table 1 here]

Centers, chairs and research groups at universities

Excellence Research Centers, Technology Parks, and research groups have become the essential form of organization, which is required for achieving high quality of theoretical, applied and technological research. This form has emphasized that compiling effective elements in the development of research processes is helpful for the formation of a critical mass that efficiently exchanges the dynamic knowledge. This form is contribute to the dissemination of experience, expertise and facilitates the movement of researchers between public and private structures.

Excellence Research Centers

In 2007, Eight Excellence Research Centers were established in the first phase at a number of Saudi universities. After one year, four Excellence Research Centers were established in the second Phase. In 2014, the total number of research centers was (6) at King Abdul Aziz University, (5) at King Saud University, and (4) at King Fahd University, as shown in Table (2). According to the report published by the

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International Economic Forum for research centers, Saudi Arabia was ranked at 52nd number at global level on the development of scientific research centers. Moreover, Saudi Arabia was also ranked at 5th in accordance to Arab countries (ATF, 2013: 222-3; OECD, 2002a; Arab Thought Foundation, 2010).

[Insert Table 2 here]
Research activity in Saudi universities was not limited with excellence research centers but it also extends to other centers of research that completely belong to the Deanship of Scientific Research at each university. There are also research chairs and institutes for research and consultations. At King Saud University, for instance there are (4) other research centers and (5) institutes for study of research and consultations. On the other hand, King Abdul Aziz University has (12) chairs that belonged to the institute of consultations and research. At the end of December 2012, the total number of research chairs at all Saudi universities and research institutions were reached to 189 chairs. They also aimed to provide brilliant research competencies, advanced devices and technologies for these chairs in order to strengthen effective partnership between university and society (Ministry deputy for planning & information, 2012, 59).

In 2010, a series of contracts were signed at a cost of more than (63) million SAR for three years that could be renewed in case the center was effective. The contract of Najran University was renewed because of its high and distinguished research productivity. With regard to the research projects of Nano technology, three centers were established at King Saud University, King Abdul Abdulaziz University and King Fahd University. Programs of this technology are also found at Taiba University in Medina that cover the topics of medical, biotechnology and environment.

In 2003, Prince Abdulla bin Abdul Aziz technology garden was established to the north of King Fahd University for Petroleum and Minerals. Jeddah garden for technology and innovation was also planned to be established near King Abdul Aziz University. This technological garden will be specialized in researches and industries that specifically based on Biotechnology. In 2010, the cabinet agreed on the recommendations of Universities Higher Council to establish Riyadh Valley for Technology, Jeddah Valley for Technology, under the supervision of King Saud and King Abdul University. These two valleys were established to simulate international centers such as Silicon Valley in America, Technology Oasis in Cambridge in Britain, and so on. They provide researchers with the technological environment for research and industrial development that is helpful towards knowledge-based economy (ATF, 2013, 222-223).

King Abdul Aziz City for Science and Technology
The city of King Abdul Aziz supports and encourages the scientific research for applied purposes. It coordinates activities of scientific research institutions and centers in a way that fits the requirements of development in Saudi Arabia. The city was also entrusted with the main role to prepare the national policies and plans for science, technology and innovation. In addition, it was entrusted to develop strategies for the implementation of work that leads to development of industrial products and

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transformative mechanisms. Of course, it can only be done through scientific research conducted in the research institute of city. It includes: the Energy Research Institute, Institute of Natural and Environmental Resources Research, Institute of Atomic Energy Research, Institute of Petroleum Research and Petrochemical Industries and Institute of Electronics and Calculators Research, (ATF, 2013, 223; King Abdulaziz University, 2014).

The Science, technology and innovation program in the first five-year plan is the major reason for the establishment of King Abdul Aziz City. In 2008, the programs were called "Baader Program for technology incubators. It mainly aimed to support and care for the emerging technology projects that contribute to the creation of investment opportunities by supporting works entrepreneurship, innovation and technology incubators. Three incubators have been completed, namely Baader ICT Incubator in (2008), Baadir Incubator for biotechnology in (2009), and Baadir Incubator for advanced manufacturing in (2010) (KACST, 2014).

