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ENGINEERS, THEIR INFORMATION NEEDS AND INFORMATION SOURCES USED: A NIGERIAN PERSPECTIVE

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Abstract

This study explored the information needs and sources used by engineers in Nigeria with a questionnaire randomly administered to 120 respondents using a survey research approach. The quantitative data were analysed using descriptive statistics. There were more male (89.7%) than female engineers, the higher greater percentage (45.2%) being between 41 and 50 years, and many (40.5%) had PhD degrees, with most being senior lecturers. The main areas of specialisation were materials and metallurgy, electrical and electronic engineering and agricultural engineering. Their primary areas of information needs were research (79.8%), current developments (61.9%) and new designs (47.6%). The most popular information sources used at least once a month were formal sources, including 'books' and journals (print and electronic), software, technical report papers, theses and dissertations; and informal sources such as face-to-face and email discussions, social networking, conference and seminar attendance. The main methods of accessing the sources include contacts with colleagues and personal procurement of useful sources. Barriers to meeting information needs were irregular power supply, insufficient funding and inadequate resources (laboratories, workshops, facilities, and libraries). Some findings suggested that sufficient funds, well-equipped and functional engineering workshops, laboratories, libraries and other facilities be provided by the parent organisations, and that the Nigerian government should ensure a regular power supply. These provisions will enable engineers to make meaningful contribution to national development in an environment supported with current, accessible and relevant information.

Keywords: Engineers, Engineering, Information needs, Information sources, Methods of information access, Nigeria

Introduction

Engineers are important role players in various areas of life, including housing, transport, equipment, machines and tools, health, sports, recreation, food, clothing, and medicine. Scientists are sometimes regarded as people who produce information, with engineers applying their knowledge to produce factors that enable development and modernity for humanity. Relevant data are therefore important to provide information for engineers to execute their activities. Engineering has a long history, with one of the earliest records dating to the days of the Israelites. This occurred when Uzzah and other men built engines and other tools (The Holy Bible, 2 Chronicles 26:15). Gulman (1999) generated a list of engineering feats accomplished by people with respect to transportation, agriculture,

industries, communications, technology and food. The world is regarded as a 'global village' with little restrictions on distance and time (Abiolu, 2017 quoting Marshall McLuhan 1964) all due largely to technology and engineering. The word "engine" is derived from "ingerare" meaning "to create"; "engine-ering" derived from designer of engines of war referred to as "Engine-er" (Gulman, 1999).

The history of engineering in Nigeria had moved from the use of sticks, stones and local artifacts (Eide, Jenison, Northup and Michelson, 2007) to the present-day use of sophisticated tools, machines and equipment, ranging from ships to software. Eide et al. (2007) identified eleven main functions of engineering, including research, development, design, construction, production, operations, management services, testing, sales, consulting and teaching. These authors noted that engineering functions revolve around problem-solving, which is regarded as the bedrock of all engineering endeavours. Visulind and Gunn (1998) referred to engineering as the "the people-serving" profession, in which case the professionals' work has to do with the interaction with the human immediate or remote environments, in other words, it serves the public. For these to occur, engineering and information professionals should possess necessary information to enable them provide appropriate service to the general populace they serve. This in turn can result into producing informed citizens who will further contribute to better life for humanity. The type of information required by engineers is diverse, with seemingly little research having been conducted on the sources holding or bearing it. Moaveni (2005) averred that engineers make life better for the people through the art of developing products and services, and do this by accessing the right kind of information. Information can have as many meanings assigned to it as the contexts within which it is used. For example, providing web definitions of information, Ayanyemi (2006) listed 15 out of 30 obtained from web search; some of these include received messages, data, result of processing, facts, concepts, instructions and representations of knowledge.

Bellinger, Castro and Mills (2004) quoting Rusell Ackoff, classified the content of the human mind into five categories listed as follows:

1. Data: these being symbols of the items they represent;
2. Information: data that are processed to be useful answers to "who", "what", "where", and "when" questions;
3. Knowledge: the application of data and information, answers "how" questions;
4. Understanding: the appreciation of "why"; and
5. Wisdom: evaluated understanding.

Narayana (2010) referred to information as wealth, as it has the capability to fulfill the criteria of material goods in terms of utility, transferability, externality and scarcity. Information is also regarded as combined and summarised data (American Institute of Certified Public Accountants, 2013) depending on its relevance to a particular situation or condition. From another perspective, information is regarded as a tool for authority (Bigdeli, 2007), and an essential factor for development (Bigdeli, 2007 and Abiolu, 2013) and security (Abiolu and Okere, 2009).

