

Knowledge issues in the global innovation index: Assessment of the state of Saudi Arabia versus countries with distinct development

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ABSTRACT: *This paper is concerned with exploring the state of Saudi Arabia with regards to the main knowledge issues of the global innovation index (GII), in order to direct its future knowledge development. For this purpose, the paper follows a method of three main steps. In the first, it organizes GII knowledge issues into a framework of five integrated layers: People's layer, which is concerned with education and research; technical tools' layer, which is associated with the Information and Communication Technology; knowledge-in-business layer, which is related to knowledge workers, innovation linkages, and knowledge absorption; knowledge and technology output layer, which is concerned with knowledge creation, impact and diffusion; and finally creativity output layer, which is associated with creative intangibles, goods and services and online creativity. In the second step it investigates these layers for Saudi Arabia relative to four other countries: Brazil and Russia, which are the first two of the distinguished BRIC countries; and Malaysia and South Korea, which are Asian countries that enjoy distinct development drive. The final step discusses the outcome of the investigations and emphasizes future knowledge development requirements for Saudi Arabia.*

KEYWORDS: knowledge issues, global innovation index, information and communication technology, Saudi Arabia, Brazil, Russia, Malaysia, South Korea

This section explores the global innovation index (GII). It emphasizes the main directly related knowledge issues of the index; and it introduces the work presented in these papers.

The global innovation index

The creation, preservation, diffusion and utilization of knowledge produce value that contributes to wealth generation and job creation (Bakry, 2009). The activation of these activities has been attracting attention, as this leads toward building knowledge-based societies that enjoy knowledge promotion culture (Bakry & Alfantoukh, 2010), with economic and social benefits (Bakry & Al-Ghamdi, 2011).

Innovation is of course at the core the knowledge culture. It has been defined as follows (BRIC, 2012):

Innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.

Looking at this definition, the following can be viewed:

- Innovation is driven by implementable *knowledge* that can be utilized for a purpose.
- The purpose has an outcome that delivers *value*; and this value results from goods, services, processes, marketing methods, or organizational methods.
- The outcome has a *target* where the value can be explored; this target includes: Business practices, workplace organization or external relations.

The GII was initiated in 2007 for enhancing the development of policies that promote innovation. For this purpose, the index has been continuously developed over the past years to include various parameters associated with innovation on the one hand, and to assess the state of these parameters in different countries of the worlds on the other. In 2012, the index appeared in its latest form consisting of '84 parameters,' and assessing '141 countries.' The basic dimensions of the index are shown in Figure 1 (Dutta, 2012).

As shown in Figure 1, the index has *seven* dimensions. *Five* dimensions are considered to

be an input to innovation or innovation enablers; and these collectively provide the innovation input sub-index. The other *two* are considered to be the output of innovation or its deliverables; and these collectively provide the innovation output sub-index. The two sub-indexes together give the GII; and their ratio provides the innovation efficiency sub-index.

Each of the GII dimensions consists of three main parts. These are given in Table 1. Each part has three or more parameters measured for different countries by various international organizations interested in the subjects of certain parameters. These organizations include: The World Bank; The United Nations Educational Scientific and Cultural Organization (UNESCO); the International Telecommunication Union (ITU); the

International Standards Organization (ISO); and others (Dutta, 2012).

The GII 2012 report provides two numbers for each parameter: One gives its value according to its definition, while the other uses this value to give the rank of the country concerned, with regards to the parameter considered. The report also computes the two numbers for: Each part, every dimension, the sub-indexes and the overall index.

GII knowledge issues

All GII dimensions, with their parts and parameters, are related to knowledge. However, some of these are directly associated with the knowledge activities of knowledge creation, preservation, diffusion and utilization. They include the following:

- Human capital and research, which include education and research;
- Information and Communication Technology (ICT), which provide information storage, processing and transfer;
- Business sophistication knowledge, which involves: Knowledge workers; innovation linkages and knowledge absorption;
- Knowledge and technology outputs, which are concerned with: Knowledge creation, impact and diffusion; and
- Creative outputs, which include: Creative intangibles, creative goods and services and online creativity.

