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Research Output and Sustainable Development: Webometric Analysis of Scopus Indexed Publications 2008 -2014

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RESEARCH OUTPUT AND SUSTAINABLE DEVELOPMENT: WEBOMETRIC ANALYSIS OF SCOPUS INDEXED PUBLICATIONS 2008 -2014

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Abstract

The study evaluated research output indexed by Scopus between 2008 and 2014 in the month of April 2015. It assessed the quantity of research publication within the period, top ten published universities, fields, journals and their impact factors, cited authors, and top ten published countries. This was with a view to determining author relevance, institutional priority, the extent of sustainable development in the fields and host countries. Findings revealed that Li, Wei, of Harbin Institute of Technology China, Wang, Wei of Beijing University of Chemical Technology (BUCT) China, Zhang, Wei of Tsinghua University China, and Li, Hui Technische University Berlin, Germany were foremost among others during the period and their institutions and countries had more publications. Therefore, it is recommended that scholars, universities, and other institutions of higher learning especially in the developing nations should emulate these few to realize the yearnings of the world (sustainable global development).

Keywords: Webometrics, Research output, Sustainable development, Research Impact, China

1. BACKGROUND

Research is paramount in a university apart from teaching and learning because of its unique characteristics and numerous benefits to both its immediate university community, society and the world at large. Meaningful development in societies and continents have emanated from the stable of research output. Thus any nation that desires sustainable development must encourage and engage its academia in quality research. In essence, the quality and level of development in a society is directly or indirectly dependent on the quality and level of research carried out by stakeholders. In Developed nations, researches are continually being sponsored and carried out and results communicated to appropriate quarters for use. Thus research outcomes are veritable instruments in the hands of policy makers, inventors, entrepreneurs, including any other facet of life and more importantly they are used for ranking institutions. The quality and quantity of research outcomes of a university cannot be traded for any other activity due to the prestige, honour, and respect that it attracts to the institution (Popoola, 2008). Consequently, research outcomes are measured using different parameter in order to determine where nations, institutions, fields' etcetera stand in this sphere.

In addition to the benefits of research output for a nation, society and institution, it determines the growth of a profession as well as the individual researcher's productivity. Research outputs of a profession form new knowledge in the field thereby serving as literature and bases for further research. Also, local and international recognition and respect are determined by research outcomes that are published in books or journals, presented orally at conferences, workshops, and seminar or disseminated on the internet. In a bid to measure and evaluate research outputs properly, bibliometric tools are employed.

Biliometrics, sometimes called scientometrics is a quantitative technique for measuring and analyzing different aspect of literature in any field of study (Larivière, 2012). It is used for identifying the pattern and trend in publication, authorship and journal coverage to gain insight into the dynamics of growth of knowledge in the areas under consideration. This kind of quantitative analysis provides data on all activities in an area, summaries of these data, and a comprehensive perspective on the activities and achievements (Nkiko & Adetoro, 2007). Thus bibliometrics is the application of quantitative analysis and statistics to publications such as journal articles and their accompanying citation counts. Quantitative evaluation of publication and citation data is now used in almost all nations around the globe for research performance evaluation, especially in universities, government labs, by policymakers, research directors, administrators, information specialists and librarians, and researchers themselves.

1.1 Rationale for the Study

The importance of bibliometric evaluation cannot be overemphasized as it is vital for specific assessments and decision making in almost every facet of life. For instance, it is a very valuable instrument for measuring research activities of nations, institutions, fields and individuals. In the

same vein research determines efforts towards development of nations, industries, organisations, institutions, professions, fields of study etcetera. Nations like the United States of America, Israel, Japan, United Kingdom and a host of others that are referred to as developed are neck deep into research which is the hub for their developments. This automatically translates to mean that the nations regarded as underdeveloped are not towing enough, this path of research which is much required for development.

What then is the level of research efforts worldwide? Which institutions and countries rank tops based on Scopus record, in this regard? It is against this background that the researchers decided to carry out webometric analyses of research output of global universities from 2008 – 2014 using publication records available on Scopus. The study is analyzing data from Scopus because it is adjudged to be the largest indexing database and has been given the sole right for world ranking of universities and their research/ publication activities.

1.2 Objectives:

Bibliometrics have been widely accepted to be very useful for measuring a gamut of quantitative data in all fields of study thus the specific objectives of the study include the following to:

- ascertain the extent of research and publication within the period under study
- ascertain the most published universities and countries within the period
- ascertain the most published Field and document type within the period
- ascertain the top ten authors within the period under study
- ascertain the top ten Cited authors within the period
- ascertain the top ten publication outlets and their impact factors
- determine the relationship between the most published institution in a nation and the rate of development in the nation

2. LITERATURE REVIEW

2. 1 The Concept of Metrics

The term ‘metrics’ refers to a system or standard of measurement which has changed overtime with evolution in the society. Metrics comprises different instrument for systematic evaluation in all facet of life and can either be qualitative or quantitative. According to Abbott, Cyranoski, Maher, Schiermeier and Van-Noorden (2010) qualitative metrics include evaluation of countless hours spent on troubleshooting experiments, guiding students and postdocs, writing or reviewing grants and papers, teaching, preparing for and organizing meetings, participating in collaborations, advising colleagues, serving on editorial boards and more which are not easily quantified. Quantitative metrics on the other and as the name implies deals with a number of publications, publication in high impact journals and citations of published research (Lane, 2010). Some prominent quantitative metrics units include scientometrics, which covers science in general

without restriction to just publication, Infometrics, covers all information objects, Webometrics or cybermetrics cover web connections and activities via the use of biliometric techniques to study the relationship or properties of various sites on the web and biliometrics, among others. However, bibliometrics is most commonly used (Hussain, 2011).

