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# Performance Analysis of Nigeria'n Global Innovation Index (GII)

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**Abstract**

Today, developed countries like some of the European countries, USA and Japan limit most of the innovations but developing countries are still behind in the field of innovation and management of technology. On the other hand, it is also being considered seriously to achieve certain advancement of technology by the developing countries. The obstacles encountered by developing countries are low education level and lack of world-class research universities, poor business models, political instability, physical infrastructure, and lack of compact technology based on trained human resources are admitted. Nigeria was selected as a sample for this study which presents the issues and challenges in innovation and technology management in the country and comes up with proposed solutions. Theoretical and conceptual framework analysis was provided for managing innovation and technology by this research. The work relates between competitiveness, sustainability and innovation, primarily targeting at socio-economic level in Nigeria.

**Keywords**: innovation, competitiveness, Nigeria, technology

## 1. Introduction

Innovation is known both a key element of a nation's competitiveness (Schumpeter 1942; Penrose, 1959; Hall & Soskice, 2001) and a key element of company performance (Mone, McKinley & Barker, 1998). According to Schumpeter, innovation is doing things in a different way: can be a new good or a new quality of a good; a new method of production; a new market; a new source of supply; or a new organizational structure. After Schumpeter (1942) that innovation is considered

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both an element of a nation competitiveness leading to the opportunity to study possible relationships with sustainability and competitiveness.

Zadek (2006) and others have discussed how "Corporate Social Responsibility" can encourage innovation at a macro level. Likewise, improved stakeholder relations can encourage joint opportunities leading to further innovation and shared value (Porter & Kramer, 2011). Innovation is an important factor guiding the economic activities throughout the world by increasing the productivity and the competitive power, thus leading to economic growth. There are innovative ideas behind many developments that improves daily lives. The owners of these ideas have been the countries supporting the innovative activities, investing more in R&D activities and the productive research facilities, and establishing effective innovation systems. Such countries also have taken huge steps towards improvements in socio-economics dimension (Can and Sagbansua 2014).

The innovation process and technology management are evolving field in the developing-world companies. Companies in developing countries having cutting-edge technology don't have often detailed idea or knowledge about the essential technology. To handle any kind of technical tools and equipment, production or selection of any appropriate technology, at least basic education is crucial and continuous human resource development can play an important role in this regard. Education levels in the developing countries are very low (Aubert, 2004).

Rixse (1978) noted that in the pre-industrial phase, educational needs demand only basic literacy while in post-industrial phase, more technical, professional skills are required. What is the source of new idea or new technology, definitely, one of the answers is educational institutions? The world top universities belong to developed world. If we see in the world ranking of top 100 universities, only 3% universities belong to developing countries and remaining 97% world top ranking universities belong to developed countries (North America: 44%, Europe: 34%, Asia: 19%). The academies of these top ranked universities have also strong affiliations with entrepreneurs and most of the academies are also entrepreneurs by themselves. Most of the developing countries engineers, those graduated from the U.S or European universities on returning to their countries approach their responsibilities in their own country seeking to transfer

what they have learned to their own home environment. These engineers have no idea how to approach in their own country's technical, social and cultural environment.

According to Salimuddin (2004) innovation and technology at grass root level in developing countries is a new emerging attention. These innovations may not be commercialized at global level, but these can be new sources of innovation at national level. The real problem is to recognize, objectify and patent these innovations and then to commercialize it at national level. Due to limited resources, the research and development R&D environment is also not so conducive. Research in these countries is limited to publications and to develop linkages with industries and business world is very poor. In the case of developing countries as indicated in literature, Nigeria's institutions of higher learning are very much left behind in the area of research and innovation (Can et al, 2018). And most of the developing countries are very poor in developing innovation policies. The case of South Korea and Singapore proved that the government role in supporting business environment and developing new technology is very significant.