Engel, Robbins and Kulp (2011) surveyed the information seeking habits of engineering faculty members at 20 large research institutions from the United States (USA). Their study revealed a heavy reliance on information sources such as scholarly journals, internet resources, and face-to-face discussions with students and colleagues in their research endeavours, with the first two being the main resources. Heavy reliance of engineers on internal sources, such as interpersonal communication with colleagues is part of what studies have identified (Fidel and Green, 2004). In a case study on information seeking behaviour and user satisfaction of university instructors, Rafiq and Ameen (2009) demonstrated that books, journal articles, communication with colleagues and friends (interpersonal communication) in industry were the most valued sources of information. Other preferred formats in the same study included electronic, digital and print formats and audio-visual

materials while the most used sources are the Internet and email followed by CD-ROM and e-journals. The least used are website and OPAC of other libraries.

In an investigation on the information needs and seeking habits of Iranian engineers in an agro-industry, Bigdeli (2007) using Turkey test, collected information from 250 engineers working on sugar-cane and by-products at Khuzestan. This researcher's study confirmed that engineers working in various areas demonstrated significant difference in their information-seeking behaviour. The findings also showed that Persian books, periodicals, and English books ranked first, second and third respectively among the various information sources used by the respondents. Bigdeli (2007) also found that engineers used informal channels more than formal channels (libraries and other information centres). The greatest motivation for obtaining information by engineers includes increasing their knowledge, staying current in the professional trends and the need to access recent research findings. The study participants' constraints included the long working hours and distance between respondents working place and information centre, with the lack of time being the greatest constraint.

In a study of information needs of faculty members in a private university in Nigeria, Nandozie and Nnadozie (2008) suggested that faculty contributed to the goals of teaching, research and community service using information sources such as journals, monographs/textbooks, and newspapers/magazines more than other sources. They also used non-book sources including the internet and online databases, computers and television set while radio was less used. Major barriers to accessing information are the non-currency and non-relevance of the sources.

Abdusalami (2013) surveyed the information needs of engineers in the Nigerian Institute of Transport Technology, Zaria using 72 respondents randomly sampled. Unlike the findings of Rafiq and Ameen (2009) and Bidgeli (2007) who found interpersonal communications to be the primary means of exchanging information among their respondents, Abdusalami (2013) found that books, newspapers, theses and research reports were the primary sources of

obtaining engineering information. In all of these findings the internet was of priority, and a well used resource.

Many systems of communication and gathering of information have emerged to the extent that their periodical investigation is necessary. Due to the fact of dynamism and diverse increase in information-bearing sources, librarians and other information workers need to identify those used by each group of professionals especially engineers to enable them know what kind of information, and in what format to provide for their patrons. The era of information scarcity seems to have given way to information overload, and information is borne in many sources ranging from human to print and non-print including electronic types. However researchers (Tackie and Adams, 2007) found that the specific information that engineers need are either not well known or not well understood; there is no intersection between the things known about information-seeking behaviour of engineers and existing information sources and services. There seems to be a limited current research in areas relating to information needed by engineers and the sources they access from this considering their workplace as well as their engineering interests . The rationale for this study arises from the fact the study on information needs of professionals such as engineers appears neglected because of the preoccupation with information systems and not with their users and the fact that getting the necessary information needs' data seems problematic. A caution was therefore raised against the issue of placing undue emphasis on technology against the peculiarity of information itself. This study therefore investigated what the information needs of engineers are and sources used by engineers in meeting such needs. It also looked into the main methods of accessing the information sources by engineers in their areas of interest as they work on their research, development, teaching and other engineering engagements. This information will be useful for librarians and other information workers in ensuring that they are aware of information sources relevant to meeting needs of engineers and therefore provide or promote programmes, products and services borne in those sources that are current, relevant and time-saving with appropriate access to information being required, to be

able to provide the best services possible for the engineers. The five research questions developed for the study are:

1. What are the areas of specialisation/interest of the engineers?
2. In what areas do they need information?
3. What sources do they consult for their information needs?
4. How do they access the information sources?
5. What constraints do they face in using information sources?

Methodology

This quantitative survey investigated the engineering participants during the second annual conference organised by the School of Engineering and Engineering Technology of the Federal University of Technology, Akure, Nigeria, held in August, 2016 in the University's Hilltop Auditorium. A purposive sampling technique was used for the study- the researcher selected these respondents being aware of the conference to be held in the institution and its participants. Questionnaires were randomly administered to 120 engineers in the public or private engineering sectors during the conference. Ethical approval was obtained from the School; and permission to conduct the research was obtained from the conference Chair of the Organising Committee. The instrument used to elicit information from conference participants was a questionnaire which consisted of 13 questions with Likert scale replies, with choices consisting of "yes" or "no" and other options. SPSS software package was used for the descriptive analysis consisting of frequencies and percentages.