Bibliometrics, is the application of mathematical and statistical analysis to books, journals, and other publications and their affiliates. According to Larivière (2012), it is the analysis of the characteristics of documents published by researchers. It measures aspects of literary works which include Journals counts, authors' publication output counts, article counts in different fields and from intuitions etc. It has been widely accepted to be very useful for tracking performance and are now used to quantify imprecise notions of scientific quality, impact or prestige. Bibliometrics, also known as citation analysis, is a method aimed at determining the importance and influence of peer-reviewed journals, journal articles and their authors by tracking citations, journal ranking etcetera (Iroaganachi, Itsekor & Osinulu, 2014). Avenues to evaluate the foregoing have greatly increased in recent times. Thus, several techniques have been developed which have attracted varied discourse about the strengths and weaknesses of each. Also, with the increase in online publication, emphasis on bibliometrics is fast shifting to webometrics, thus, there exist several studies on same presently.

2. 2 The Concept of Development

Gboyega (2003) defined development as an idea that embodies all attempts to improve the conditions of human existence in all ramifications. He explained that development implies improvement in material wellbeing of all citizens and not just the most powerful and rich alone, in a sustainable way such that today's consumption does not imperil the future, it also demands that poverty and inequality of access to the good things of life be removed or drastically reduced. In the same vain Todaro (1981) in Deepashree (2007, p. 16) opined that development is a multi-dimensional process involving reorganization, reorientation of entire economic and social system that translate to improvement of the quality of all human lives which include the following aspects:

- to raise peoples' levels of living, in the area of incomes and consumption, medical services, education and feeding levels through appropriate development processes
- to create conditions that are conducive to the advancement of peoples' self-esteem through the standard political, economic and social systems and institutions which advance respect and human dignity
- to increase persons' freedom to choices by increasing the array of their choice variables, e.g. variety of goods and services

Thus development can be interpreted as 'modernization' a process that emphasizes social change which is required to create economic advancement; scrutinize changes in political, social, and psychological processes with highlights on distributive justice. When development achieves lasting satisfaction of human needs and improvement of quality of life, it could then be referred to as sustainable development. However, reaching the level of sustainability in development requires

series of investigation and research for appropriate policies and actions. Adeniyi (1999) defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Accordingly, log-term strategic policies and interventions born out of targeted research are necessary for continuity.

2.3 Research and Sustainable Development

The role that research plays in development cannot be over emphasized. Research is a veritable instrument for exploring problems, experiences, actual situation of events and phenomena which provides outcomes or result that reveal the forces, challenges and reasons behind same and proffers solutions to the issues. According the Ministry of Finance, Planning and Economic Development (2014) The main objective of research for development is to serve as an instrument improving people's living standards by motivating growth and increased productivity in critical productive sectors of the economy noting that research can bring about product innovations, product improvement, increased service efficiency, effectiveness, and improved performance in the market place. Blewitt (2015, p. 7) opined that research and development has become the most enduring and effective means of boosting sustainable economic development and re-enforcing competitiveness in face of rapid growth taking place between industries, countries and peoples in the world. He further asserted that research is an investigative parameter of getting new information or looking for new ideas for the development of man and the society. This point was supported by Laws, Harper, Jones, and Marcus (2013) when they said that research for development sets out to explore issues so as to plan specific programmes that would appropriately address specific needs in the society and make provision for change. Thus research for development can either be policy-focused or programme-focused; these were categorized to include the following:

2.3a Figure 1: Aspects of Research for Development

Policy-focused Research	Programme-focused Research
❖ Raising a new issues in the public domain ❖ Putting forward a new perspective on a 'Live' issue or refraining an existing issue in a new way ❖ Producing strong evidence of the benefit or danger of a particular policy ❖ pulling together learnings from varied studies to support a policy	❖ Investigating the needs of a community or specific group of people ❖ Investigating the needs of a particular programme ❖ Demonstrating convincingly the effectiveness of a particular programme

(Laws, Harper, Jones, and Marcus, 2013).

In addition to the above, there is the scientific research that focuses on **products and patents** which has a most vital place in the development of a nation. It is based on the foregoing that nations like Israel, United States of America, Japan etcetera invests the largest share of the` world's R&D capital, became home of the largest number of world class universities and controls the largest share of the world's knowledge economy (World Bank, 2002 and Bako 2005). Such developed nations have consistently engaged research to attain sustainable developments.