In EU and OECD literature, innovation is described as: "transforming an idea into a marketable product or service, a new or improved production or distribution method or a new method of society service". Innovation also means the new or improved product, service or method at the end of this transformation process. Innovation has technologic and organizational dimensions. In the organization level, networking and cooperation between companies has become even more important from the competitive power point of view. Moreover, intrafirm organizational innovations can play a significant role towards increasing the competitive power through technological changes (Can and Sagbansua 2015). The European Commission has defined competitiveness at the macro-economic level 'as a sustained rise in the standards of living' (EC, 2008, pp. 15). Consequently, to Aiginger (2006) based on literature review, country competitiveness can be defined as 'the ability of a country or location to create welfare', which incorporates both an outcome of competitiveness and the analysis of factors that produce the outcome. The competitiveness also incorporates a benchmark for comparing the performance as it is the case of the IMD (2014) World Competitiveness Yearbook, which is available since 1989 as one of the most recognized survey studies on nation competitiveness. It ranks countries according

to their ability to attain economic prosperity. This index was used in this wok to measure the competitiveness of a country.

The Global Innovation Index 2019 is issued by Cornell University, INSEAD, and WIPO is widely used to measure countries innovation scoring. The model includes eighty (80) indicators, which fall within the following three categories: fifty-seven (57) variables of hard data, eighteen (18) composite indicators from international agencies and five (5) survey questions from the World Economic Forum's Executive Opinion Survey (EOS).

## 2. Global Innovation Index (GII) and Competitiveness Index Performance of Selected Countries

The Global Innovation Index report analyzes global innovation trends and the performance of approximately 130 economies every year. The GII has fostered national innovation strategies and international debates on innovation in three main ways for more than a decade. First, the GII helps place innovation firmly on the map for countries, particularly for low- and middle-income economies. Second, the GII allows countries to assess the relative performance of their national innovation system. A significant number of countries work hard to "unpack their GII innovation ranking" and to analyze their innovation strengths and weaknesses. These findings then inform innovation policies and actions. Third, the GII provides a strong motivation for countries to collect fitting innovation metrics (WIPO, 2019). The Global Innovation Index (GII) project was launched by Professor Dutta in 2007 during his tenure at INSEAD. The goal was to find and determine metrics and methods that could better capture the richness of innovation in society, going beyond the traditional measures of innovation such as the number of research articles and the level of research and development (R&D) expenditures. There were several motivations for setting this goal. First, innovation is important for driving economic progress and competitiveness, both for developed and developing economies. Many governments are putting innovation at the center of their growth strategies. Second, the definition of innovation has broadened, and it is no longer restricted to R&D laboratories and to published scientific papers. Innovation could be and is more general and horizontal in nature, including social, business model, and technical innovation. Last,

but foremost, recognizing and celebrating innovation in emerging markets is critical for inspiring people, especially the next generation of entrepreneurs and innovators.

The GII ranking during the 2015-2019 years of top 10 countries are presented in Table 2.1. Given table shows that since 2015, Switzerland has ranked 1st in the GII every year. While Germany re-entered the top 10 in 2016. The Netherlands entered the top 3 in 2017. Sweden maintained 2nd position for the second time. In 2018, Singapore makes it to the top 5 of the GII. Israel enters the top 10 for the first time in 2019. The eight out of ten countries that have maintained their positions in top 10 are Switzerland, UK, Sweden, Netherlands, USA, Finland, Singapore, and Denmark. Table 2.1 below indicates that out of the maintained in top 10 countries six are European along with USA and Singapore.

**Table 2.1. (2015 - 2019) Trend in the GII of top 10 countries**

| Rank | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| 1 | Switzerland | Switzerland | Switzerland | Switzerland | Switzerland |
| 2 | UK | Sweden | Sweden | Netherlands | Sweden |
| 3 | Sweden | UK | Netherlands | Sweden | USA |
| 4 | Netherlands | USA | USA | UK | Netherlands |
| 5 | USA | Finland | UK | Singapore | UK |
| 6 | Finland | Singapore | Denmark | USA | Finland |
| 7 | Singapore | Ireland | Singapore | Finland | Denmark |
| 8 | Ireland | Denmark | Finland | Denmark | Singapore |
| 9 | Luxembourg | Netherlands | Germany | Germany | Germany |
| 10 | Denmark | Germany | Ireland | Ireland | Israel |

Austria, Luxembourg, Belgium, and France are described as the "Innovation Followers". The innovation performance of these countries is lower than the innovation leaders' but higher than the average of the EU. The fastest developing country in terms of innovation performance in this group is Ireland.