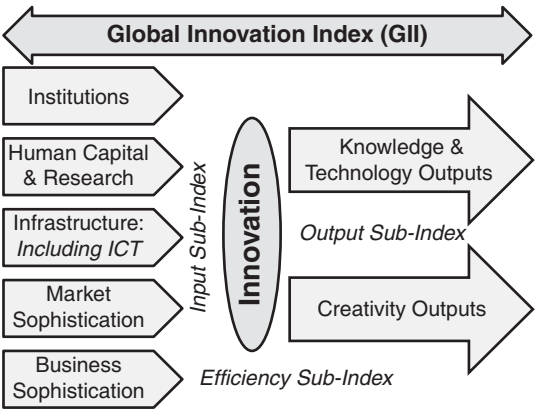


FIGURE 1: THE ‘BASIC DIMENSIONS’ OF THE ‘GLOBAL INNOVATION INDEX: GII’ (AFTER DUTTA, 2012)

The issues associated with these will be called here the ‘GII knowledge issues.’

TABLE 1: THE STRUCTURE OF THE GLOBAL INNOVATION INDEX (GII)

Innovation input sub-index					Innovation output sub-index	
Institutions	Human capital & research	Infrastructure	Market sophistication	Business sophistication	Knowledge & tech. outputs	Creative outputs
Political environment	Education	ICT	Credit	Knowledge workers	Knowledge creation	Creative intangibles
Regulator environment	Tertiary education	General infrastructure	Investment	Innovation linkages	Knowledge impact	Creative goods & services
Business environment	Research & development	Ecological sustainability	Trade & competition	Knowledge absorption	Knowledge diffusion	Online creativity

Innovation efficiency sub-index = (output/input).

The presented work

This paper considers the above knowledge issues as the core of innovation; and it provides an approach for their integrated assessment. It uses the approach to assess the state of Saudi Arabia in these issues relative to the state of countries enjoying distinct development. The selected countries include: Brazil and Russia, the two BRIC countries (also include: India and China), which are considered to be at a similar stage of newly advanced economic development; and they also include: Malaysia and South Korea, which are among the fast developing countries of Asia. From this assessment, it derives conclusions and recommendations on the requirements of the future development of Saudi Arabia.

ASSESSMENT APPROACH

This section is concerned with presenting an approach to assess the GII knowledge issues in an integrated manner. It presents the principles upon which the approach is based; and it describes related issues.

Approach principles

The assessment approach considered is based on two main principles. The first is concerned with restructuring the GII knowledge issues into layers in order to emphasize their integrated nature. This would illustrate how the various components of the knowledge layers are correlated. The second principle is associated with reconsidering the GII ranking system in favor of the decimal ranking system provided by the World Bank for the

indicators of the Knowledge Assessment Method (KAM) (KAM, 2012). In this way the ranking reference value will be ‘10’ instead of being the numbers of assessed countries. The knowledge layers and their related issues are described in the following, together with the decimal ranking system.

The knowledge layers

Figure 2 structures the GII knowledge issues into layers; and these layers are described in the following.

The base layer is concerned with *people* who are the knowledge manipulators. It consists the knowledge issues of the GII Human Capital and Research, which include the following (Dutta, 2012):

- General education issues, which involves: Expenditures; school life expectancy; the state of reading, mathematics and science; in addition to the teacher–student ratio in secondary education.
- Tertiary education issues, which involves: Enrollment including inbound, outbound and total; in addition to science and engineering graduates.
- Research and development including: Number of researchers; expenditures; and the quality of research institutions.

The layer above is concerned with the *tools* that enable people to easily access, process and share knowledge in all fields. These of course are associated with the GII issues of ICT, which include the following (Dutta, 2012):

- Access to ICT, involving: Access to fixed and mobile telephones; computers; and the Internet.
- Use of ICT, including: Use of the Internet; and use of the fixed and mobile broadband.
- Government online services concerned with both: The delivery of the main services, and their level of development.
- Online e-participation including: Online quality of connections, information sharing, consultation and decision making.