Stakeholders such as government, businesses, research institutions, media, and organizations play important roles in achieving sustainable development. Each of these sectors has specific focus per time for sustainable development. It may be in areas such as environmental preservation and protection, economic development or social development. According to UNESCO (2000) the way each nation, cultural group and individual views sustainable development will depend on its own values. Consequently, many European nations, Universities and other institutions of higher learning train their citizens and students in acquiring skills that helps to build more sustainable societies. Lately, the emphasis in other parts of the world and especially institutions of higher learning is on research that will provide life and occupational skills that will enhance individual potentials and reinforce self-sufficiency thereby improving quality of life.

2.4 Early Research outcomes and Sustainable Development

The level of research capacity of a nation determines its level of sustainable development (Adeniyi, 1999, p. 5). This is premised on the fact that research outcomes functions as a guide to the route to be taken on a meaningful sustainable developmental expedition, thus research and development are inseparable. Major early development feats in different facet of societal life and fields of study that have endured over the years globally were born out of quality research engagements. Suffice to note, that apart from policies and programmes as instruments of development, enduring patents and products (inventions) are veritable proofs of the development of a nation. These gained prominence in the early days which has continued till date, especially in western part of the world. It is based on the foundations laid by these early inventions that we have several innovations all around the world nowadays. The following are some of such feats and inventions that are still impacting the world up until now.

2.4a Products and Patents Invented by Early Researchers

- Calculating Machine and Actuarial Tables – Charles Babbage (1792 - 1871): This formed the basis for what the whole now know as computer and apply to every field of endeavor.

- Trans-Atlantic Cable – Lord (1824-1907) invented at Glasgow, Britain in 1858. (Craig, 2001, p. 54).

- Absolute Temperature Scale – Lord Kelvin (1824-1907). (Craig, 2001, p. 54)

- Fermentation Control, Biogenesis law, Pasteurization and Vaccination & Immunization – Louis Pasteur (1822 - 1895) of French origin discovered that microbes were responsible for souring alcohol and came up with the process of pasteurization, where bacteria is destroyed by heating beverages and then allowing them to cool. His work in germ theory

also led him and his team to create vaccinations for anthrax and rabies. (Encyclopedia Britannica, 2014).

- Law of Gravity and Reflecting Telescope – Isaac Newton (1642 -1727). (Craig, 2001, p. 54).

- Electric Motor, Galvanometer and Self Induction – Joseph Henry (1797 - 1878). (Craig, 2001, p. 54)

- Chloroform – James Simpson (1811-1870). (Craig, 2001, p. 54)

- Electric Generator – Michael Faraday (1791-1867): a British discovered Electric Generator within 1831–1832. The generators you see in power stations today are more powerful and more complicated, but the basic idea is the same as the one invented by Faraday (par, 2003, p. 32).

- Barometer – Blaise Pascal (1623-1662). (Craig, 2001, p. 54).

- Telegraph – Samuel F. B. Morse (1791-1872): Developed in the 1830s and 1840s, the telegraph revolutionized long-distance communication. It worked by transmitting electrical signals over a wire laid between stations (History.com).

- Thermionic Valve – Ambrose Fleming (1849-1945): the valve was first invented in 1904, and it was not widely used until the 1910s, the same is pivotal in laying the foundations of what we call electronics technology today. He was a British electrical engineer and physicist. (Science Encyclopedia)

2.4b Scientific Disciplines Established By Researchers

- Computer Science – Charles Babbage (1792-1871)
- Comparative Anatomy and Vertebrate Paleontology - Georges Cuvier (1769-1832)
- Pathology – Rudolph Virchow (1821-1902)
- Hydrography and Oceanography – Matthew Maury (1806-1873)
- Antiseptic Surgery – Joseph Lister (1827-1912)
- Bacteriology – Lois Pasteur (1822-1895)
- Calculus and Dynamics – Isaac Newton (1642-1727)
- Celestial Mechanics and Physical Astronomy – Johann Kepler (1571-1630)
- Chemistry and Gas Dynamics – Robert Boyle (1627- 1691)
- Gynecology – James Simpson (1811-1870) etc. (Craig, 2001, p. 54).

The list above shows that the researchers are form developed countries of the world. Until recently, the nation of Israel topped the list of researching countries of the world. However, a country like China is one of the nations of the world that is now into serious research and development activities and as such one of the fastest growing developing nations of the world. Xiaole (2015) opined that China's investment in Research and Development (R&D) is second only to the United States while

a report by Kigotho (2014) revealed that China was the second largest R&D spender in 2012, allocating US$294 billion compared to top-spending America at around US$454 billion that year.

Also due to quality research activities, the world now has inventions such as Self-driving cars which represent an important achievement in the fields of artificial intelligence and robotics invented by a German pioneer Ernst Dickmann while Jaguar Land Rover is taking part in a new research project to foster the development of safer and more effective autonomous cars (Marc, and Chow, 2016). The internet was invented in 1989 by Tim Berners-Lee (Clarke, 2016) and a host of others that have made life more easy and comfortable in most parts of the world. The same is expected everywhere around the globe and research is required. Thus, the place of research in sustainable development cannot be undermined.

