Jewel Journal of Librarianship
ISSN: 2141-3908 (Print); ISSN: 2736-0881 (Online)
Volume 16, Issue 2; Published: June, 2021
https://www.jeweljournals.com

Information-seeking Behaviour and Information-access Challenges of National Industrial Engineers

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Abstract

Studying engineers in diverse organizations where they work can never be too much because of their complex nature and the assorted tasks they are involved in. This study sought to investigate the information-seeking behaviour and information-access challenges of national industrial engineers. A survey research design was adopted. Total population sampling, a type of purposive sampling technique was employed. A structured questionnaire was distributed to all the 31 national engineers of a foremost federal research institute in Nigeria. Data analysis was univariate using descriptive statistics of percentages. The study revealed that Internet sources were the most frequently used of the information sources. Findings on the kinds of subject information, revealed that information on fundamental areas of industrial engineering were not satisfactorily sought. Poor infrastructure, poor research environment and lack of recent books were revealed as topmost challenges faced in accessing information. Despite the study's limitation of adopting a small and non-probabilistic sample, it evidently shows that national industrial engineers utilize many human and non-human information sources at significantly high levels simultaneously. Consequently, provision must be made for all these information sources.

Keywords: Information access; information-seeking behaviour; information sources; national industrial engineers; non-academic engineers

Introduction

Engineers of numerous specialties have been well studied in the field of information behaviour. Of course, studying engineers in diverse organizations where they work can never be too much because of their complex nature and the assorted tasks they are involved in (Fidel & Green, 2004). Engineers' traits will result in changing needs and behaviours per time and certainly varying information requirements. Engineers have been found to influence in no small way the economy of a nation and their tasks largely depend on the ability to find, use, and share information (Allard *et al.*, 2009). Saab *et al.* (2018) illustrate information behaviour to be the whole behaviour exhibited by an individual, which corresponds with sources and channels of information, plus functional and unreceptive information seeking and use. If information behaviour represents the entirety of human behaviour integrating sources and channels, this purports that information-seeking behaviour is a part of information

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behaviour (Kuske *et al.*, 2017), and it has to be suitably studied especially with respect to an institution that seeks to satisfy its engineering personnel. Zha *et al.* (2015) portray information-seeking behaviour as the need to get one's purpose or ambition gratified leading to conscious seeking of information. Naturally, it is expected that any individual or an expert when searching and seeking a desired information (information need) will consult information sources (either manual or electronic based) to achieve his/her goals with inherent challenges embedded in this process that must be overcome.

Reddy et al. (2018) emphasize the importance of knowing the elemental attributes of every user of scientific information and the use that the information obtained is set to achieve. They stress that this insight will uncover a number of unknown features on users' approach to obtaining information and will eventually influence how scientific information will be stored and retrieved. The implementation of this assertion would positively affect the judicious use of limited funds in addressing core material needs of users in our days of shrinking library budget. In our study, we will underline that the prioritization of the evaluation of information-seeking behaviour of national industrial engineers will be of great advantage to all stakeholders in our study industry. This study will in the end if applied: try to inspire the design of information systems and services that will be employed in the library towards knowledge enhancement of national industrial engineers, assist the library/information professionals in adequate information delivery and support, and the formulation of well-directed information policies by the appropriate authorities aimed at assisting the research activities of national industrial engineers. Subsequently, national industrial engineers will be well-armed with information that will in turn bring about innovations for economic advancement.

Statement of the problem

For years, researchers have struggled conceptually and empirically with the information needs, seeking, and use of engineers in general and particularly those in research and development (Kwasitsu, 2003). Kaufman *et al.* (2019) have made it evident that "the design of effective information systems, publications, instruction, and services that are relevant to engineers in all contexts rely on knowing about their current needs and likely future wants related to high quality information resources". Therefore, researching to find out specifics on the information-seeking behaviour of a desired group of engineers will contribute in no little way to this field's literature.