The third layer is associated with knowledge in practice that is in *business*, and this is concerned

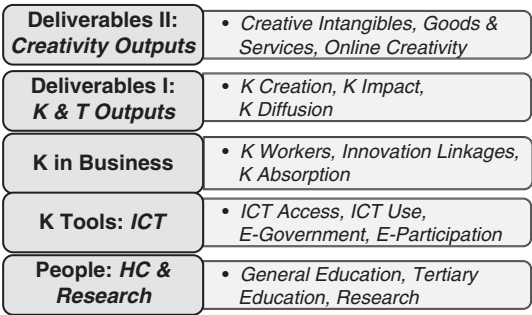


FIGURE 2: THE ‘KNOWLEDGE LAYERS’ OF THE ‘GLOBAL INNOVATION INDEX: GII’ (AFTER DUTTA, 2012)

with GII business sophistication issues, which include the following:

- Knowledge workers issues, involving: Employment in knowledge intensive services; training firms; research in business; in addition to graduate studies in management.
- Innovation linkages, including: University–industry research collaboration; cluster development that is development through groups of firms in different geographical areas; external funding of research; joint venture activities; and sharing of patents with foreign inventors.
- Knowledge absorption, involving: Royalty and licenses payments; imports of high-tech and computer and communications services; and the net inflows of foreign investment.

The next layer is related to *knowledge deliverables*, and these include the GII knowledge and technology outputs, which involves the following:

- Knowledge creation, including: National and international patents and utility models; and scientific and technical articles.
- Knowledge impact, which involves: Labor productivity; business registrations; computer software spending; and ISO quality certificates.
- Knowledge diffusion, including: Royalty and licenses receipts; exports of high-tech and computer and communications services; and outflows of foreign investment.

The top layer is concerned with an *advanced step* of knowledge deliverables, and these include the GII creativity outputs, which include the following:

- Creative intangibles, including: National and international trademark registrations; and the

creation of ICT-based business and organizational models.

- Creative goods and services, which involves: Recreation and cultural consumption; national production of feature films; circulation of newspapers; and exports of creative goods and services.
- Online creativity, including: Global and national Internet domains; and Wikipedia edits and You Tube uploads.

Decimal assessment

Ranking the various issues of GII provides a relative view of the state of a country with regards to these issues. GII in its 2012 report (Bakry & Al-Ghamdi, 2011) has ranked ‘141 countries.’ For each country, the report provides a rank in the range ‘1–141’ for every GII component. A ranking method that transforms the rank into a decimal number has been used by the World Bank in its KAM (KAM, 2012).

The method of transforming a rank into a decimal number is given in Table 2 in five steps. The value ‘10’ in this ranking means that the actual rank of the country is ‘1.’ The value ‘6.5’ means that the country is ahead of ‘65%’ of assessed countries; while ‘35%’ of the countries are ahead of it.

Using the approach for assessing the knowledge layers of Saudi Arabia and other countries of distinct development is given in the following investigation section.

INVESTIGATIONS

The state of Saudi Arabia in the knowledge layers of innovation is investigated here and compared with other countries that enjoy distinct development. The countries are first identified; and this is followed by providing the state of the knowledge layers in each of them using the data in the GII report of 2012 (Dutta, 2012). Observations and comments on the resulting differences relative to Saudi Arabia are also presented.

TABLE 2: FINDING THE RELATIVE RANK IN A DECIMAL FORM

Step	Action	Expression
(1)	Specify the number of countries considered	N
(2)	Find the value of the parameter concerned for all countries considered	$X[i]$, for $i = 1$ to N
(3)	Sort the countries according to parameter value	$X[i = 1]$: Highest $X[i = N]$: Lowest
(4)	Find the rank of the country considered	$i = K$
(5)	Find the relative rank in decimal form	$D = 10 \times (1 - ((K - 1)/N))$

The countries considered

The countries considered for comparison with Saudi Arabia include the following:

- Brazil and Russia, which are two of the BRIC countries that also include: India and China; and of the BRICS that add South Africa. These countries are considered to be at a similar stage of newly advanced economic development (Malaysia and South Korea, 2012).
- Malaysia and South Korea, which are among the Asian countries distinguished for their economic performance (Oslo Manual, 2012).