Human resources

There is a general agreement that the human resources index is the most important indicators regarding the situation and prospects of research and development system in society and economy. In regards of higher education institutions, the available data indicates important differences in the number of full-time researchers. It is normally estimated that a person who spends (30%) of his time in research and development and the rest of his time on other activities is considered as a full-time equivalent researcher. This result is very important in the analysis and exploration of research prospects and interpretation of number of researchers (ATF, 2010, 30-31; Saleh, 2009, 5-6).

In fact, most Arab universities have lack qualified human resources for the advancement of scientific researches. However, they have such resources; the universities were not devoting to hire them in a large proportion. A relatively new report shows that Arab universities need more than a hundred and fifty thousand PhD holders to ensure the minimum level of academically qualified faculty members. It is worth mentioning here that Arab countries are still far away to get out of this dark tunnel. Rates of joining higher education in these countries are still low as compared with the other international rates. They also failed to provide highly qualified faculty members that meet the current needs of higher education and give appropriate supervision for the growing numbers of newcomers to higher education institutions (ATF, 2010, 52).

Naidoo (2010) stated that in Saudi Arabia (23) researcher per (100.000) inhabitants were engaged in the activities of scientific research and development. Of course, it is a modest rate compared with an average of researchers to population in the developed countries, which is (500) researcher per (100.000) inhabitants. The data presented in Table 3 facilitates the comparison between Saudi Arabia and some Arab countries. It clearly shows a big difference between researchers' number per one million, although they are all below the needed level, which is (5000) researchers per one million inhabitants.

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[Insert Table 3 here]

Expecting high level of research productivity is illogical when the general average number of students per each faculty member at Saudi universities is more than 43 students. On the contrary, in other place of the world the average number of students per faculty member should not be more than 16 students. Table 4 illustrates the percentage of faculty members who are Ph.D. holders to the total number of students registered at higher education institutions from (2010- 2014) (Ministry deputy for planning & information, 2015, 254, & 315; ATF, 2013, 208).
[Insert Table 4 here]

Ph.D. holders represent the largest percentage of faculty members in Saudi Arabia. Table 5 illustrates the relative distribution of faculty members according to their education level. The table shows that Ph.D. holders in 2010 and 2014 were representing about 43% of the whole faculty members at Saudi Higher education institutions. This percentage regressed gradually and reached to 39% in 2012. Faculty members of Ph.D. holders are assumed to be in majority because they are more capable to guide and lead the scientific processes. However, instructors with degrees in Bachelors in Arts (BA) were 30% in most years.

This might be due to the opening of many nistry deputy for planning & information, 2015, 242-244). universities in the last years, which increased the percentage of appointing those instructors. There is no doubt that faculty members at many universities have big teaching loads in addition to administrative works, quality committees and so on. This load is negatively affects the quality and quantity of research products (Mi
[Insert Table 5 here]

Scientific research expenditure and funding
The total expenditure on scientific research in 2014 was 24.40 billion Saudi riyals, which equals 0.873% of the Gross Domestic Product (GDP) of the country. The governmental expenditure in 2014 on research was reached to 16.60 billion Saudi riyals, which was 0.59% of GDP and nearly 68% of the budget devoted for scientific research. The two sizes of expenditure and percentage to the gross domestic product and country budget for the period of 2010-2014 is mentioned in table 6.The rate of increase in the overall expenditure on research in the two years was 39.3%. That is, the increase in research did not parallel to the increase in gross domestic product (GDP) (Ministry deputy for planning & information, 2015).

[Insert Table 6 here]

Table 7 presents a summary of the non-governmental expenditure. It shows that the large amount comes from the private sector. At the end of 2012, the total amount spent by more than a hundred companies and institutions in Saudi Arabia on research and development was (4,243,583,187). The total expenditure of private universities were (3,774,826,555) SAR. The total expenditure of King Abdulla University for Science and Technology was 3.750.000.000. The other amount (about 25 millions)

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was spent by three universities and seven colleges, which shows a clear image of the absence of the scientific research in most private sector colleges.
[Insert Table 7 here]

In 2010, a report was published by the Arab Thought Foundation, which shows that the spending rates on scientific research and development in the Arab world is not more than 0.02% to 0.04% of the total National Gross Product (NGP). In general, the range of rates in developed countries was 2% to 2.5% of the total national gross product (ATF, 2010). For instance, in Israel, the expenditure rates in (2008) and (2009) on the non-military scientific research were (4.7%) and (4.44%) of its national gross product.