So many studies have been carried out to find out the information-seeking behaviour of engineers in various non-academic establishments. Studies outside Nigeria include Allard et al. (2009), Kwasitsu (2003), Leckie *et al.* (1996), Court (1997), Hertzum and Pejtersen (2000), Ansari and Kumar (2010), Chaudhry and Al-Mahmud (2015), Wellings and Casselden (2019), and Phillips et al. (2019), amongst others. Studies within Nigeria include Abdulsalami (2013), Nwagwu and Segilola (2013), Edonkumoh *et al.* (2015), Makinde et al. (2019a), Makinde *et al.* (2019b), and Makinde *et al.* (2020). Clearly, in Nigeria, Abdulsalami (2013), Makinde *et al.* (2019a), Makinde *et al.* (2019b), and Makinde *et al.* (2020) focused on national institutions having engineers.

Regarding Abdulsalami's (2013) study, transport engineers working at the Nigerian Institute of Transport Technology under the Federal Ministry of Transportation were surveyed (not engineers under the Federal Ministry of Science and Technology). Makinde *et al.* (2019a), Makinde *et al.* (2019b), and Makinde *et al.* (2020) studied science and technology researchers (including engineers) as industrial researchers. But, national industrial engineers were not

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studied as a distinct unit as to determine and single out their information-seeking behaviour. But then again, it is pertinent to ask questions such as: Are the information-seeking behaviours of engineers in these above-mentioned non-academic establishments the same with that of our study engineers? Will this study be identical or dissimilar when compared to previous studies on non-academic engineers?

Research questions

The following are the research questions:

- What categories of information sources do national industrial engineers utilize in their daily undertakings to find important information?
- What kinds of subject information do national industrial engineers access from the information sources categories?
- What challenges are faced by national industrial engineers in accessing information?
- Are attributes of information-seeking behaviour of national industrial engineers similar to previously studied non-academic engineers?

Review of related literature

The review of related literature is important to give this study the needed foundation on which our results, discussion and conclusion will be built. Non-academic engineers are found in many settings including research and development organizations, industrial environments, construction firms, innovative high-tech firms, multinational engineering design corporations, and many others. By and large, several extant studies have shown that engineers use a collection of information sources with accompanying information-seeking behaviours. These exhibited information-seeking behaviours of engineers will depend on their tasks and workplaces (Kaufman *et al.*, 2019). The information-seeking behaviours of non-academic engineers based on previous related studies are hereby discussed in following subsection.

Information seeking behaviours of non-academic engineers

In their analyses, Kwasitsu (2003), Court (1997), Ellis and Haugan (1997), and Edonkumoh *et al.* (2015) identified the outstanding utilization of human information sources by engineers in non-academic settings. Court (1997) found that non-academic engineers as designers trusted their personal knowledge especially their ability to recall in the course of their design activities. However, Ellis and Haugan (1997) ascertained that non-academic engineers in keeping up to date (using information) in an industrial environment relied on internal communication in their specific departments. Kwasitsu (2003) pinpointed that of the 11 categories of information sources examined, the studied groups of engineers (design engineers, process engineers and manufacturing engineers) majorly preferred people in their own business groups (more than two-third of the respondents) followed by their own memory (close to two-third of the respondents). Edonkumoh *et al.* (2015) detected that non-academic engineers majorly consulted interpersonal communication, that is, colleagues/expatriates as an information source as they engage in their tasks.

Robinson (2010), in his study uncovered that non-academic engineers applied a substantial part of their time using non-human sources and not human sources to find information. Correspondingly, Kwasitsu (2003) ranked the usage of personal files in second place, and close to two-third of the non-academic engineers in his study utilized this source. Though, this source is directly tied to a human source accumulating the information overtime. In a

recent study by Kaufman *et al.* (2019), non-academic engineers judged standards and manuals/spec sheets to be of topmost importance as important publications relevant to their work out of thirteen different types of publications.

Nwagwu and Segilola (2013) disclosed that the Internet source was notably used by non-academic engineers; however, many of them also used colleagues, seminars/workshops/conferences, work team, television and personal collections/magazines/newspapers/lectures/radios as information sources. Likewise, Phillips *et al.* (2019) demonstrated the preference of some selected sources by non-academic engineers as they acquire information. In using the selected sources, more than two third of the non-academic engineers used corporate intranet and also the remaining three out of the first five selected resources (e-journals, databases and eBooks) pointed to the Internet as a constant source.