Findings and Discussion

Of the 120 questionnaires administered, only 84 were fit for analysis, giving a response rate of 70%, the remainder being returned incomplete or unanswered. The demographics (Table 1) of the respondents indicate that there were more male respondents (89.3%) than females, the majority (45.2%) being aged above 41 and 50 years and many were from the university (44.0%) and polytechnics (42.0%). Considering their qualifications, 40.5% had a PhD degree, with senior lecturers being main respondents (27.4%) and at least a quarter (25%) had

worked for more than 15 years as engineers. The three main areas of specialisation were materials and metallurgy (17.9%), electrical and electronics engineering (EEE, 13.1%), and agricultural engineering (11.9%).

Table 1: Demographics of respondents

Sex	**No**	**(%)**	**Rank**	**No**	**(%)**
Male	75	89.3	Professor	7	8.3
Female	9	10.7	Reader	4	4.8
Age			Senior Lecturer	23	27.4
20-30	4	4.8	Lecturer I	8	9.5
30^{+}- 40	30	35.7	Lecturer II	11	13.1
40^{+}- 50	38	45.2	Assistant Lecturer	6	7.1
Above 50	12	14.3	Teaching Assistant	1	1.2
Respondents' organisations			Chief Engineer	4	4.8
University	37	44.0	Principal Engineer	5	6.0
Polytechnic	35	42.0	Senior Engineer	7	8.3
College	1	1.2	Resident Engineer	1	1.2
Government	3	3.6	Construction Engineer	2	2.4
Private	7	8.4	Pupil Engineer	1	1.2
Missing	1	1.2	Program Analyst	2	2.4
Qualifications			Missing	3	3.6
PhD	34	40.5	**Area of Specialisation**		
Master's degree	26	31.0	Materials & Metallurgy	15	17.9
Post graduate	9	10.7	EEE	11	13.1
Bachelor	13	15.5	Agricultural Engineering.	10	11.9
HND	2	2.4	Civil Engineering	8	9.5
Missing	1	1.2	Mining Engineering	7	8.3
Working experience (years)			Computer Engineering	6	7.2
0-5	19	22.6	Others	27	32.1
5^{+}-10	20	23.8			
10^{+}-15	10	11.9			
15^{+}-20	21	25.0			
Above 20	11	13.1			
Missing	3	3.6			

Areas of information need

From a list of work-related areas, respondents were required to state the areas in which they need information to accomplish their engineering endeavours, and could choose more than one option (Table 2). The two main areas of needs were research regarding their area of interest (79.8%) and keeping abreast of current development (61.9%). The next four highest items were relevant for their work environment ranging between 40.5% and 48%, with the least important being data and products (14.3%).

Table 2: Areas of information needs

S/N	Areas of information needs	Frequency	%
1	Research in engineers' area of interest	67	79.8
2	Current developments in related areas of interest	52	61.9
3	New designs	40	47.6
4	Current developments in any areas of interest	36	42.9
5	Grant preparation	34	40.5
6	Research in product, development in competitive advantage	34	40.5
7	Conference paper presentation	27	32.1
8	Field work	23	27.4
9	Laboratory research	21	25.0
10	Reviews	20	23.8
11	Specific processes and principles	15	17.9
12	Students' supervision	14	16.7
13	Students' lectureship	12	14.3
14	Data and products	12	14.3

These findings are similar to those of Bigdeli (2007), who reported that engineers sought information for knowledge development and expertise, use of new technologies, obtaining up-to-date information and research. Nwagwu and Segilola (2013) reported that the major information needs of their respondents was acquiring more knowledge, especially relating to new discoveries in their field. However, the study's finding here contradicted Engel et al (2011), who found that preparing for students' lectures and conference paper presentation were the main information needs of their respondents.