Review of Studies in Webometrics

Webometrics, is the quantitative study of Web-based phenomena that was driven rapidly by a number of pioneering researchers and investigations which established it as apparently the largest coherent field within library and information science. Early researches in this area of study were focused on; link impact evaluation, link relationship mapping and search engine results analysis (Thewall, 2010). According to Harinarayan and Vasantha (2013) Webometrics is traditionally used for quantifying Web data related to footprints of researchers or institutions on the Web measured in terms of their research publications and other parameters. Reviews of some studies in webometrics are as follows:

Thelwall (2010) conducted a study titled Webometrics: emergent or doomed? Where he used a survey of webometricians to assess the extent to which webometrics has found applications outside of its parent discipline. Whilst webometrics already has several claims to usefulness, there is still progress to be made. He explained that the results suggest that there has been a turn towards applied webometrics with several externally-financed studies being contracted. Moreover, there is a significant amount of citation of webometrics research by disciplines outside information science, including computing, communication science and health. Nevertheless, it seems that the potential user base for current webometric techniques is wider still, creating a need for awareness-raising.

Harinarayan and Vasantha (2013) eveluated the recent developments in webometrics research in light of emergence of social Web and big data, and their applications in new research fronts and future perspective of webometrics research. The paper also discusses about the recent developments in research techniques in webometrics such as query splitting and virtual memetics in the social network sites. It is observed that the growth of Web technologies has possibly posed new challenges for traditional citation databases which have been extensively used so far for measuring research impact of universities, institutions or individual researchers. The new trend has shown that impact measures are in the verge of acceptance as new method for measurement of academic and research contributions. One notable example for this is altmetrics. In a nutshell, the paper gave an overview of the emerging trends and impact measuring techniques used in webometrics research.

Shari, Haddow and Genoni (2012) described the methods and findings of a pilot study which applied bibliometrics and webometrics to examine collaboration in Malaysian biotechnology

Design/methodology/approach. The bibliometric analysis focused on biotechnology-related journal articles indexed in Web of Knowledge while the webometric analysis examined the web sites of top biotechnology institutions generated in the bibliometric analysis. Collaboration behaviour was assessed in three ways: intra-institutional versus inter-institutional; national versus international collaboration; and by type of institution collaboration according to the triple helix model. Findings of the pilot study, which applied bibliometric and webometric analyses to a limited sample, indicated that the methodologies would collect the desired data for a more extensive study and provided a framework for similar research exploring the impacts of collaboration in an e-research environment. This methodology is innovative and practical in terms of the combined use of bibliometric and webometric analyses. This is one of the few studies that has examined collaboration using both bibliometric and webometric methods, which is unique to the study.

Isfandyari-Moghaddam, Danesh, and Hadji-Azizi (2015) in their study aimed at determining the most accredited free English electronic journals (EJs) in Medical Sciences, as accessing free scholarly EJs in the medical field is difficult in the web environment Design/methodology/approach. The research population consisted of 700 free EJs of Medical Sciences, which were collected from two reputable websites, namely, Directory of Open Access Journals and Free Medical Journals. After first screening, 269 free EJs including 76 journals in health, 4 journals in nursing, 175 journals in medicine and 14 free EJs in dentistry remained for final investigation. Findings revealed that most accredited journals in four medical disciplines studied here are; New South Wales Public Health Bulletin, PLoS Biology and Environmental Health Perspectives, National Institute of Environmental Health Sciences and Online Journal of Rural Nursing and Health Care and Online Journal of Nursing Informatics.

Levitt, and Thelwell (2011) in a study titled A Combined Bibliometric Indicator to Predict Article Impact' observed that in both the UK and Australia there has been a recent move to use citation analysis in the evaluation of the research of individuals. They further discovered that the future UK Research Excellence Framework (REF), proposed the use of citation data in the research evaluation of articles published as recently as the year prior to the evaluation. Thus they developed an indicator at the level of individual articles that, when normalized, can supplement peer review in response to REF's move. The new hybrid indicator was the weighted sum of two indicators in common usage: the article's total number of citations in a citation window, and the Impact Factor of the journal in which the article was published. The study compared this new indicator with the article's total number of citations in a longer citation window (the standard indicator of article impact). For citation windows of 0 or 1year, the correlation of the simplified weighted sum with long-term citation was substantially higher than the correlation of the standard indicator of article citation with long-term citation. Moreover, for citation windows of as long as 3years the standard indicator of citation correlates significantly with the month of publication, in that articles published earlier in the year are on average more highly cited than those published later in the year. By contrast, the skewing of the simplified weighted sum towards articles published early in the year is considerably less than that of the standard indicator.

Pechnikov and Nwohiri (2012) analysed the interaction of websites via hyperlinks considering a web space built on a set of the university websites of Nigeria. The result of their investigation revealed a weak connectivity in the set of official websites of Nigerian universities. Nevertheless,

the connectivity became stronger when all the university websites were taken into consideration. It further increased appreciably with the addition of the web communicator to the university websites National Universities Commission the sole body that accredits the establishment of higher educational institutions in Nigeria and every academic programme run by them.

3. STUDY METHOD

The study is a Webometric analyses that adopted citation report and evaluation of research output of the world's Universities between 2008 and 2014 using records that were available on Scopus in the month of July, 2015. It evaluated the quantity of research publication globally between the aforementioned years, the most published university, field, the top ten most cited authors, most published journal, most published impactful author and the top ten most published countries. In other to compare research activities of the highest published country and development of the nations. Findings were discussed in relation to author relevance, institutional priority and development of most published countries.