These countries, together with Saudi Arabia, are identified in Figure 3 in terms of their population, and their GDP per capita. The GDP per capita is given in US\$ ‘purchasing power parity (PPP),’ which is based on an economic theory used to determine the relative *value* of the US\$ in different countries (PPP, 2012).

The state of knowledge layers

The state of the main issues, and of the total, of each of the five knowledge layers for Saudi Arabia, and for the other four countries, is given in Figures 4 through 8 organized according the layered architecture of Figure 2. The given values are based on the decimal ranking system of Table 2 using the data provided by the GII report of 2012. Observations and comments on these Figures are given here in two stages: Saudi Arabia versus Brazil and Russia and Saudi Arabia versus Malaysia and South Korea.

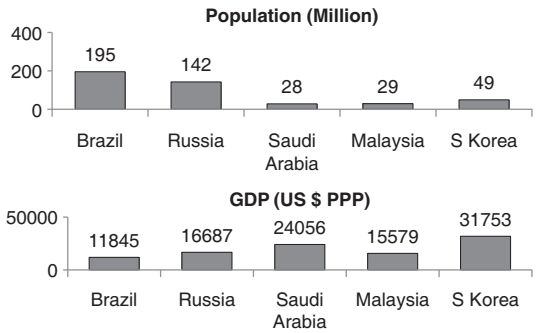


FIGURE 3: POPULATION AND GDP OF THE COUNTRIES CONSIDERED: SAUDI ARABIA, BRAZIL, RUSSIA, MALAYSIA & SOUTH KOREA

Saudi Arabia versus Brazil & Russia

In terms of population Brazil and Russia are much higher than Saudi Arabia, but in terms of GDP per capita, Saudi Arabia is more than ‘twice’ that of Brazil, and ‘1.5 times’ that of Russia. With regards to the knowledge layers, here are some observations on each layer:

- For the *people’s* layer, Saudi Arabia is well ahead of both Brazil and Russia in general and tertiary, but much less in research and development.
- Concerning the knowledge *tools’* layer (ICT), Saudi Arabia and both Brazil and Russia enjoy close states in ICT access and use, and in e-government and e-participation. The only exception is that Brazil is relatively lower in ICT access.
- Regarding knowledge in the *business* layer, Saudi Arabia has a slightly better overall state than both Brazil and Russia, and has a superior state with regards to innovation linkages issues where Russia is poor. However, Saudi Arabia

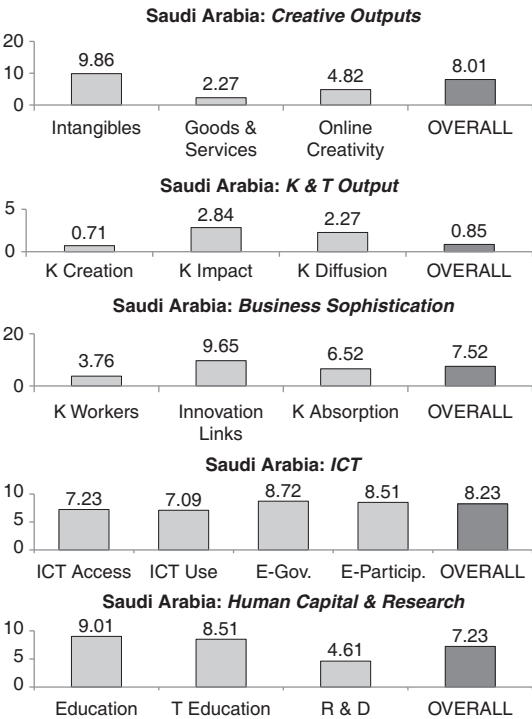


FIGURE 4: THE STATE OF THE KNOWLEDGE LAYERS IN SAUDI ARABIA

has an apparent problem with regards to knowledge workers.

