Information Services and Scientists' Research Productivity in Nigeria: Evidence from Research and Development Institutions

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Abstract
Scientists in Research and Development Institutions (RDIs) require the use of information services to gain access to frontier knowledge nationally and internationally to keep abreast of developments in inventions and innovations, which they also need to adapt to the local environment, while creating awareness for the dissemination of their research results. Scientists in many developed countries have been observed to incorporate the use of information services to maintain and react promptly to organizational and individual professional demands in this respect. Scientists require the use of information services of different types which include library, internet and communication services amongst others in anticipation of user needs or interests, packaging/re-packaging of information to meet specific demands. This study investigates the relationships between the use of information services and research productivity of scientists in RDIs in Nigeria.
Keywords : Information Services, Scientists', Productivity Nigeria, RDIs

1. Introduction

Scientists have a primary function to undertake research and development (R & D) activities focused towards boosting knowledge generation and innovation capacity to ensure the attainment of development in the economy. Scientists in research and development institutions (RDIs[1]) especially in the developed countries have been observed to use information services such as library and reference services, consulting and planning services, current awareness activities, selective retrieval services, analysis and interpretation services; advisory services, and publishing services, to access knowledge and to keep abreast of inventions and innovations. Some of the resultant effects have been shown to include increased information flow, and increased research productivity, in terms of publications output (Owens, Wilson and Abel, 1997).

The use of information services is one of the channels which scientists manage their research activities that helps in decision-making, communications; improvement of performance and enhancement of productivity (Levitan, 1982; Porter, 1985; Owens et al, 1997; and Grimshaw, 1995). Scientist research productivity is therefore increasingly viewed as an important contributor to the production of knowledge and growth within any National Innovation System (NIS) (Salter and Martin, 2001). It is in this regard that scholars are beginning to examine the knowledge produced by public research organizations and, which types of firms exhibit a higher propensity to draw upon these knowledge base, and also the channels used by both types of actors to interact (Meyer-Krahmer and Schmoch (1998), and Adeoti, Odekunle and Adeyinka (2010).

Literature is replete with some of the significant research work carried out on the activities of RDIs in both developed and developing countries (Etim, 1992; Igwe & Okpala,1981; Olayide 1981; Bamiro, 1994; Alo 1995; and Freeman & Soete, 1997; Idachaba, 1998). There is also evidence that much progress has been made in understanding the strategic importance of information services, especially in the library environment in both developed and developing countries. Very limited research studies have however been undertaken on factors that influence research productivity of scientists and the linkage with the use of information services. There is a particular observed gap in the existence of research work in this aspect in African environment and especially in Nigeria.

The objective of this paper is to highlight the relationships between the use of information services and research productivity of scientists in RDIs in Nigeria. The paper addresses four research questions as follows:
- What are the demographic features of scientists in Nigerian RDIs?
- What is the frequency of use of selected information services by scientists in Nigerian RDIs?
- What is the research productivity of scientists in terms of their publications?
- Is there any relationship between the use of information services and the research productivity of the scientists?

This paper is organized into five sections, including this introduction. Section two presents a review of

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[1] RDIs in Nigeria are of different types namely; government research institutions; higher education research in universities and colleges of science and technology; private sector research companies; and international research centers. Records from the National Planning Commission (NPC) show that as at 2006, the country had over 66 public research institutions (PRIs), but with only 24 involved in core R & D activities, and the other PRIs being training, data-gathering, and policy research institutions.

literature on the relationships between use of information services and productivity. Section three highlights the methodology of the research, while results and discussions are presented in section four. Section five concludes the paper with some policy recommendations on how to engender effective use of information services and increased productivity of the scientist.

2. Use of Information Services and Research Productivity

The concept of "use" implies the putting of a thing or service into action so as to accomplish an end, or apply to a given purpose, while "productivity" is understood to be "a function of the *quantity* of factors required for production in relation to the *quantity* of items produced" (i.e. units of output produced per factor inputs over times. Productivity is also now recognized as a consideration of qualitative measurements, such as quality of service, consumer satisfaction, timeliness of service, etc. are important and significant productivity measurements, because they allow for inputs on 'perceived benefits' by users of the service.