4. DATA PRESENTATION AND DISCUSSION

4.1 Table 1: Total Publications Generated from Scopus for 2008 – 2014

Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Vol. of Publications	3,056	3,571	4,096	4,881	4,810	5, 317	5, 504	31,234

Table 1 revealed that research output (publication) indexed in Scopus recorded a steady increase over the previous year beginning from 2008 to 2011. 2012 experienced a decrease with a difference of 94 publications below that of the previous year and shut up 2013 with a difference of 507 publications above the preceding year. Thus the highest volume of research output was recorded in year 2013. A culmination of all research publication output as recorded by Scopus between 2008 and 2014 was 31,234.

4.2 Table 2: Top 10 published Institutions per Year on Scopus 2008 - 2014

Institutional Research Output (Country)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Chinese Academy of Sciences (China)	18	-	21	-	-	45	204	288
Tsinghua University China	-	25	24	33	30	43	217	372
Daneshgahe Azad Eslami (Iran)	-	-	-	38	36	42	186	302

North China Electric Power University (China)	17	22	30	26	26	35	209	364
Beihang University (China)	27	-	-	30	30	33	185	305
Huazhong University of Science &Tech. (China)	27	24	-	28	-	33	177	289
Zhejiang University of Tech. (China)	24	31	22	33	31	32	202	375
Harbin Institute of Technology (China)	35	33	33	40	34	32	243	450
Nanjing University of Aeronautics & Astronautics (China)	-	29	22	-	29	30	180	290
Shanghai Jiaotong University (China)	-	23	-	-	-	30	146	199
Chongqing University (China)	-	-	-	-	34	-	-	34
Beijing Jiaotong Univerity China	-	-	-	-	27	-	-	27
Southeast University (China)	-	-	22	-	-	-	-	22
Beijing Institute of Technology	-	-	21	26	-		-	47
National University of Defense Technology (China)	-	-	-	27	-	-	-	27
Tianjin University (China)	15	-	-	29	-	-	-	44
Harbin Engineering University (Harbin Institute of Technology, China)	-	24	24	-	-	-	-	48
North-Western Polytechnica University (Northwestern University, United States)	15	-	-	-	-	-	-	15
Wuhan University of Science and Tech. China	-	26	-	-	-	-	-	26
IEEE (United States)	19	-	-	-	-	-	-	19
University of Manchester (UK)	18	-	-	-	-	-	-	18
Graduate University of Chinese (China) Acad.of Sc. (China)	-	-	23	-	-	-	-	23
University of Tehran, Iran	-	-	-	-	23	-	-	23
University of Melbourn (Australia)	-	20	-	-	-	-	-	20

Table 2 above revealed that twenty-four institutions have appeared on the list of top ten most published countries between 2008 and 2014. However, only three have been on the list consistently within the periods, which are namely Zhejiang University, Harbin Institute of Technology and North China Electric Power University (china). Tsinghua University was listed except in 2008. Others are Beihang University, Huazhong University of Science & Tech. and Nanjing University of Aeronautics and Astronautics which were listed for five years out of the seven year period. Daneshgahe Azad Eslami in Iran has been listed four times and Shanghai Jiaotong University three times. It was revealed that majority of institutions listed within the period under analyses appeared

only one time. This indicated that the three consistently listed institutions of higher learning made research and publication a priority among other responsibilities.

4.3 Table 3: Top 10 published Subject Area on Scopus 2008 – 2014

Research Output on Subject Area	2008	2009	2010	2011	2012	2013	2014	Total
Engineering	1215	1338	1661	1918	1954	2187	2333	12606
Computer Science	798	1122	1153	1351	1204	1285	1224	8137
Medicine	383	442	430	548	562	624	655	3644
Social Sciences	306	369	393	474	483	558	601	3184
Physics & Astronomy	342	341	435	409	414	508	461	2910
Mathematics	215	392	366	454	409	444	412	2692
Energy	181	333	293	348	387	394	502	2438
Material Science	204	284	338	307	317	353	368	2171
Agriculture & Biological Science	167	191	226	278	280	320	350	1821
Earth & Planetary Science	177	158	198	220	256	321	292	1622
Business, Management & Accounting	160	211	266	310	237	242	331	1757
Biochemistry, Genetics & Molecular Bio	151	160	150	195	185	239	254	1334

Table 3 above revealed that Engineering was the most published subject area from 2008-2014 as recorded by Scopus, with a total number of 12,606 documents. This was followed by Computer Science having a total number of 8,137. Next to Computer Science was Medicine with total number of 3,644 documents. The Social Sciences was directly next to Medicine with a total of 3,184 documents while the subject area with the least number of documents amongst this category was Biochemistry, Genetics and Molecular Bio, having a record of 1,334 documents. From this findings, it can be inferred that faculty in Engineering and Sciences were more productive during the period under study than any other group of academics in this category as this is one of the major ways of determining academic productivity. The finding also is confirmed by the reports of the volume of research output in these subject area found on various databases hosting learning resources such as EBSCO, IEEE, ScinceDirect, Nature etcetera. More so, Engineering, Computer Science and Medicine are in the forefront of sustainable development and industrialization thus it not surprising to have them leading research activities globally.