This percentage was about (9 billion) Saudi Riyals, which represents the highest rate of spending in the world. In other words, the amount that Israel spends on scientific research is double the amount that all Arab countries spend. Although the national gross product of Arab countries is eleven times greater than the Israeli income. Table 8 illustrates the spending percentage on scientific research in some of the developed countries to regards of their national domestic gross.
[Insert Table 8 here]

The contribution of the industrial and business sectors' spending on scientific research and development is clearer in the developed countries. The contribution of industries to the funding of scientific research is nearly 80%. They focused their attention on supporting and funding research that helps the knowledge production and technological innovation. In general, private sector in the Saudi Arabia and in oil-producing countries is not effectively contributing in the development of a scientific research. It is a good step that the spending rate on scientific research in Saudi Arabia is increased during the period of 2010 to 2014. However, this spending rate has gone down and still under the international levels.

Outputs of research and development

It is clear that the indicators are merely focused on the development of quantitative measures. However, lack of attention was paid on the inputs and outputs of qualitative research activities. These indicators portray a clear picture about the size and amount of existing research and developmental activity. In order to measure the outputs of research and development, there are two major indicators that are mostly used to express the benefits of scientific activity. These indicators are the Index of Scientific Publishing, which includes the research production, size of published documents, and number of citations. The other indicator is the scientific impact of the researcher according to Scopus and Elsevier. The comparisons between developed, developing, and Arab countries will be conducted to identify position of Saudi Arabia in this side, and its impact on the classification of the Saudi universities.

Scientific Publication

The scientific publication index is characterized by clear indications about the level and quality of knowledge and scientific progress. It is possible to measure the scientific productivity and levels of personnel in different scientific institutions.

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Perhaps the best way to ensure data validity about the scientific production of any state or institution is to adopt the approach that is widely used across the globe. The specialized and proven information of independence and credibility of the sites is Thomson Reuters Thomson site - Reuters, Web of Knowledge ISI, Elsevier, and Scopus (ATF, 2010, 34).

The size of published documents in various scientific journals and publication vessels was mentioned in the international report on SCImago website during the period of 1996-2014. The data revealed that the total number of documents were (34963102) documents, among which (31,606,182) were citable documents. Another report by the same site and in the same time revealed that Middle East countries, i.e. Turkey, Iran, Israel, and Arab countries, except Northern Africa, Libya, Tunisia, Algeria, and Morocco have (1,261,762) published documents.

The percentage was about 0.036% of the world publication size. The numbers of citations were (11.458.881) and the rate of citations was (9.08 per each document that is equal to 0.028% of the whole world citations. Similarly, the total number of Saudi published documents was (91.460) documents with (0.07%) of the Middle East's published documents. However, there was (87.643) citable documents (SCImago, 2007).

It is noted that most of Middle East production comes from three countries, i.e. Turkey, Israel, and Iran. Their publication reached to (950.236) documents, while Arab countries in Middle East have only (345.926) published documents. This weak production is also less than what is produced by Turkey alone, which published (390.874 documents). On the other hand, in the same year, Singapore was produced the documents that is more than Saudi Arabia and Egypt together. It published (192.942 document) among which (182.169) were citable.
[Insert Table 9 here]

Hirsch index analyzes the conditions of overall scientific publishing in various countries in the world. This index reveals the efficiency of the research system of each country through their distinguished scientific publishing (See table 9).According to Hirsch index in 2014, the comparison of Saudi Arabia with some developed countries like the United States (1648), United Kingdom (1015), Japan (745). The qualitative and quantitative disparity can be clearly noticed regarding the efficacy of the research systems in Saudi Arabia and these countries. Differences are presented in table (10).

[Insert Table 10 here]

According to Hirsch index, there is a difference noticed between the comparison of Saudi Arabia and Middle East countries (531). This difference is perhaps due to the size and efficiency of the scientific production of only three countries, which are all non-Arabic, i.e. Turkey, Israel, and Iran. With regard to Arab countries, a clear convergence between Egypt and Saudi Arabia is found, while the rest of countries have lowered ranks. Table (11) illustrates these differences.