Investigations of the relationship between the use of information services and research productivity generally find support for the view that information services enhance productivity. Hesse et al. (1993) surveyed oceanographers and found a positive relationship between oceanographers' use of computer networks and their publication counts as well as professional recognitions. In a survey of scientists from four disciplines, namely, chemistry, philosophy, political science and sociology in 26 institutions, Cohen (1996) similarly found that scientists using computer-mediated communication tools reported higher numbers of publications and more professional recognition. Evidence of a positive IT-productivity relationship is also reported in Bonzi (1992) and Odesanya & Ajiferuke (2000).

Valida et al (1994), Thong & Yap (1995), Ang & Koh (1997), and Yap et al (1999) have also contributed to the discourse on relationship between use and purpose of information services in the Asia-Pacific region. Ang and Koh (1997) explored the relationship between use of information services and job satisfaction in a Singaporean organization and found a positive correlation between the two variables, while Burn (1990) studied the strategic use of information technology services in small and medium sized organizations in Hong Kong, and found out that that the purpose for using the information services was related to a mindset of accomplishing a competitive advantage. To these end, many of the firms were observed to have developed an offensive strategy as suggested by Freeman and Soete (1997). An offensive strategy involves the combination of the following organizational enablers: adequate funding for information services; recruitment of competent personnel; good information system; consultancy and brokerage activities, and continuous learning.

Highly productive organizations have been observed to be ardent users of steady stream of information services to sustain a competitive advantage (Davidow & Malone, 1999). It is in this respect that (Koenig, 1999) concluded that the more competitive the market place, the greater the information need, and the greater the investment in information services, but also adds that that there is evidence that companies consistently under-invest in information resources. Olson & Weill (1989) showed that internal and external factors affect a company's productivity gains. Internal factors may be top management's commitment, a company's prior experience and satisfaction with information investments, and company politics. External factors can include marketplace, a company's financial standing prior to the investment, and the company's size and ability to benefit from economies of scale. Bryssonfson (1993) identified accessibility costs; usage costs; experience of users; ease of use; income of user; urgency of use ; technology associated,; planning and management as expectation of what happens to the service in future, as variables that may influence use in the context of an information service. Overall, the studies have provided mixed empirical evidence with regard to the view that information services differentially affects subsets of the scientific labor force. This paper makes its contribution in this regard to this debate.

3. Methodology

Three[1] information services namely, library services; Internet Services; and communications services were considered in this study. The choice of these three information services is also based on the justification that they are some of the information services required majorly at institutional and individual levels of use of scientists in RDIs (Bell & Pavitt (1993), Bamiro (1994) and Oyeyinka-Oyelaran (2002).

This study adopted a survey design. The study population for this study comprised the total population of scientists in the twenty four RDIs involved in core R & D activities in Nigeria. Based on data from some of the past[2] surveys on RDIs in Nigeria, this study purposively selected 30 scientists in ten[1] RDIs. In each of the

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[1] One of the assumptions made in the paper is that by 2000 all the scientists in RDIs in Nigeria had all the information services understudy available, accessible and functional. Information to support this is available in Adeyinka, .F. M (2008) Demand and Use of information services in Research and Development Institutions in Nigeria.Unpublished PHd thesis. African Regional Centre for Information Science, University of Ibadan

[2] Survey reports on RDIs in Nigeria have shown that 1 government research institution employed fewer than 5 scientists, while 16 institutions employed 10 to 35 scientists each, and 5 institutions each

selected RDIs, the snowball sampling technique was adopted in the selected of 30 scientists, to give a total of 300 scientists from all the sampled RDIs. Primary data was collected through the administration of a structured questionnaire. Data was collected on the frequency of use of information services in RDIs in Nigeria. Data was also collected on the number and types of publications of scientists for five years, and this was the main variable used in the measurement of productivity. A publication in an international journal was given a score of 3 points, regional journals (outside Africa) was given a score of 2 points, local journals were given a score of 1 point, and seminar/conference/workshop articles were given scores of 0.5 points.