- In the knowledge *delivery (I)* layer, that is the knowledge and technology outputs, Saudi Arabia faces problems in all issues: Knowledge creation, knowledge impact and knowledge diffusion. The most sever of them is in knowledge creation. Russia is relatively ahead of Brazil, but both are much ahead of Saudi Arabia.
- In the knowledge *delivery (II)* layer concerned with creative outputs, Saudi Arabia is well ahead of both Brazil and Russia in the main issue of creative intangibles, where brazil is lower and Russia is worst. However, Saudi Arabia face a problem in online creativity and a more sever one in creative goods and services.

Saudi Arabia versus Malaysia & South Korea

Malaysia is very close to Saudi Arabia in terms of population, but its GDP per capita is around

two-thirds; while South Korea is around ‘double’ in population, and around ‘1.3 times’ in GDP per capita. Observations on the relative states of the issues of the knowledge layers are presented in the following, aiming at complementing the above ones.

- Considering the *people’s* layer, Saudi Arabia is ahead of both Malaysia and South Korea in general education; but it is behind in tertiary education, and much less in research and development.
- For the knowledge *tools’* layer (ICT), Saudi Arabia is ahead of Malaysia in all ICT issues. However, South Korea is ahead in all issues, and it is number 1 in the world in the overall ICT sub-index.
- Regarding the layer of knowledge in *business*, Saudi Arabia remains much behind with regards to knowledge workers; but it also remains superior with regards to innovation linkages, where