**Table 2.2. (2016-2019) Trend in the competitiveness of top 10 countries**

| Rank | 2016-2017 | 2017-2018 | 2019 |
|---|---|---|---|
| 1 | Switzerland | Switzerland | Singapore |
| 2 | Singapore | USA | USA |
| 3 | USA | Singapore | Hong Kong |
| 4 | Netherlands | Netherlands | Netherlands |
| 5 | Germany | Germany | Switzerland |
| 6 | Sweden | Hong Kong | Japan |
| 7 | UK | Sweden | Germany |
| 8 | Japan | UK | Sweden |
| 9 | Hong Kong | Japan | UK |
| 10 | Finland | Finland | Denmark |

As it can be seen in Table 2.2 which contains the components to calculate Global Competitiveness Index between 2016-2019 nine countries; Switzerland, Singapore, USA, Netherlands, Germany, Sweden, UK, Japan, and Hong Kong have maintained their positions in top 10 of the list. Finland has been in top ten for the 2016-2018 years while Denmark replaced it in 2019. From the listed top 10 countries six out of ten are European countries (Schwab, 2019).

When the considered period of time deeply analyzed, it is seen that the innovation capacity, which is composed of the quality of scientific research institutions, R & D expenditures of corporate sectors, university-industry collaboration in R & D, the public's purchasing policy for advanced technologies, the presence of scientists and engineers, patents and intellectual property rights protection, has increased five steps and taken the 50th place in the 2016-2019 report compared to the previous year (Schwab, 2016, 2017, 2018).

## 3. Innovation Performance of Nigeria

According to Can and Maigari (2019), after prolonged foot dragging by the strongest economy in the continent, on 7 July 2019 at the 12$^{th}$ Extraordinary Session of African Union on African Continental Free Trade Agreement was signed by Nigeria. This Agreement will bring together all 55 member states of the African Union covering a market of more than 1.2 billion people, including a growing middle class, and a combined gross domestic product (GDP) of more than US$3.4

trillion. It is expected that this agreement will foster better positions of innovation and competitiveness of continent in the global economy. In Nigeria, most firms introduce innovations through information gotten by their interaction with market sources such as clients and suppliers while knowledge sources like universities and research institutes constitute the least source of information for innovation (Egbetokun, 2010; Jegede et al., 2012).

This chapter mainly focuses on analysis of Nigerian innovation performance. Firstly, the rank of Nigeria in Global innovation index will be analyzed. After that Institutional framework of an economy in Nigeria will be reflected. The analysis of Human Capital & Research framework of an economy in Nigeria will follow subsequently. Finally, Knowledge & Technology Outputs framework of an economy in Nigeria will be presented.

**Table 3.1 The overall Global Innovation Index (GII) rank for Nigeria.**

| | **2018** | **2019** |
|---|---|---|
| **GII rank** | 118 | 114 |
| **Income** | Lower-middle | Lower middle |
| **Region** | SSF | SSF |
| **Population (mn)** | 190.9 | 195.9 |
| **GDP, PPP$** | 1,118.4 | 1,169.1 |
| **GDP per capita, PPP$** | 5,929.2 | 6,027.2 |

As Table 3.1 indicates in 2018 and 2019 by GII Nigerian rank increased from 118$^{th}$ to 114$^{th}$ respectively. Stability in income level was maintained as lower level category. GDP PPP which was 1,118.4 in 2018 has slightly increased to 1,169.1 in 2019. And finally, an increase in GDP per capita, PPP$ can be seen in the values of 2019.