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[Insert Table 11 here]

According to Institute of Scientific Information (ISI) classification of peer reviewed journals during the period of 2010-2014. The data shows that the number of researches in Saudi Arabia reached to 2436 in 2010 in various fields. However, in 2014 it reached to 7194 researches with a growth rate 195.32% (Ministry deputy for planning & information, 2015, 260). The research that was produced by King Saud and King Abdul Aziz universities only in the (ISI) journals in 2013 was about 44% of the Saudi's total research output.

In the sixth Arabic Report of cultural development, it was stated that the efforts of Saudi Ministry of Higher Education and subsequent universities and centers has resulted in a distinguished increase in the number of scientific papers published in international scientific journals (ISI) base. Their total number reached to 8272 papers in 2012 and achieved unprecedented rapid growth on the global level during the time span of 2011 and 2012 (ATF, 2013, 206). Table 12 illustrates the research production in Saudi Arabia (King Saud University, 2014).

[Insert Table 12 here]

The report of Thomson Reuters database revealed that the number of published research papers in peer reviewed journal according its (ISI) Journals database has reached to 44,674 research documents during the time frame of 2011 to 2015. The total output of published research in (ISI) journals was (8235) research papers. The number of research papers' citations in the last five years from (2011-2015) was (219,821) citations, with a citation ratio about 4.92 per each research paper (Thomson Reuters, 2015).

According to Scopus classification of scientific journals, Table 13 shows the number of research papers in Saudi Arabia. It shows that the number of research papers was about (6781) papers in (2010). Then, the number increased to (22325) in (2014), with a total growth rate of (229.23%) and an annual growth rate of (34.7%) (Ministry deputy for planning and information, 2015, 261).

[Insert Table 13 here]

.sJournal issued by research institutions

The newly documented journals issued by Arab research and academic institutions in 2011with regard to SCImago website. It can be noticed that Egypt and Saudi Arabia are the top Arab countries with 25 and 17 journals. Kuwait was in the third place with 8 journals, followed by Jordan with 7 journals. At the bottom of the list, we can see two journals for Tunisia and one journal for both of Qatar and Oman. Therefore, researcher of the present study believe that it is important to raise the level of these Arab journals in all disciplines whether applied or theoretical. Editorial methodology should be unified and publishing criteria should be improved in line with the global trends that deal with quality not quantity (SCImago, 2007).

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In 2010, a report was published by Arab Thought Foundation revealed that there are 50 international journals indexed in Thomson-Reuters, which owns knowledge network and issues the index of scientific citations. Scopus-Elsevier issues countries and universities' positions regarding their research productivity; whereas, Eniest Database for humanistic and social sciences gathered all indexed journals in one database. There are 28194 international journals indexed in Scopus-Elsevier among which 74 are Arabic journals. There are 36 out of 11403 journals indexed in Eniest database for humanistic and social sciences with a percentage of 3.002. Table 14 also illustrates that Egypt is at the top of the list regarding the international journals' documentation, followed by Saudi Arabia (except the humanistic and social journals) then Morocco (ATF, 2010: 53-5).

[Insert Table 14 here]

Classification of universities

Three Saudi universities achieved advanced positions in the latest classification of Shanghai. King Abdul Aziz University was between the rank of 151-200; whereas, King Abdulla University for Science and Technology was between the rank of 301-400. King Fahd University for Petroleum and Minerals was stand between the ranges of 401-500. Shanghai classification is one of the international classifications that have many indexes such as the index of top researchers' citations, the index of published research in respectable international journals such Science and Nature and the index of research in arts and humanistic sciences. In other words, Shanghai Classification has got (60%) of the evaluation of scientific research and research efficiency.

In 2015, Saudi universities progressed in other famous international rankings that pay much attention to the index of research and scientific output such as Quacquarelli Symonds (QS) and United States News classifications. For instance, King Saud University achieved the rank of 237 in the QS classification and 489 in US News classification. However, King Abdul Aziz had a progress in US News order, and was ranked at the number of 378 internationally. The illustration of universities ranking is mentioned in table 15.