A total of 300 copies of questionnaires were administered, while 273 copies of usable questionnaires was returned, representing 83% response rate.To analyze the data, frequency distributions of the responses were constructed to describe the data. The analysis of Variance (ANOVA) technique was used to establish how the observations vary across scientists based on the RDI characteristics. Thereafter we cross-examined significant dimensions of use with number of publications by scientists in order to explain the pattern of variation. In all tests, we placed our significance level at 95 per cent. The study evaluated research productivity as a function of use of selected information services based on the following generalized model:

$Y_n = f(x_{i...j}) + \mu$

Where: Y represents the dependent variable,

n represents each information service that is considered, namely: Library services; Internet Services; and Communications services

$x_{i...j}$ represents the independent variables, which include: demographic characteristics; organizational attributes; availability of information services; accessibility; accessibility; affordability; ease of use; skills and training ; quality of information services etc.

The following hypothesis was evaluated to establish and explain the nature of the relationships that exist between research productivity of scientists and use of information services

Ho : The research productivity of the scientists in RDIs in Nigeria is not significantly influenced by use of information services

H_1: The research productivity of the scientists in RDIs in Nigeria is significantly influenced by the frequency of use of information services

4. Results and Discussions
4.1. Characteristics of Respondents

Demographic characteristics of respondents are shown on table 1. The mean age of all the respondents is 40 years, The age distribution of the responding scientists indicated that those in the age group 26-30 years constituted the lowest percentage (8.1%), while those in the age group 41-45 years constituted the highest (30.8%). Scientists in the age group of 31-35 years and 46 years and above constituted 19.0% of the respondents, while those in the 36-40 years age group were 22.3 This result indicated that the modal class of age of scientists in RDIs in Nigeria is 41 -45 years.

About 78.0% of the scientists were male, and 22.3% female. With respect to educational qualification, about 58 % of respondents had masters' degrees, about 7 % had bachelor's degrees, and almost 26 % had doctoral degrees. The pattern of this distribution shows that scientists with masters' degrees dominate RDIs. Further investigations revealed that over 50 % of respondents with master's degree are presently pursuing a doctoral qualification, while many of the B.Sc holders were pursuing master's degrees. Respondents representing about 9% had diploma[2]degrees.

Respondents had been working in their respective institutions for periods ranging less than one to 33 years. Close to 80% of the respondents had been working for at least five years. The modal class for work experience of scientists in RDIs in Nigeria is 5- 8 years with about 26% respondents indicating that they had been working for at least an average of 6.5 years. This modal class is followed by another 23 % who had been working for at least 16 years. This study used the job designations of the respondents to gauge information about the level of the scientists within the RDI. About 5 % of the scientists were Directors and Deputy Directors respectively, there were 28.6 % Junior Research Scientists, while the remaining 42.1% were Senior Research Scientists. There were no significant differences in the demographic characteristics of respondents across the RDIs, which serves to confirm that there were minimal (if any) biases in the demographic characteristics of the

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[1] Due to the promised confidentiality involved in this study, the names of the selected five agricultural RDIs will not be used; rather we shall refer to them as RDI-1, 2, 3, 4 to 10 respectively

[2] This group is considered relevant to this study; because investigations showed they had been working with scientists in the RDIs for an average of six years, and were also observed to be presently pursing their degree programmes.

scientists sampled from the different RDIs.

4.2 Use of information services

Data on the use of each of the information services by scientists was collected and coded in terms of frequency of use on a five point scale as follows: Daily= 5, Weekly = 4, Fortnightly =3, Monthly =2 and Seldom =1. Table 2 presents responses on the frequency of use of information services Respondents indicated that they use Internet services closely followed by communications services more frequently than library services on a weekly basis. In almost all the RDIs, the frequency of the use of library services in terms of physical visit is reported to be on the decrease, while there is an increase in Internet services use. The increased use of internet services confirms that hitherto library services are now available virtually.