Allard *et al.* (2009) revealed the expansive usage of the Internet by non-academic engineers to access information in their study. They believed that the change in the information-seeking behaviours of these engineers when compared with so many previous studies might be attributed to advancement in information technology. Although, they established that Google was the most used search engine for finding known materials but some non-academic engineers favoured colleagues in finding responses to poised questions. A current study by Wellings and Casselden (2019) showed that electronic version of sources was preferred over print because of the ease attached to searching them. This is similar to Kaufman *et al.* (2019), where more than two-third of non-academic engineers were inclined to electronic sources considering the format of article read by them. Also, the survey of Kaufman *et al.* (2019) uncovered that non-academic engineers mostly obtain the publications that they read from free websites once they are aware of them.

Abdulsalami (2013) demonstrated that the combination of human and non-human sources was used by non-academic engineers – the percentage of 53 to 47 respectively. Though, the human sources of discussion with librarians/references staff and consultation with colleagues constituted the highest but they were poorly ranked with other used human and non-human sources when one looks at their percentage distribution. Lundin and Eriksson (2018) divulged that non-academic engineers counted on the combination of colleagues (human source) and self-created sources (human source cum non-human source) before other sources were accessed.

Hertzum and Pejtersen (2000) revealed the complex interaction between document and people sources as information sources as non-academic engineers engaged in information-seeking practices which were made clear by the nature of the design tasks they were involved in. They further stated that the technical phase of engineering design is inclined towards design documentation; consequently people sources become indispensable in that they are able to explain and argue puzzling parts of designs documentation. Chaudhry and Al-Mahmud (2015) disclosed that non-academic engineers favoured websites (the Internet), personal documents and colleagues. The survey of Phillips *et al.* (2019) reported that non-academic engineers majorly acquired information from their peers and Google with them favouring their colleagues a little higher than Google. With respect to the library, they reported that half of their surveyed non-academic engineers also acquired information from the library. This is contrary to Kwasitsu (2003), where just a little above a quarter of the surveyed non-academic engineers approved of the library in getting information but the library was still used at least.

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Abdulsalami (2013) showed that information was sought by non-academic engineers for knowledge update (fairly above one third of the respondents) followed by doing research work (close to one third of the respondents) and then writing and presenting paper (a quarter of the respondents). Kaufman *et al.* (2019) reported that journal articles read by non-academic engineers were for research but most likely they read for current awareness or checking facts. The Internet, that was broadly used by the non-academic engineers in the study of Allard *et al.* (2009) was majorly used to source for information pertaining to research, development, and management. These encompassed information related to work-related issues, technical specifications requirements for a conference-paper submission, technical discussions, reference, and monitoring the industry.

Nwagwu and Segilola (2013) reported that engineers majorly sought information for specific information need such as the need to acquire knowledge in their profession (ranked as first) followed by keeping abreast with recent development and for better job performance information. The connection among the studies of Allard *et al.* (2009), Kaufman *et al.* (2019), Abdulsalami (2013), and Nwagwu and Segilola (2013) in relation to information sought by the non-academic engineers is their quest for research and knowledge awareness and updated information. Edonkumoh *et al.* (2015) observed that non-academic engineers sought information types related to their work such as health/safety information and oil/gas information. Comparably, Kwasitsu (2003) revealed that the subject information sought by non-academic engineers also depends on their workplaces and the kinds of tasks carried out. The non-academic engineers in their study repetitively used their industry specific information (product/technical information, technical specifications and preventive maintenance procedures). A similarity among the studies of Allard *et al.* (2009), Kwasitsu (2003), and Abdulsalami (2013) is the sourcing of conference-related information by the non-academic engineers. Non-academic engineers are expected to attend conferences where they communicate their research findings to their peers.