[Insert Table 15 here]

In 2012, Scopus-Elsevier published the ranking of 3290 universities and research centers. The data shows that the total number of universities and research centers in Middle East is 166, among which 15 were in Egypt and 7 were in Saudi Arabia. While, universities and research centers in Israel, Turkey, and Iran were 20, 61, and 45 in numbers, respectively. In regards of Saudi Universities, table 15 shows that King Saud University was in the first place locally, and in the (22^{nd}) rank at Middle East level.

[Insert Table 16 here]

In conclusion, it can be argued that the indicators of databases and publishing index in peer reviewed journals were varied according to the classification of universities.

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Hence, difference between registered numbers of published documents arises among databases. This difference is also dominated by the quantitative aspect, which is no doubt an indicator of research activity. In the Arab World in general and in Saudi Arabia, particularly, natural wealth and resources are still the dominant export.
The humility of their exports is clearly seen from of the commodities that have an advanced technological nature. For this purpose, a question about the efficiency of scientific research in Saudi Arabia raised that has increased rapidly qualitatively and quantitatively from 2005 to 2015. It emerged as a result of governmental spending because of the rise in oil price that was reflected on the country's budget (Department for Education and Skills, 2002b).

Testing the index of cited research works published in international documented journals reveals that there are eleven people working in Arab universities whose names appear among the most cited scientific authors. They all belong to universities in Saudi Arabia. Only one author of those eleven authors holds an Arabic nationality while the other ten are of foreign nationalities. The indicator also reveals that there are seven to ten people of Arabic nationalities or origins working in foreign universities.
Most of them work in USA and their names are among the most cited scientific authors. Thus, there is one Arab researcher who works in an Arab university but not in his homeland and whose scientific works are widely cited in international scientific domains. With regard to scientific domains it can be argued that Arabs are completely absent in the scientific and social sciences field (ATF, 2010, 45-46).

This can be explained by the criticism made by many academicians and writers to Saudi universities. They mentioned that these universities seek to obtain advanced ranks through contracting foreign researchers who got reputable Nobel prizes in the field of scientific research (Bahattacharjee, 2011). These advanced classifications do not really reflect accurately the reality of universities. They were because of contracting famous faculty members for the sake of supervising or participating in research projects, or establishing higher studies programs. This undoubtedly was beneficial for universities and empowered them to occupy advanced positions in the classification of rankings.

Carnegie International Foundation emphasized the fact that Saudi universities spent million to attract international scientists and researchers who got Nobel Prize and have the ability to publish in the best journals. A member of Saudi Shoura (parliament) Council and a faculty member at King Saud named Mohammed Alguenibt says that such strategy created wrong impression within the remote observer. Alguenibt believed that Saudi universities are advanced in the production of major research, while they only pursue advanced academic categories without an emphasis on the output.

They seek to buy academic reputation and jump quickly on classifications. Consequently, this is a negative phenomenon, denigration and irresponsible conduct. However, this does not mean that all this movement was negative, but there were positive aspects, especially in some of the research centers where Saudi researchers participated with other foreign experts. The link to the labor market is another issue

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that needs special study. Those who bet that education and research guide the labor market are actually mistaken.

The political economic plans are a decisive factor in the development of the labor market that leads to the development of scientific research and innovation automatically. At that time, the relation becomes reciprocal in a continuous competition between the scientific research and market.

Second: A proposed vision to develop the system of scientific research at Saudi universities and research centers in light of the standards of knowledge-based society

Through the answers of the first two questions, it is clear that the main idea of scientific research is knowledge development that has received wide attention by the European Center for the Development of Training (CEDEFOP). In 2002, European center expressed the concept of knowledge development as "interactive and cooperative learning processes, including social interactions and exchanges.

This concept leads to a new wider role for research and implies the activation of all parties in the development of coalitions, which allows more beneficiaries to implement scientific research (p.19). The success of an evidence-based knowledge relies heavily on the linking of the knowledge management process to a concept of accumulative innovation that should be understood as a process of cultural learning or evolution inside its research context (Kearns, 2009, 18; Arab Thought Foundation, 2013; OECD, 2002b; CEDEFOP, 2002).