Sources of information used

The information sources consulted by engineers in meeting their research, academic, engineering and professional responsibilities are presented in Table 2. They were required to choose these sources that they used on a "daily", "weekly", "monthly" and "not used" basis. The information sources were divided into internal and external sources. In this regard, internal sources of information were taken as those provided or made available within the engineers' parent organisations and so such sources are used therein. External sources of information were regarded as those consulted outside the respondents' organisations or simply those that were provided outside the respondents' place of work. All the information sources in Table 2 can also be categorised into formal and informal sources both of which seem to show some overlap with internal and external sources. Examples of formal sources

are library collection, newspapers, textbooks, scholarly journals, databases, reports, patents/standards, codes of practice, government publications. Informal sources include conference attendance, interpersonal communication, social networking activities and emails (Kumar and Hussain 2012, and Kaur and Akhter 2016). Table 3 shows these categories of sources. The most commonly used daily sources were books (52.4%), online journals (44.0%), discussions (46.4%) and newspapers (40.5%). However, these were not the same as the weekly sources, which were email communication with colleagues (28.6%), journals (25.0%), and print reference materials (25.0%). The monthly accessed sources were technical reports (46.4%), and conference attendance and seminal papers (41.7%). The least used daily were visits to engineering sites and projects (9.5%), standards and patents (9.5%), conference attendance and seminal papers (7.1%), organisation's library (4.8%) and IR (3.6%), which differed from those accessed only weekly, monthly or those not used at all.

Table 3: Internal and External Sources of Information used by Respondents

S/N	Information Sources	Responses: Frequency (% are in brackets)			
		Daily	Weekly	Monthly	Not used
	Internal Sources				
1	Books	44 (52.4)	18 (21.4)	12 (14.3)	1 (1.2)
2	Online scholarly journals	37 (44.0)	21 (25.0)	11 (13.1)	1 (1.2)
3	Face-to-face discussion with colleagues	39 (46.4)	12 (14.3)	15 (17.9)	1 (1.2)
4	Newspapers	34 (40.5)	14 (16.7)	10 (11.9)	7 (8.3)
5	Print scholarly journals	25 (29.8)	14 (16.7)	22 (26.2)	5 (6.0)
6	Personal collections	25 (29.8)	12 (14 .3)	16 (19.0)	2 (2.4)
4	E-mail discussion with colleagues	20 (23.8)	24 (28.6)	14 (16.7)	7 (8.3)
4	Engineering databases & other databases	17 (20.2)	19 (22.6)	6 (7.1)	5 (6.0)
5	Print reference materials	17 (20.2)	21 (25.0)	20 (23.8)	6 (7.1)
6	Mentors	15 (17.7)	15 (17.9)	19 (22.6)	8 (9.5)
	Technical reports	12 (14.3)	10 (11.9)	39 (46.4)	4 (4.8)
7	Dissertations/theses	11 (13.1)	14 (16.7)	31 (36.9)	5 (6.0)
8	Government publications	9 (10.7)	11 (13.1)	26 (31.0)	15 (7.9)
9	Conference /seminar papers	6 (7.1)	9 (10.7)	35 (41.7)	8 (9.5)
10	Organisation’s library	4 (4.8)	13 (15.5)	29 (34.5)	12 (14.3)
11	Institutional repository (IR)	3 (3.6)	9 (10.7)	22 (26.2)	17 (20.2)
	External Sources				
13	Social Networking	26 (31.0)	19 (22.6)	7 (8.3)	10 (11.9)
14	Software	20 (23.8)	15 (17.9)	22 (26.2)	5 (6.0)
15	Codes of practice	17 (20.2)	10 (11.9)	20 (23.8)	10 (11.9)
16	Visits to engineering sites and projects	8 (9.5)	13 (15.5)	30 (35.7)	12 (14.3)
	Standards/Patents	8 (9.5)	11 (13.1)	21 (25.0)	15 (7.9)

(Percentages are in brackets)

Out of a list, results indicated that books and scholarly journals were the most popular sources used by the respondents. As shown in this study, the popularity of books, journals and theses/dissertations among engineers reinforces Abdulsalami's (2013) findings of their high use for research purposes. Researchers (Bigdeli, 2007; Engel et. al. 2011) reported that respondents ranked physical books as very important to their engineering and research activities, and stated that the use of journals generally in gaining important information among engineering scholars and researchers continues to attract prominence. Studies have also demonstrated that the use of the Internet, email, electronic networks and other electronic sources is increasing in engineering circles, with advances in information and communications technologies (Fidel and Green 2004; Abudulsalami 2013). Other sources used for meeting engineering information needs include formal sources such as conference papers (Tackie and Adams, 2007), and informal sources such as face-to-face discussion with colleagues **(**Abudulsalami 2013**)**. The finding in this study on the use of online scholarly journals, email discussions, engineering software and social networking sites lends credence to this, confirming the rising use in external and formal sources. Pinelli (1991) and Abdusalami (2013) found interpersonal contacts to be popular sources that were commonly consulted among engineers. The need for information on technical issues was noted, as was found by Magnier-Watanabe and Benton (2013), that Japanese engineers desired accessing technical information (knowledge) from various completed projects and innovative 'technology and market trends for future development tasks'. This study supports other studies (Borg, Alegroth and Runeson 2017) that engineers often tilt towards information sources that are more flexible than those that are otherwise.