The problems faced by non-academic engineers in obtaining job-related information have been found as knowing where to look for information, information overload, and unavailable information (Kwasitsu, 2003). Similarly, the frustrations (challenges) experienced by practicing engineers (non-academic engineers) as they collect information for their latest projects were concluded as locating, evaluating and accessing information (Phillips *et al.*, 2019). These challenges are identical to the problems pinpointed by Kwasitsu (2003), in that, looking for information addresses locating information and both information overload and unavailable information talk about information access. Likewise, Abdulsalami (2013) majorly identified the challenge of accessibility as an impediment to seeking information by non-academic engineers. The factor of accessibility became apparent when the engineers pointed to challenges such as materials paucity, difficulty in locating information sources in the library, information overload, catalogues issues and dated information materials. Lack of organizational support was identified to hinder information access for non-academic engineers and the need for information literacy training courses to assist them to make the best use of available information was also conspicuous (Chaudhry & Al-Mahmud, 2015). Relatedly, accessibility issues (accessing desired information from existing systems) along with reliability (credibility of an existing information source) were also found to be leading challenges faced by non-academic engineers as they sought information (Edonkumoh *et al.*, 2015).

Methodology

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The study was conducted at the Federal Institute of Industrial Research Oshodi (FIIRO) located in Lagos State in Nigeria. This paper is the part of a doctoral project concentrating on the information behaviour of national industrial researchers. The institute and her national industrial engineers working in the Department of Project Design and Development were preferred for this study because: (1) the researcher worked in the institute's library and at different times many of the national industrial engineers complained about their information-seeking behaviour not being well understood and undeniably their information needs were not sufficiently met (2) it is a leading national research organization (created in 1956) and supervised by the Federal Ministry of Science and Technology, therefore, applicable findings and conclusion can be deduced from the responses of the institute's national industrial engineers. Unquestionably, national industrial engineers are needed in the process of attaining industrialization because of the ample food processing techniques, and locally-fabricated machines and equipment they have produced, and are expected to invent as they carry out research.

All the 31 national industrial engineers of the institute were selected using nonprobability sampling method of total population sampling - a type of purposive sampling technique. This was certainly because of their concentration and proximity. Data used for this study were mainly primary and were obtained from these engineers using a structured survey questionnaire. A survey was chosen because by the way of its application, standardized questions when presented to the respondents can homogeneously and reliably collect and investigate desired information (Bhattacherjee, 2012). In designing the survey questionnaire, a professional colleague and two senior researchers in library and information science criticized the content, language, and format of the questions. Further, the questionnaire was pretested on four national industrial engineers in the target population to verify its clarity and appropriateness.

The pre-test showed that the questionnaire was understandable and explicit to the respondents in the target population, requiring only slight revisions. The copies of the questionnaire were administered to the respondents, regrettably, only 22 out of 31 copies of the questionnaire (a response rate of 71%) were returned. This was due to some of them being on leave, the work schedules of some of these engineers, and the fear that it might be a fact-finding project by some researchers, and the possibility of being victimized as civil servants. However, errors were identified in two copies of the questionnaire and they were discarded and not analysed. Hence, usable returns totalled 20 (64.5%). The key themes covered in the questionnaire were demographic information, information sources utilized, information types, and factors responsible for the difficulty faced by national industrial engineers in accessing information. Data analysis was univariate using descriptive statistics of percentages. Due to the small sample size, our research does not make generalizations about the wider population. Since our survey respondents are non-academic, our results will be compared with the studies on non-academic engineers that were earlier discussed in the review of related literature in order to reveal similarities and differences.

Results

Demographic background of national industrial engineers

Table 1 shows the demographic information of the survey respondents. The respondents were 85% male and 15% female. More than half of the respondents (60%) reported that they were of the age range, 20 to 49 years. More than half of the respondents (60%) reported possessing

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either a master or a doctoral degree with respect to educational qualification. More than half of the respondents (60%) reported that they had 11 to 26+ years of work experience.