Transition towards the interactive model

The importance of transformation toward this interactive model, there should be a profound change in the way by which research and studies are carried out at universities and research centers. To enhance the ability of the research system in the interaction among beneficiaries and the impact on the studies, the following strategies are proposed:

1. Develop a research strategy by a political decision from the supreme authority and take into account all related laws and regulations. This strategy should aim to plan the general policy of the scientific research system in Saudi Arabia. It also aims to determine means of support and funding. It should include the Saudi's vision for the future system of scientific research, which should contribute to the transfer of Saudi Arabia to the developed world. All research strategies for universities and research institutions should be based upon its inspiration and guidance (ARWU, 2012).
2. Develop the infrastructure of scientific research system in Saudi Arabia to keep pace with the aspirations in the transition towards a knowledge-based society, through:

- Building a network system, policy makers and practitioners should link with researchers in order to enhance the communication and ongoing dialogue in a more interactive and multidirectional ways. For example, if stakeholders of any university think of establishing a center for childhood studies, they should involve researchers from the faculty of medicine (specialists in pediatrics), researchers from the college of education (specialists in kindergartens, curriculum), researchers from the college of computer science (to help in the design of games and software). They all should spend

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two to three years on ongoing and continual to achieve theoretical and applied results that can contribute effectively to child upbringing, development, and protection.

- Establish and support specialized research centers in priority fields of development. These centers do not have strict limits (concerning specific disciplines) as mentioned in number one. The concept of dedicated (specialized) research center, according to the British Ministry of Education and Skills involves the following features:

3. The dedicated research center focuses on a specific area where disciplines and institutions overlap. It relies on the main researchers in each field, regardless their specialties and locations (childhood or terrorism, for example).
4. The dedicated research center includes collaborative research teams from different fields and institutions who work on a relatively long-term research program of (3-5) years.
5. Each center should function as an active institution that works on raising the ongoing dialogue between the beneficiaries in all the different sectors, (Kearns, 2004; Department of Education and Skills, 2002b, 9).

Examples of specialized research centers:

- Centre for Research on the Wider Benefits of Learning located at London University.
- National Research Center for ICT in Education, Training and Employment.
- Research Center on Economics of Education in London

Examples of adopted communication forms are found in the American National Centre for Vocational Education Research (NCVER) such as:

1- Main findings of the research, which is provided through a single page for each study produced by the center.

- Fast Facts about policies and practices, which are made in two pages and summarize the most important key findings related to a particular issue, and provide the reader with sources that can be accessed for follow-up.

2- Implement the research findings at work: that means conditioning and synthesizing research results and related information into practice applications.

- Connect research directly to policies of development and revision.
- Recognition of the key role of information and communication technology in promoting interaction between the beneficiaries. It increased the effectiveness of interactive strategies among research policies and practice via facilitating the process of communication among beneficiaries. The establishment of strategies includes information provision, summaries and share insights through Web sites, e-mails and social networks (Kearns, 2004; Beerkens, 2008; Valima & Hoffman, 2008).

3- The percentage of private sector's contribution in knowledge-based societies in funding research and development reached to 80% of the overall scientific research funding. This percentage represents evidence about the conviction of knowledge-based societies of the economic viability for scientific research from a financial and capital perspective. Scientific research plays a major role in the progress of nations and peoples and the achievement of their visions and missions to better lives. This sector in Saudi Arabia is an intermediary sector between the knowledge and a consumer; it does not actively participate in supporting and funding scientific research. Therefore, the state should intervene and oblige companies of huge profits to

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support scientific chairs and endowments that serve research sectors in universities and other places.

4- Introduce knowledge culture that supports freedom and creativity and encourages knowledge production and utilization through:

- Promoting the principle of university independence, intellectual freedoms, and thought tolerance within the research system. The methods should reach scientific facts and getting away from myths, legends, and narrow-mindedness, and to open the way for creators and thinkers.
- Instill a lifelong learning culture that change the learning methods and enhance the capacity of individuals for self-learning. It is also necessary they should be encouraged to work with an interactive team that strengthens the activities both financially and morally.

5- Encourage scientific publishing in international journals. Universities and research centers have to:

- Familiarize researchers at universities and research centers with international journals and their classification in (ISI).
- Train researchers to consider standards and methodologies adopted by international journals.
- Contracting international researchers to work with local research teams within research projects for benefitting their abilities and experiences. This interaction will raise the level of local researchers and enable them to apply the best research standards and consequently publish in international journals and research vessels.