**Table 3.2 Institutional framework of an economy in Nigeria**

| | **2018** | | **2019** | |
|---|---|---|---|---|
| | Score/Value | Rank | Score/Value | Rank |
| **INSTITUTIONS** | 44.7 | 119 | 49.3 | 114 |
| **Political environment** | 19.4 | 125 | **30.7** | **126** |
| Political and operational stability | 21.7 | 122 | 23.3 | 125 |
| Government effectiveness | 18.2 | 123 | 18.2 | 122 |
| **Regulatory environment** | 58.9 | 81 | **60.4** | 81 |
| Regulatory quality | 20.5 | 117 | 23.5 | 121 |

| | | | | |
|---|---|---|---|---|
| Rule of law | 15 | 118 | **56.7** | 117 |
| Cost of redundancy dismissal, salary weeks | 8 | 1 | 45.6 | 1 |
| **Business environment** | 55.7 | 111 | 8.0 | 113 |
| Ease of starting a business | 80.8 | 98 | 83.0 | 92 |
| Ease of resolving insolvency | 30.6 | 114 | 30.4 | 119 |

An institutional framework that appeals business and encourages growth by providing good governance and the correct levels of protection along with incentives is essential to innovation. The institutional framework of an economy in Nigeria which is captured by the Institutions section is presented in Table 3.2. It gives values mainly for political, regulatory and business environments.

According to Table 3.2 GII Nigerian ranking for Institutional framework of an economy in the country an increase from 119$^{th}$ to 114$^{th}$ is observed for 2018 and 2019 respectively. Indicators for political and business environment scores show a decrease while a constant value is seen in regulatory score for the last two years.

Research & Development and technology innovations have been showed to positively associate with profitability in developed countries, though, in most instances, these investments take time to appreciate (Hanel and St-Pierre, 2002; Roper et al., 2006). For example, Hanel and St-Pierre (2002) found out that R&D investment has a positive impact on profitability, especially in sectors with noteworthy levels of patent protection. Similarly, in a study using Irish panel data, Love et al. (2009) exposed that product innovation is more vital for less profitable firms. Also, Klette and Kortum (2004) noticed a positive correlation between R&D intensity and productivity across firms.

In the GII index human capital and research indicates that standard of education and research activity in an economy are prime determinants of the innovation capacity of a nation. This section tries to measure the human capital of economies. The first sub-section includes a mix of indicators aimed at capturing achievements at the elementary and secondary education levels. Education expenditure and school life expectancy are good proxies for coverage. Government funding per

pupil, secondary, gives a sense of the level of priority given to secondary education by the state (excluding funding from abroad).

**Table 3.3 Human Capital & Research framework of an economy in Nigeria**

| | 2018 | | 2019 | |
|---|---|---|---|---|
| | Score/Value | Rank | Score/Value | Rank |
| **HUMAN CAPITAL & RESEARCH** | 12.9 | [116] | **11.3** | **119** |
| **Education…** | 29.5 | [109] | 26.4 | **[114]** |
| School life expectancy, years | 8.7 | 108 | 8.7 | 113 |
| Pupil-teacher ratio, secondary | 23.2 | 91 | 23.2 | 94 |
| **Tertiary education** | 7.8 | [110] | **7.5** | **[114]** |
| Tertiary enrolment, % gross | 10.2 | 102 | 10.2 | 107 |
| **Research & development (R&D** | 1.3 | 103 | **0.0** | **[120]** |
| Researchers, FTE/mn pop | 38.6 | 94 | n/a | n/a |
| Gross expenditure on R&D, % GDP | 0.2 | 88 | n/a | n/a |
| Global R&D companies, avg. exp. top 3, mn US$ | 0 | 40 | 0.0 | 43 |
| QS university ranking, average score top 3 | 0 | 78 | 0.0 | 78 |

In the GII index knowledge and technology outputs indicates that covers all those variables that are conventionally thought to be the results of inventions and/or innovations. The first sub-section refers to the creation of knowledge. It includes five indicators that are the result of inventive and innovative activities: patent applications filed by residents both at the national patent office and at the international level through the PCT; utility model applications filed by residents at the national office; scientific and technical published articles in peer-reviewed journals; and an economy's number of articles (H) that have received at least H citations. The second sub-section, on Knowledge impact, includes statistics representing the impact of innovation activities at the micro- and macro-economic level or related proxies.