4.4 Table 4: Top 10 published Countries on Scopus 2008 to 2014

Research Output Per Country	2008	2009	2010	2011	2012	2013	2014	Total
China	759	938	1184	1379	1384	1590	1608	8,842
United States	682	758	803	955	932	953	871	5,954
United Kingdom	278	284	289	396	360	460	381	2,451
India	-	-	119	150	187	209	421	1,086
Germany	146	153	200	192	175	202	209	1,277
Australia	121	167	129	179	159	195	192	1,142
Canada	118	124	155	175	162	156	165	1,055
Spain	-	91	101	-	-	153	138	483
Japan	108	144	134	167	158	150		861
Italy	97	102	-	154	149	146	141	789
Iran	-	-	-	126	137	-	-	263
Taiwan	-	-	107	-	-	-	-	107
Netherlands	85	93	-	-	-		-	178
France	82	-	-	-	-		-	82
Malaysia							142	142

Table 4 above revealed that majority of publication output indexed by Scopus between 2008 and 2014 were from china with a total of 8,842 documents. The second most publish nation as shown by Scopus records for the period was the United States of America which had a total of 5,954 documents while United Kingdom with 2,451 followed in that order. Other countries were German y 1,277, Australia 1,142, India 1,086, and Canada 1,055. However it was observed that china, US and UK constantly led the trial from 2008 to 2014. This could be rightly assumed to be the reason for the high level of consistency in the development of these countries (Kigotho, 2014). Ho, Yuhshan, from Taiwan was one of the top ten most cited authors, yet Taiwan was only among the top ten countries in 2010 and Konur,O from Turkey was also one of the top ten most cited authors whose country did not appear as part of top ten researching countries. This means that there were fewer researchers in countries like Taiwan, Turkey, Iran, Netherlands, France and Malaysia than the other countries or their works were not indexed within the period under study. Although, China is still a developing nation, it is one of the countries controlling the economy of the world such as Israel, US and UK etcetera, and a major force to be reckoned with globally as its citizens are fast taking over global production of several items and is fast developing (Kigotho, 2014).

4.5 Table 5: Top 10 Cited Authors on Scopus 2008 – 2014

Top Ten Authors with the Highest Citation								
Name	**No. in 2008**	**No. in 2009**	**No. in 2010**	**No. in 2011**	**No. in 2012**	**No. in 2013**	**No. in 2014**	**Total**
Ho, Y	2	36	85	181	266	312	461	1,343
Gupa, B.M	0	2	11	10	13	30	30	96
Wang, W	98	569	1252	2203	3525	6768	10,302	24,7184

Li, W	181	1231	2920	4995	7400	10,722	13365	40,814
Zhang, W	53	358	838	1,371	2251	4199	6794	15,864
Konur,O	-	-	-	3	366	87	15	471
Scutaru, C.	5	24	54	76	59	52	44	314
Inman, D. Joshua	21	111	260	503	767	898	961	3,521
Li, H	30	194	451	833	1658	3194	4991	11,351
Groneberg D.A.	16	35	73	114	151	131	181	701

Table 5 above showed that Li, Wei of Harbin Institute of Technology China was the most cited author during the period under study (2008- 2014) as reported by Scopus. Thus he was the most impactful author within the period with a total citation of 40,814. Second most cited author within same period was Wang, Wei of Beijing University of Chemical Technology, Beijing Key Laboratory of Environmentally Harmful Chemical Analysis, Beijing, China with a citation count of 24,7184. Wang was followed by Zang Wei of Tsinghua University, China with a count of 15,864 while Li Hui of Technische University, Berlin, Germany was the fourth in the category. The breakdown of each author's citation by year, showed that the authors were cited more in the year 2014 and that their citations increased progressively by the year from 2008 to 2014. The implication of this discovery is that the works of these most cited authors that were cited within the period under study were the most impactful. In essence, the content of their documents were relevant to many other write ups in their field as well as related fields for the citations to be these much (Levitt & Thelwall, 2011). It showed that the authors are astute researchers and writers who are influential in their fields.

4.6 Table 6: Top Ten Published Authors H-Index/Co-authorship 2008 - 2014

Author	**Field of Study**	**Institution**	**Country**	**No. of Co-authors**	**h-Index**
Li, Wei	Computer Science	Harbin Institute of technology	China	150	74
Ho, Yuhshan	Environmental Science/ Chemical Engineering	Asia University	Taiwan	144	22
Gupa, B.M.	Computer Science	NISTDS	India	35	7
Wang, Wei	Computer Science	BUCT	China	150	61
Zhang, Wei	Material Science	Tsinghua University	China	150	48
Konur,O	Energy	Sirmak Univ.	Turkey	10	11

Scutaru, C.	Medicine	Universitats Medizin	Germany	150	10
Inman, D. Joshua	Physics and Astronomy	Univ. Michigan Ann Arbor	United States	150	28
Li, Hui Germany	Computer Science	Technische Univ. Berlin		150	37
Groneberg D.A.	Medicine	Univ. of JWGUF	Germany	150	13