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APPENDICES

Tables

Table 1: Public and private universities growth and their number percentage per one million from 2005- 2014

Year		2005	2011	2015	Total Growth Ratio
Number of universities	Public	11	24	32	191%
	Private	4	8	11	175%
	Total	15	32	43	187%
Population in million		22.7	27.1	30.8	35.7%

Table 2: Excellence research centers at the biggest three Saudi universities

Excellence Research Center at King Abdul Aziz University	Excellence Research Center at King Saud University	Excellence Research Center at King Fahd University
In environmental studies	In science and mathematics education development	In petrol and primary petrochemicals refining
In medical genome	In information security	In corrosion
In advanced Materials	In coagulation and haemophilia	In renewable energy
In climate change research	In modern technology	In Nanotechnology
In desalination technology	In Biotechnology	-------
In Osteoporosis	-------	
Source: Scientific research at university www.kau.edu.sa	Source: Deanship of Scientific Research www.ksu.edu.sa	Source: Deanship of Scientific Research www.kfupm.edu.sa

Table 3: Number of researchers per one million inhabitants in some Arab countries in (2007)

Country	Number of researchers per one million inhabitants
Jordan	1952
Tunisia	1588
Morocco	647
Egypt	617
Algeria	170
Kuwait	166
Sudan	290
Libya	61
Saudi Arabia	42

*Source: UNESCO SCIENCE REPORT 2010, The Current Status of Science around the World, UNESCO Publishing, Paris, 2010, p261.

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Table 4: Percentage of students to faculty members to Saudi higher education institutions from (2010- 2014)

Year	2010	2011	2012	2013	2014
Students/faculty member (BA. MA. Ph.D. holders)	18/1	19/1	20/1	21/1	20/1
Students/faculty member (only Ph.D. holder)	42/1	44/1	52/1	52/1	47/1

Table 5: Faculty members' number and relative distribution according to educational level (2010-2014)

Level	2010	2011	2012	2013	2014	Annual growth average	Percentage of total growth
Ph.D.	21317	23433	23211	26111	31758	10.5%	49%
	43%	43.3%	39%	40.4%	43%		
MA	10118	10190	14861	16091	17867	15.3%	76.6%
	20.4%	18.8%	25%	24.9%	24.2%		
BA	17673	14808	19693	20220	23322	7.2%	32%
	35.7%	27.3%	33.1%	31.3%	31.6%		
Other	420	5736	1677	2267	870	20%	107.1%
	0,8%	10.6%	2.8%	3.5%	1.2%		

Source: indicators of education in Saudi Arabia-Ministry of Education (2015)

Table 6: Indicators of expenditure on research and development for the years (2010 – 2014) indicators

Statement of expenditure on research (Billion SR)	2010	20111	2012	2013
Gross Domestic Product (Billion SR)	1.630	2.100	2.727	2.794
Governmental expenditure on research (Billion SR)	12.25	13.65	15.20`	16.60
Non-governmental expenditure on research (Billion SR)	5.26	8.95	9.02	7.80
Total expenditure on scientific research	17.51	22.60	24.22	24.40
Percentage of governmental expenditure on research from GDP	0.75%	0.65%	0.56%	0.59%
Percentage of expenditure on research from GDP	1.074%	1.076%	0.888%	0.873%

Source: Ministry of Education. Education indicators in KSA, (2015: 263).

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Table 7: A summary of the non-governmental expenditure in (2012)

Expenditure party	Total amount	% of the non-governmental sector total	% of overall total
Private sector	4.243.583.187	47.06%	2.48%
Private universities and colleges	3.774.826.555	41.86%	18.22%
Local research chairs	150.000.000	1.66%	0.72%
Foreign research chairs	433.725.000	4.81%	2.09%
Scientific awards and funds	21.450.000	0.24%	010.%
Endowments (Awqaf).	394.283.000	4.37%	1.90%
Total	9.017.867.742	100%	43.52%

Source: Ministry of Education. Ministry Deputy for Planning and Information 2013.

Table 8: Percentage of National Domestic Gross spent on scientific research in some countries.

Year	USA	Japan	Britain	Federal Russia	China	South Korea	Singapore	Israel
1999	2.64	3.02	1.82	1	0.76	2.25	1.85	3.52
2009	2.86	3.36	1.86	1.25	1.70	3.56	2.27	4.44

Source: Ministry of Education. Ministry Deputy for Planning and Information (2013).