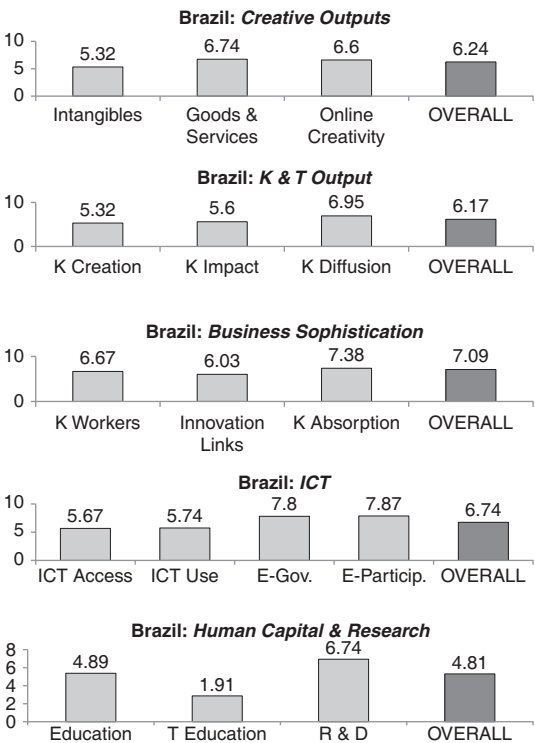


FIGURE 5: THE STATE OF THE KNOWLEDGE LAYERS IN BRAZIL

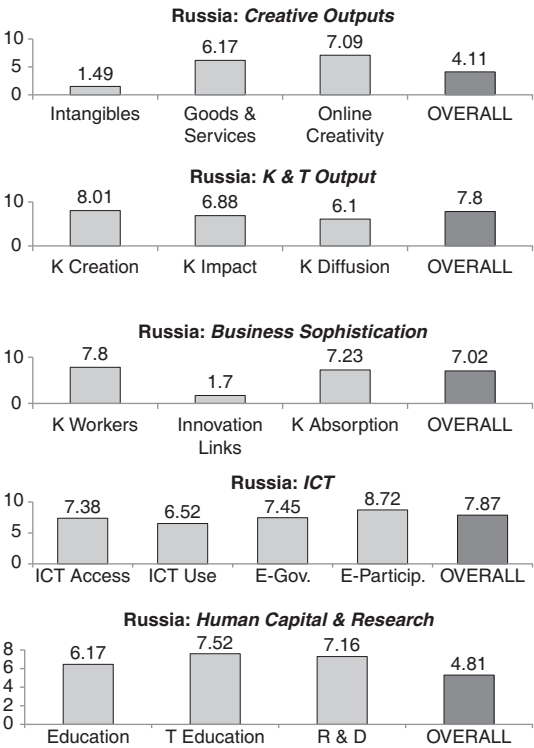


FIGURE 6: THE STATE OF THE KNOWLEDGE LAYERS IN RUSSIA

South Korea is relatively poor. Malaysia enjoys the highest overall score in this layer.

- In the knowledge *delivery (I)* layer that is knowledge and technology outputs, both Malaysia and South Korea are ahead of Saudi Arabia, which faces problems in all issues of the layer.
- In the knowledge *delivery (II)* layer concerned with creative outputs, Saudi Arabia is ahead of both Malaysia and South Korea in the main issue of creative intangibles, where South Korea is relatively poor. However, the state of Saudi Arabia in online creativity and in creative goods and services is lowest.

The above observations are used in the following for drawing conclusions and providing recommendations.

CONCLUSIONS AND RECOMMENDATIONS

This paper has emphasized the issues that are directly associated with knowledge in the GII. It

has re-structured them into five layers in order to illustrate their interrelationships and integration. For these layers, the paper has also transformed the GII ranking into the decimal ranking form used by KAM, in order to ease assessments. Using the layered architecture of the knowledge issues together with the decimal ranking form, the paper has investigated the state of the knowledge layers in Saudi Arabia relative to countries that enjoy distinct development experience.

The results obtained showed that Saudi Arabia is relatively in good shape in various knowledge issues, similar or even better than the distinguished countries considered. These issues involve: Education; knowledge tools, including ICT access and use, e-government, and e-participation; innovation linkages and knowledge absorption; and creative intangibles. However, the results also showed that Saudi Arabia is relatively weak in various other knowledge issues. Therefore, it is recommended