Table 6 above showed that Li, Wei's h-index was higher than those of his counterparts. Between 2008 and 2014 his h-index was 74 on Scopus' record as at the time of this study. Next to his was Wang Weis' which was 61 and then Zhang Weis' 48. Others were Li, Huis', Inman, D. Joshuas' and Ho, Yuhshans' 37, 28 and 22 in that order, while the rest had less than 20. This finding appropriately correlated with the author's output citations on table 6 confirming the impact of the researchers' works (Hirsch, 2005). In the same view, it was deduced from the findings that the order of the H-index was the order of the volume of publication of each author, since H-index is derived from (Productivity and Citation). Also, the table revealed that majority, seven out of the top ten listed authors on Scopus have co-authored up to 150 publications which is the maximum that can be displayed on Scopus. The findings implied that joint effort is more robust, consequently more valuable which has culminated in much relevance to have made the authors' works more cited within the period under study. It showed that co-researching and co-authorship are important aspects of scholarship that must not be downplayed but encouraged within academia.

4.7 Table 7: Report on Document Type indexed by Scopus 2008 to 2014

Research Output Per Document Type	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Article	1589 (52.0%)	1864 (52.2%)	2078 (50.6%)	2528 (51.8%)	2617 (54.3%)	3,126 (58.8%)	3,339 (60.7 %)	**17,139 (55.0 %)**
Conferenc e Paper	1201 (39.3%)	1419 (39.7%)	1687 (41.1%)	1978 (40.5%)	1794 (37.2%)	1766 (33.2%)	1654 (30.1 %)	**11499 (36.9 %)**
Review	166 (5.4%)	159 (4.5%)	177 (4.3%)	228 (4.7%)	257 (5.3%)	240 (4.5%)	212 (3.9%)	**1439 (4.6%)**
Article in Press	-	2 (0.05%)	3 (0.1%)	10 (0.2%)	12 (.02%)	43 (0.8%)	229 (4.2%)	**299 (1.0%)**
Book Chapter	41 (1.3%)	62 (1.7%)	67 (1.9%)	70 (1.4%)	71 (1.5%)	53 (1.0%)	10 (0.2%)	**374 (1.2%)**

Conference Review	8 (0.3%)	13 (0.4%)	12 (0.3%)	12 (0.2%)	12 (0.2%)	37 (0.7%)	34 (0.6%)	**128 (0.4)**
Note	10 (0.3%)	11 (0.3%)	11 (0.3%)	11 (0.2%)	5 (0.1%)	16 (0.3%)	6 (0.1%)	**70 (0.2%)**
Editorial	11 (0.4%)	10 (0.35)	11 (0.3%)	7 (0.1%)	10 (0.2%)	11 (0.2%)	5 (0.1%)	**65 (0.2%)**
Book	14 (0.5%)	12 (0.3%)	21 (0.5%)	23 (0.5%)	16 (0.3%)	15	4 (0.1%)	**105 (0.3%)**
Bus. article	4 (0.1%)	4 (0.1%)	3 (0.1%)	2 (0.04%)	8 (0.2%)	-	2 (0.03%)	**23 (0.07%)**
Letter	-	3 (0.1%)	4 (0.1%)	6 (0.1%)	7 (0.1%)	5 (0.1%)	6 (0.1%)	**31 (0.09%)**
Short Survey	12 (0.4%)	11 (0.3%)	22 (0.5%)	5 (0.1)	8(0.2%)	5 (0.1%)	2 (0.03)	**65 (0.2%)**
Erratum	-	1 (0.02%)	-	1 (0.02%)	1 (0.02%)	-	1 (0.01%)	**4 (0.01%)**
Total	**3056 (100%)**	**3571 (100%)**	**4096 (100%)**	**4881 (100%)**	**4810 (100%)**	**5317 (100%)**	**5504 (100%)**	**31,235 (100%)**

Table 7 above revealed that a total of 31,235 (100%) documents were indexed by Scopus between 2008 and 2014 including all document types as at the time of this evaluation. Article was the highest of all document types indexed by Scopus from all over the world within the period under study. Even a breakdown by individual year showed that scholars write and publish more of articles than they do other types of documents thus it constituted 55% of the total research output within the period. Conference Paper is the next in the order constituted 36.9% of total output while this was followed with a wide gap by Review which constituted 4.6% of total documents indexed. The least is Eratum with a cumulative output of 0.01% within the period. The indication of this finding is that academics are more involved in research activities which are major sources of new knowledge that has its primary source of reportage as articles in Journals and conference papers that published in conference proceedings. Also, research results are highly germane to development thus scholars are not only committed to same but to publish them for the stakeholders and the public generally to be aware of what is new in varied fields. Another reason for this trend could also be that articles and conference papers are faster and easier to write if compared with the writing of books.