Table 9: Scopus rating of the Middle East according to the published documents indicated by Hirsch index for each state from (1996 – 2014)

N	Country	Documents	Citable documents	Citations	Self-Citations	Citations / Document	Hirsch index
1	Turkey	390874	368197	2938841	737423	9.79	266
2	Iran	287010	278388	1504541	573856	9.83	180
3	Israel	272352	255036	5079652	694959	20.56	496
4	Egypt	120493	117104	818728	162544	9.19	165
5	KSA	91460	87643	547167	89352	8.95	164
6	U.A. E.	26690	25166	166455	17582	9.13	112
7	Jordan	25514	24845	167105	21438	8.74	102
8	Lebanon	18218	16817	151940	15122	11.56	122
9	Kuwait	16848	16230	134541	16324	9.2	100
10	Oman	11139	10434	70272	8474	8.71	83
11	Qatar	10287	9708	49372	6021	7.39	70
12	Iraq	9555	9097	28608	3624	5.95	51
13	Syria	5151	4916	44354	5266	11.86	74
14	Bahrain	4180	3856	20118	2091	6.12	48
15	Palestine	3942	3729	23425	3178	9.05	53
16	Yemen	2447	2378	15096	1786	9.98	46

Source: SJR – International Science Ranking, 6/3/2016

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Table 10: Research in Saudi Arabia compared with some developed countries according to Hirsch Index (2014)

Country	Saudi Arabia	United Kingdom	United States of America	Japan
Hirsch Index	164	1015	1648	745

Source: SCImago Journal & Country Rank

Table 11: Research in Saudi Arabia compared with some international areas and continents according to Hirsch Index (2014)

Country	Saudi Arabia	Middle East	North America	Western Europe
Hirsch Index	164	531	1664	1376

Source: SCImago Journal & Country Rank

Table 12: Saudi research output according to (ISI) classification for (2010-2014), the annual growth rate and total growth percentage

Year	2010	2011	2012	2013	2014	Annual growth rate	Total percentage of growth
Number of researches	2436	2735	3047	5063	7194	31.1%	195.32%

Table 13: Research papers in Saudi Arabia according to Scopus classification in (2010-2014), annual growth rate, and percentage of total growth

Year	2010	2011	2012	2013	2014	Annual growth rate	Percentage of total growth
Number of researches	6781	10131	15768	18258	22325	34.7%	229.23%

Table 14: Journals issued in Saudi Arabia and some Arab countries that are indexed in international knowledge database

Country	Journals in Thomson-Reuters	Journals in Scopus-Elsevier	Journals in Eniest for humanistic and social sciences	Total
Saudi Arabia	8	20	2	30
Egypt	24	16	9	49
Jordan	7	5	5	17
UAE	3	5	1	9
Bahrain	0	3	0	3
Tunisia	1	2	3	6
Algeria	1	1	2	4
Syria	0	0	2	2
Iraq	0	4	0	4
Oman	0	1	1	2
Qatar	1	4	0	5
Kuwait	2	6	1	9

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Lebanon	1	4	3	8
Libya	0	1	1	2
Morocco	2	2	6	10
Arab country total	50	74	36	160
Overall	16539	28194	11403	56136

Table 15: Saudi universities in the most important international ranking (2015)

Classification	King Abdul Aziz University	King Saud University	King Fahd University	King Abdulla University
Shanghai	151-200	151-200	401-500	301-400
QS	303	237	199	---
US	378	489	---	294

Table 16: The order of Saudi universities based on published research in worldwide documented journals in Scopus-Elsevier in comparison with some universities, (2012 report)

Local rank	Regional rank (Middle East)	International rank	University	Number of published documents
1	1	118	Tel Aviv University	18432
1	2	231	Azad Islamic University	12678
2	3	232	Hebrew University	12574
3	4	242	Israel Institute for technology	12164
1	22	724	King Saud University	4634
2	45	1093	King Fahd University	2895
3	78	1660	King Abdul Aziz University	1634
4	105	2020	King Faisal Specialized Hospital	1247

Source: SJR World Report 2012, http://www.scimagoir.com

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Conflict of Interest
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