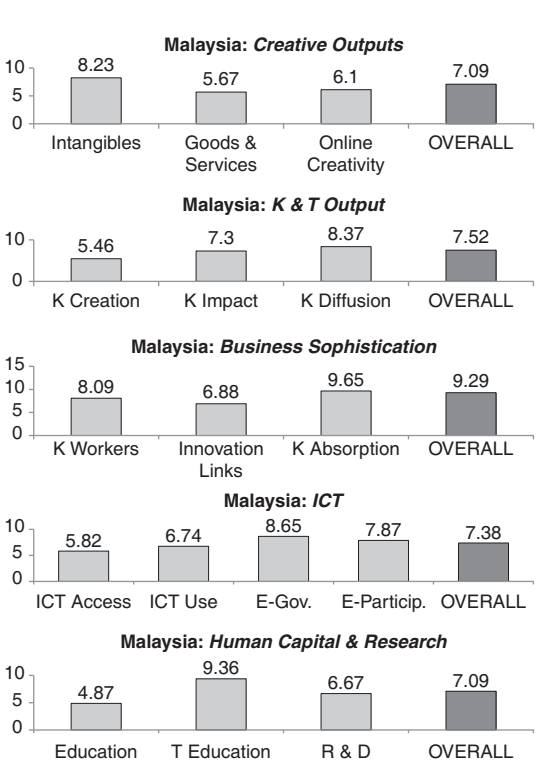


FIGURE 7: THE STATE OF THE KNOWLEDGE LAYERS IN MALAYSIA

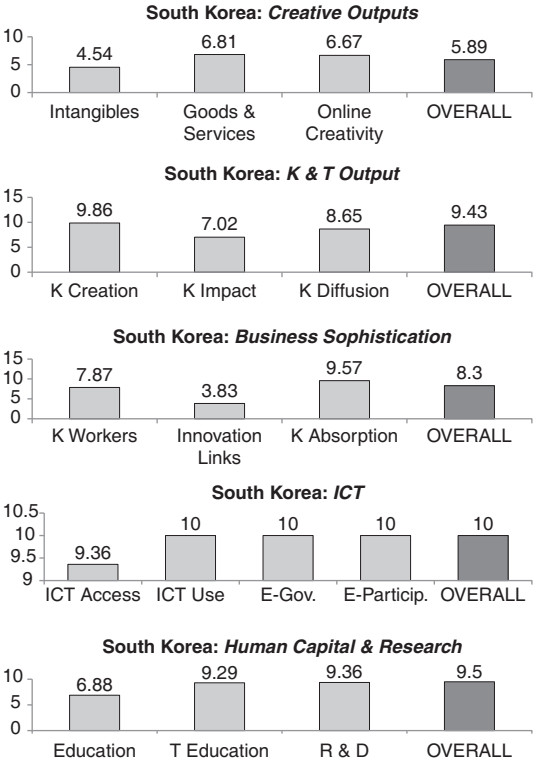


FIGURE 8: THE STATE OF THE KNOWLEDGE LAYERS IN SOUTH KOREA

that these knowledge issues should be given priority attention in the future Saudi national development plans. They include the following issues:

- Research and development, especially in knowledge fields that contribute to providing needed knowledge workers and knowledge deliverables of the upper knowledge layers;
- Knowledge workers issues of the knowledge in business layer, including: Employment in knowledge intensive services; training firms; research in business; in addition to graduate studies in management;
- All the issues of delivery layer (I) that is knowledge and technology outputs, which include: Knowledge creation, knowledge impact, and knowledge diffusion issues.
- Creative goods and services and online creativity issues of the delivery layer (II) concerned with creative outputs.

It should be noted that while national development should emphasize the above priority issues, they should not neglect the other issues, in order to achieve consistent and comprehensive development. It should also be noted that the priority issues are mainly associated with the upper layers. In addition, attention to the only problem of the lower layers that is research and development can contribute to solving the problems of the upper innovation delivery layers.

While the current main generator of wealth in Saudi Arabia is oil, the future main generator of wealth in the country should be knowledge. Since knowledge is people, Saudi Arabia spending on education exceeds that of all other distinguished countries considered. However, the knowledge delivery state in the country is still generally below expectations relative to the other countries considered, and relative to spending on education. What is perhaps needed is building

the knowledge culture in the country, in order to promote people's drive toward knowledge generation and innovation and toward making efficient utilization of the newer knowledge.

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REFERENCES

- Bakry, S. H. (2009). *The ecosystem of the knowledge society* (in Arabic). Riyadh, Saudi Arabia: King Saud University Knowledge Society Program.
- Bakry, S. H., & Alfantoukh, A. (2010, January–March). Toward building the knowledge culture. *International Journal of Knowledge Society Research*, 1(1), 46–64.
- Bakry, S. H., & Al-Ghamdi, A. (2011, January–March). Cultural pluralism in the context of the knowledge society ecosystem: Reviews and views. *International Journal of Knowledge Society Research*, 2(1), 71–84.
- BRIC. (2012). Retrieved from <http://en.wikipedia.org/wiki/BRIC>
- Dutta, S. (Ed.). (2012). *The global innovation index (GII) 2012: Stronger innovation linkages for global growth*. INSEAD and WIPO. Fontainebleau, France: INSEAD.
- KAM. (2012). *KAM: The knowledge assessment method*. The World Bank. Retrieved from www.worldbank.org/kam
- Malaysia and South Korea. (2012). Retrieved from http://en.wikipedia.org/wiki/Malaysia%E2%80%93South_Korea_relations
- Oslo Manual. (2012, December). *Proposed guidelines for collecting and interpreting technological innovation data*. Retrieved from www.oecd.org
- PPP. (2012, December). *PPP: Purchasing power parity*. Retrieved from http://en.wikipedia.org/wiki/Purchasing_power_parity

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