4.8 Table 8: Top 10 Publication outlets and Impact Factors on Scopus 2008 - 2014

Publication/Document Sources	2008	2009	2010	2011	2012	2013	2014	Total	Impact Factor
Applied Mechanics & Materials	-	-	-	45	100	207	276	**628**	0.134
Advanced Materials Research			28	106	179	174	169	**656**	0.144
Proceedings of SPIE- The International Society for Optical Engineering	85	84	79	71	55	84	56	**514**	0.203
Lecture Notes in Comp. Science	48	58	41	70	65	79	84	**445**	0.310
Dianli Xitong Zidonghua	-	24	41	46	42	67	87	**307**	1.066
Scientometrics	20	24	19	30	32	41	58	**224**	1.412
Plos One	-	-	-	-	24	35	31	**90**	1.724
Intl. Jl. of App. Engineering Research…..	-	-	-	-	-	33	137	**170**	
Nongye Gongcheng Xuebao…	-	-	-	-	-	31		**31**	0.334
Lecture Notes in Electrical Engineering	-	-	-	-	-	27	-	**27**	0.119
Dianli Xitong Baohu Yu Kongzhi	-	13	14	19	25	-	-	**71**	0.444
Communications in Comp. & Inf. Sc.	-	-	13	40	24	-	-	**77**	0.136
SAE Technical Papers	14	-	-	-	23	-	-	**37**	0.347
Procedia Engineering	-	-	-	29	-	-	-	**29**	0.394
Anesthesia & Analgesia	15	26	-	25	-	-	-	**66**	1.737
Materials Res. Society Symposium…..	23	12	31	-	-	-	-	**66**	0.128

Proceedings of the World Congress on Intelligent	21	-	14	-	-	-	-	**35**	0.129
Xitong Fangzhen X;uebao Jl. Of Sys….	-	13	-	-	-	-	-	**13**	0.266
Guangxue Xuebao Acta Optica Sinica	-	11	-	-	-	-	-	**11**	0.472
Expert system with Application	-	11	-	-	-	-	-	**11**	1.487
Zhongguo Dianji Gongchen Xuebao Pro.	17	-	-	-	-	-	-	**17**	0.965
Yi Qi Biao Chinese…	14	-	-	-	-	-	-	**14**	0.341
Gaodianya Jishu High Voltage	11	-	-	-	-	-	-	**11**	0.556
Jixie Gongcheng xuebao journal of mechanical Engineering	-	-	13	-	-	-	-	**13**	0.611
Journals of chemical and pharmaceutical research	-	-	-	-	-	-	30	**30**	0.346
Mediterranean Journal of social science	-	-	-	-	-	-	27	**27**	0.145

Table 8 above showed that the highest volume of publications/research output were published in journal titles which include; "Advanced Materials Research (656), Applied Mechanics & Materials (628), the Proceedings of SPIE the International Social for Optical Engineering (514), Lecture Notes in Computer Science (445), and Dianli Xitong Zidonghua (307). Journals with the lowest output in this category are; Guangxue Xuebao Acta Optica Sinica, Expert system with Application and Gaodianya Jishu High Voltage having (11) respectively. These are followed by Jixie Gongcheng xuebao journal of mechanical Engineering (13), Yi Qi Biao Chinese… (14). Findings here revealed that the most prominent journals except Dianli Xitong Zidonghua (307) have impact factor that is less than 1.00. While some with lower output have higher impact factor even "Expert system with Application" (11) output within this period yet its impact factor was 1.487. The implication of this finding is that impact factor is not determined by quantity but by quality. Thus

it could be inferred that some journals are not after quantity but quality which may be responsible for the low output yet impacting their field and the world directly or indirectly.

5. CONCLUSION AND RECOMMENDATIONS

Sequel to the findings and discussions above, the paper concludes that the extent of research and publication within the period under study is commendable as despite the proliferation of publications in other journals especially predatory journals and the high standard for qualifying to be indexed in Scopus, the record was high. Thus the most published universities were Harbin Institute of Technology China, Zhejiang University of technology China, Tsinghua University China, North China Electric Power University China, and Nanjing University of Aeronautics and Astronautics China and others. The most published countries included China, United States, United Kingdom and Germany etcetera. Engineering, Computer Science, Medicine, Social Science and Physics and Astronomy among others had more publications irrespective of the document type.

Also, top among the top ten published authors within the period were Li, Wei, Wang, Wei, Zhang, Wei, and Li, Hui to mention but a few and the most cited authors as well. It was discovered that some very few authors, their institutions, countries and fields of study were consistently conspicuous among the top ten between 2008 and 2014 such as Li, Wei, of Harbin Institute of Technology China, Wang, Wei of Beijing University of Chemical Technology (BUCT) China, Zhang, Wei of Tsinghua University China, and Li, Hui Technische University Berlin, Germany. In essence, these authors and institutions prioritized research and publication irrespective of other important university household tasks. This goes a long way to explain the reason China is one of the fastest growing developing nations of the world and United States of America remains top on the ranking of developed nations. Suffice to note that the findings of this study supports the claims of scholars such as Belwitt (2015) and Laws et al (2013) that research is the driving force for development that must be sustained. Consequently, it is recommended that nations of the world should commit to encouraging extensive research activities by making funds available. Also, scholars, research institutes, universities, and other institutions of higher learning especially in the developing nations should emulate these examples and engage in development oriented research for specific products, patents, policies and actions thereby helping to develop their nations and in no time the yearnings of the world (sustainable global development) would be realized.

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