Methods of accessing information sources

The respondents were asked to select from a list, as many methods of consulting information as they used (Table 4). Most of them reported accessing information through contact with colleagues (73.8%), personal materials and internet access provision (67.9%), and about 17% used the electronic resources provided by their organisations.

Table 4: Methods of accessing information sources

S/N	Method of accessing information sources	Frequency	(%)
1	Contacts with colleagues	62	73.8
2	Personal materials/procurement	57	67.9
3	Professional bodies	27	32.1
4	Organisation's library	24	28.6
5	Organisation's electronic sources, databases	14	16.7

Accessing information sources through human versus text was well demonstrated by Fidel and Green (2004), who found that engineers did so because they deal with products. The finding in this study on the methods of accessing information however showed that engineers accessed information sources first through informal means, including contacts with friends and members of professional bodies, and thereafter through text or formal means. Karen Hawkins in Research Information (2012/2013) pointed out that engineers normally used literature to be aware of engineering problems and establish whether or not they had been overcome. For formal and/ or documentary methods, engineers would sometimes procure their own copies of information sources, visit the library, or use of internet provided by their employers or make personal provision for their own access. According to Preez (2017), consulting engineers depend not only on people but also on personal collection for information they require. However, these findings disagree with those of Abdulsalami (2013), who reported the internet and reference from periodicals to be the most preferred means of accessing the information-bearing sources needed.

Constraints faced by engineers who seek information

A list of challenges that engineers face when seeking information from various sources to perform their engineering functions was provided, with the respondents being requested to select as all those that applied to them, the results are presented in Table 5. While some of these problems related to organisation factors, others were more personal. The irregular supply of electrical power was identified by 84.5% of respondents as being a major constraint, and this is a perennial problem across Nigeria. Issues related to cost were their next main concerns, followed by inadequate resources. Only one person indicated that

management culture in their organisation was a constraint to their being able to seek information.

Table 5: Constraints faced by Engineers when seeking information

S/N	Constraints	Frequency	(%)
1	Irregular power supply	71	84.5
2	Cost of information materials	59	70.2
3	Inadequate funds to procure these sources	58	69.0
4	Inadequate laboratory equipment and facilities	53	63.1
5	Inadequate library resources	31	36.9
6	Unavailability of the sources	19	22.6
7	Lack of personal expertise	18	21.4
8	Lack of time	18	21.4
9	Needed information not available in the sources	16	19.0
10	Non-familiarity with the sources	14	16.7
11	Bad management culture	1	1.2

Most of these barriers are premised on insufficient funding of the engineering and information service delivery of the country. The constraints of time (21.4%), lack of expertise (21.4%) and non-familiarity with the sources (16.7%) are what an engineer could overcome with personal will and concerted efforts. Tackie and Adams (2007) noted that unreliable internet service and delay/time constraints in obtaining information could promote lack of useful information in organisational information base, which is detrimental to the work of engineers. Abdulsalami (2013) identified most challenges confronting engineers as incomplete information, the lack of relevant information and constraint due to time factors. He noted that librarians' professional roles in making information available and easy to locate should be more reflected.

Conclusion and Recommendations

The world is in an information-based era and thus information is needed for any profession including engineering. The study findings have confirmed that information is relevant to engineers in the course of their duties especially in research, development, new designs and grant preparation. These findings also confirmed that identifiable sources such as print and electronic resources including books and scholarly journals, technical reports, interpersonal communication were important sources through which engineers could obtain information

from. The various means of accessing these sources as preferred by respondents include interpersonal contacts with colleagues, personal procurement of information sources and professional associations. Respondents' use of libraries and their organisations' database as a means of accessing information is at a low ebb. Although, the constraints associated with meeting respondents' information needs have been identified above, most of the constraints are organisationally-based, needing financial attention. The study suggests that engineering workshops or laboratories and libraries must be well equipped with up-to-date, relevant and easily accessible information-bearing resources and facilities. Adequate fund must therefore be provided regularly to procure and maintain these resources, equipment and facilities. Since engineers depend on information sources, there must be training and retraining for them to be able to share current and relevant information among themselves from time to time. The success of providing relevant information sources and engineering equipment has a bearing on engineering roles to enable engineers eject relevant transformation of scientific and technical information into novelty for the common good of all and remain people-serving professionals.

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