4.3 The productivity of scientists in RDIs in Nigeria

Output in RDIs which can be taken as a measure of productivity at organizational level include number of innovations; number of seminars and/or extension services o; number of projects commenced and completed and number of patents. At individual level, number and type of publications remain the main measurable annual output of scientists in RDIs. Productivity was measured in this study in terms of the number and type of research publications of scientists published between 2003 and 2007. The pattern of the different types of publication by scientists in RDIs is presented in table 3.

There was an observed general low pattern of publications by scientists, with at least 50% of the scientists indicating that they had zero publications between 2003 and 2007 in all types of publications Furthermore the volume of publishing is concentrated in local journals and seminar/ conference workshop articles.

4.4 Relationship between the use of Information Services and the productivity of Scientists in Nigerian RDIs

The results on Table 4 shows that there is no significant relationship between the use of information services and the productivity of scientists in the RDIs understudy ($p > 0.050$). we therefore accept the null hypothesis and reject the alternative. This finding is in agreement with that of Jimba (2000) but disagrees with other studies on productivity and use of information services such as Bonzi, (1992); Hesse et al (1993); Odesanya & Ajiferuke,2000) and general theoretical assumptions which suggests that the assumed benefits of having access to information services such as Internet services in particular include improved productivity and maximization of profitability, which can be realized through the dynamics of lower transaction costs, reduced marketing and delivery costs, and a drastic costs in production costs (see Burn, 1990; Valida et al, 1994; Thong & Yap 1995 ; Ang & Koh ;1997; Yap et al; 1999; and Oyebisi, 2000).

The study confirmed through interviews with some of the scientists that related to the general low publication output by scientists is the low level of or lack of funds for the creation of an academic environment where results of R & D could be translated into published outputs. Lack of funds for example would affect attendance at conferences and workshops and this is where opportunities for pushing publications output exist. At such conferences and workshops, ideas and research findings get further refined and the scientists also get more exposed. One of the findings presented here that ties to this is the low level of training, not only in the use of information services, but generally in the training of scientists generally.

The results on productivity of scientists seem to indicate that many of the scientists in R & D institutions in Nigeria lack international exposure, and as such are not exposed to meeting up with the requirements of publishing in international journals. Nwagwu (2006) defended the position in which Nigerian scientists find themselves. According to the author, the question of the purpose of research is expected to influence the choice of journals through which researchers publish their research results, and scientists would want their research outputs to influence others and contribute to what others know and do. They would therefore want to publish their research findings where they will be used by prospective target.

5. Constraints to the Use of Information Services

Some of the constraints identified by the scientists included the poor state of infrastructure (electricity in particular), inadequate skills of the user, unsupportive policies of government to R & D activities in the country. This study showed that over 80 per cent of respondents' claimed to make payments for the use of information services, and particularly for Internet services. For many of these respondents, the payments for Internet services are made to cyber café that are either near to the RDIs or the accommodation of the scientists, simply because there is no regular electricity to power the services. Further discussion with some of the scientists, revealed that between N2, 500 and N7, 000 are made as payments on a monthly basis, for the use of Internet services, which many of the junior scientists especially claimed was expensive, and even moreso when they had to use the services for actualizing their official-related duties. Two of the RDIs under study had actually been cut off from the national grid for about 6 months due to non-payment of electricity bills, while many of the other institutions

had to run on generator for at least 6-7 hrs a day.

This finding confirms what Oyeyinka-Oyelaran & Lai (2004) observed on the high cost often associated with the use of information services, and therefore identified as one of the major constraints that may foreclose the use of information services by scientists in African countries, particularly those in sub-Saharan Africa.

6.   Conclusions and Recommendations

This paper concludes that scientists in RDIs in Nigeria do not seem to use information services effectively to enhance their research productivity measured by publications. In an effort to reduce some of the constraints to the use of information services by scientists in RDIs, this paper recommends training of scientists in the use of information services at least once a year to update the skills and capabilities of scientists to enhance their productivity .