As Table 3.3 presents the GII index for human capital and research which includes education, tertiary education and research & development sections Nigeria has experienced decrease three steps down. Besides research & development which was at 103 it changed dramatically to 120$^{th}$ rank, education's rank dropped from 109 to 114. Finally, tertiary education showed also decrease from 110 to 114$^{th}$ ranks respectively.

**Table 3.4 Knowledge & Technology Outputs framework of an economy in Nigeria**

| | 2018 | | 2019 | |
|---|---|---|---|---|
| | Score/Value | Rank | Score/Value | Rank |
| **KNOWLEDGE & TECHNOLOGY OUTPUTS** | 10.3 | 119 | **14.0** | **106** |
| **Knowledge creation** | 3.5 | 111 | **5.0** | **99** |
| Patents by origin/bn PPP$ GDP | 0.1 | 118 | **0.1** | **119** |
| PCT patents by origin/bn PPP$ GDP | 0 | 106 | **0.0** | **98** |
| Scientific & technical articles/bn PPP$ GDP | 1.7 | 115 | **1.8** | **115** |
| Citable documents H-index | 10.1 | 62 | **10.3** | **65** |
| **Knowledge impact** | 13.8 | 113 | **26.9** | **102** |
| Growth rate of PPP$ GDP/worker, % | 7.7 | 110 | **-0.1** | **91** |
| New businesses/th pop. 15-64 | 0.8 | 78 | **0.8** | **78** |
| Computer software spending, % GDP | 0.1 | 82 | **0.1** | **83** |
| ISO 9001 quality certificates/bn PPP$ GDP | 0.2 | 123 | **0.2** | **126** |
| **Knowledge diffusion** | 13.4 | 104 | **10.1** | **101** |
| High-tech net exports, % total trade | 0 | 121 | 0.0 | 122 |
| ICT services exports, % total trade | 0.3 | 112 | 0.6 | 99 |
| FDI net outflows, % GDP | 0.3 | 78 | 0.3 | 79 |

In the GII index knowledge and technology outputs indicates that knowledge dissemination, mirrors the Knowledge engagement sub-section of section 5. It includes four statistics all linked to sectors with high-tech content or that are key to innovation: intellectual property receipts as a percentage of total trade (three-year average); high-tech net exports as a percentage of total exports; exports of ICT services as a percentage of total trade; and net outflows of FDI as a percentage of GDP (three-year average).

Table 3.4 presents the GII index for Knowledge & Technology Outputs framework of an economy in Nigeria. The three sections which are available in the given table; knowledge creation, knowledge impact and knowledge diffusion. Nigerian performance according to the given time progressed from 119 to 106. Knowledge creation contributed from 111 to 99 rank. In 2018 knowledge impact was ranked 113 which has changed to 102 in 2019. A slight change was in knowledge diffusion from 2018 to 2019.

## 4. Conclusion

In this paper, an effort has been made to point out key problems in innovation and technology management in Nigeria, which requires thorough investigation. Most of the innovations are limited to developed countries such as the ones in top 10 countries in GII and competitiveness index. Developing countries like Nigeria are still dependent on developed world technology. From the experience of Nigeria, it is suggested that developing countries have strong potential for innovation and technology management. But the challenge is how to approach the issues faced by developing countries. The existence of chief technology management component, developed infrastructure, expansion in coordination and linkages between educational institutions and business world are only part of indicators of innovation and technology management. The latter also requires up gradation of knowledge and skills in the context of country's specific technical, cultural and social environment.

The Nigerian government would also take initiatives for upgrading of existing infrastructure and development of new infrastructure. In fact, innovation is often born out of the combination of original knowledge with technological and organizational inputs from developed countries. There is a need for all engineers in Nigeria to be trained toward meeting specific developing countries, issues and problems, whether qualified in the U.S, European or their own country. The core sectors need to be identified and arranged for R&D.

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