There is also a need for increased funding of RDIs to be able to continue to acquire and maintain necessary information services, especially equipment and facilities needed for physical presence and smooth running of adequate information services. Related to this is the need for continued and improved top management awareness, appreciation and support in the provision of information services in RDIs.

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Table 1: Aggregate Demographic Data of the Respondents (N=273)

Variables	%	N
Gender		
Male	77.7	212
Female	22.3	61
Age 26-30	8.1	22
31-35	19.0	52
36-40	22.3	64
41-45	30.8	84
46 and above	18.7	51
Educational Qualification		
Diploma	8.8	24
Bachelor's Degree	6.6	18
Masters Degree	57.9	158
Ph. D	26.7	73
Working experience in the R & D institution		
Less than 1 year	3.3	9
1-4 years	19.4	53
5-8 years	26.0	71
9-12 years	16.5	45
13-16 years	11.7	32
Above 16 years	23.1	63
Designation		
Junior Scientists	48.0	131
Senior Scientists	42.1	115
Deputy Directors	5.1	14
Directors	4.8	13

Source: Field Survey 2010

Table 2:   Frequency of use of Information services in Nigerian RDIs

		RDI- Label										
	Frequency	1	2	3	4	5	6	7	8	8	10	TOTAL
Library services N=273	Daily	18.8	43.3	43.3	36.7	46.7	72.0	37.0	50.0	36.7	40.7	43.2
	Weekly	12.5	43.3	40.0	40.0	36.7	20.0	37.0	32.1	26.7	37.0	33.7
	Fortnightly	6.3	n.a	6.7	n.a	10.0	4.0	n.a	14.3	6.7	3.7	5.1
	Monthly	18.8	n.a	n.a	13.3	3.3		22.2	n.a	30.0	7.4	9.2
	Seldom	43.8	13.3	10.0	10.0	3.3	4.0	3.7	3.6	n.a	11.1	8.8
Internet services N=271	Daily	12.5	60.0	60.0	53.3	53.3	64.0	44.4	28.6	73.3	7.4	47.6
	Weekly	62.5	30.0	36.7	33.3	30.0	24.0	37.0	60.7	13.3	37.0	35.2
	Fortnightly	12.5	3.3	3.3	3.3	3.3	4.0	7.4	3.6	3.3	3.7	4.4
	Monthly	n.a	n.a	n.a	3.3	3.3	n.a	n.a	3.6	3.3	3.7	1.8
	Seldom	12.5	6.7	n.a	6.7	10.0	8.0	11.1	3.6	6.7	48.1	11.0
Communications services N=273	Daily	68.8	40.0	50.0	40.0	33.3	28.0	37.0	53.6	3.3	66.7	40.7
	Weekly	43.8	33.3	20.0	33.3	33.3	20.0	11.1	21.4	3.3	55.6	26.7
	Fortnightly	6.3	3.3	3.3	3.3	3.3	8.0	3.7	3.6	3.3	n.a	3.7
	Monthly	6.3	n.a	n.a	16.7	n.a	4.0	7.4	3.6	n.a	3.7	4.0
	Seldom	12.5	n.a	6.7	13.3	13.3	8.0	22.2	17.9	23.3	29.6	14.7

Source: Field survey 2010

Table 3: Publications by Scientists ((2003--2007)

Journal Type	Number of publications			
	0	1-5	6-10	Above 10
International Journal	71.1	19.8	5.8	3.3
Regional	64.7	27.9	7.2	-
Local	53.5	29.3	15.1	2.3
Seminar/.Conferences, or workshop papers	50.2	33.4	15	1.5

Values are percentages of number of scientists that indicated the number and type of publication
Source : Field survey , 2010

Table 4:   Use of Information Services and the productivity of Scientists

Model	R^2	Unstandardized Coefficients	Std Error	t	F	Sig.	Remarks
(Constant)		6.398	3.336	1.918			Accept H_o
USE	0.002	9.883E-02	0.122	-0.812	9.660	0.417	

Dependent Variable: PRODUC
Source: Data Analysis, 2010

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