Table 1 – Demographic background of national industrial engineers

Variables	**Total responses (%)**
Gender	
Male	85.0
Female	15.0
Age	
20-29 years	15.0
30-39 years	30.0
40-49 years	15.0
50+ years	40.0
Education Qualification	
Bachelor's degree	10.0
Postgraduate diploma	30.0
Master's degree	35.0
DPhil/PhD	25.0
Work Experience	
1-5 years	25.0
6-10 years	15.0
11-15 years	15.0
16-20 years	10.0
21-25 years	5.0
26+ years	30.0

National industrial engineers' information sources

National industrial engineers were asked to indicate the information sources that they frequently use (Table 2). Information sources were listed out as journal articles, books, professional meetings/workshops, research reports/patents/factsheets, technical reports, pamphlets/leaflets, Internet sources, newsletters, library catalogues, face to face conversation/discussions with colleagues, knowledgeable persons in the field, review articles, indexes and abstracts of journals, emails/blogs/webinars/discussion fora, librarians/library staff, sources of contents, theses and dissertations and conference abstracts and proceedings. In order to evaluate the frequency of usage of the information sources, the respondents were asked to rank information sources usage on a response scale of 1 to 3 (often – 1, sometimes – 2, and never – 3). Since often and sometimes represented positive responses of levels of usage, they were considered singly and added together so that each information source gets a percentage value (Table 2).

When considered individually, Internet sources were indicated by 100% of the respondents at the highest frequency level of often. It was followed by both newsletters and library catalogues (tied at 95%) and the least were theses and dissertations (5%). In terms of adding the levels of usage (often, plus sometimes), each of the information sources totalled to 100% with the exception of review articles, indexes and abstracts of journals, emails/blogs/webinars/discussion fora and librarians/library staff (each being 95%), sources of contents and theses and dissertations (each being 90%) and conference abstracts and

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proceedings (50%). These data indicate that some of the respondents did not tick these information sources in the questionnaire because they considered them unused in the course of their work. This observation is also supported by the different levels of information sources that were never used by the respondents (Table 2).

Table 2 – Sources of information	Total responses	Sources of information Often (%)	Sometimes (%)	Never (%)
Journal articles	**90.0**	**10.0**		0.0
Books	**60.0**	**40.0**		0.0
Professional meetings/workshops	**55.0**	**45.0**		0.0
Research reports/patents/factsheets	**70.0**	**30.0**		0.0
Technical reports	**70.0**	**30.0**		0.0
Pamphlets/leaflets	**70.0**	**30.0**		0.0
Internet sources	**100.0** **	**0.0**		0.0
Newsletters	**95.0**	**5.0**		0.0
Library catalogues	**95.0**	**5.0**		0.0
Face to face conversation/discussions with colleagues	**40.0**	**60.0**		0.0
Knowledgeable persons in the field	**90.0**	**10.0**		0.0
Review articles	**65.0**	**30.0**		5.0
Indexes and abstracts of journals	**30.0**	**65.0**		5.0
Emails/blogs/webinars/discussion fora	**25.0**	**70.0**		5.0
Librarians/library staff	**10.0**	**85.0**		5.0
Sources of contents	**10.0**	**80.0**		10.0
Theses and dissertations	5.0	85.0		10.0
Conference abstracts and proceedings	20.0	30.0		0.0

* Multiple responses received

**Internet sources are considered as the most used information source (100% at the highest frequency level of often)

Because Internet sources were reported as the most frequently used of the information sources, the national industrial engineers were required to specify the Internet-related information sources utilized in the field of science and technology and the location where they were accessed. The Internet-related information sources included an academic social network, academic search engines as well as some science and technology databases (Figure 1). Multiple responses were allowed. Majority of the respondents considered Google Scholar and Science Citation Index Expanded as core Internet-based information sources with both tied and marked by 80% of the respondents. SciFinder Scholar on the Web was the least Internet-based information source indicated by 5% of the respondents. When asked about the location for accessing Internet-based information sources, the majority of the respondents (64.9%) regarded their homes as the most common location, 18.4% indicated office, 8.8% mentioned another library apart from institute's library and 6.1% chose institute's library.

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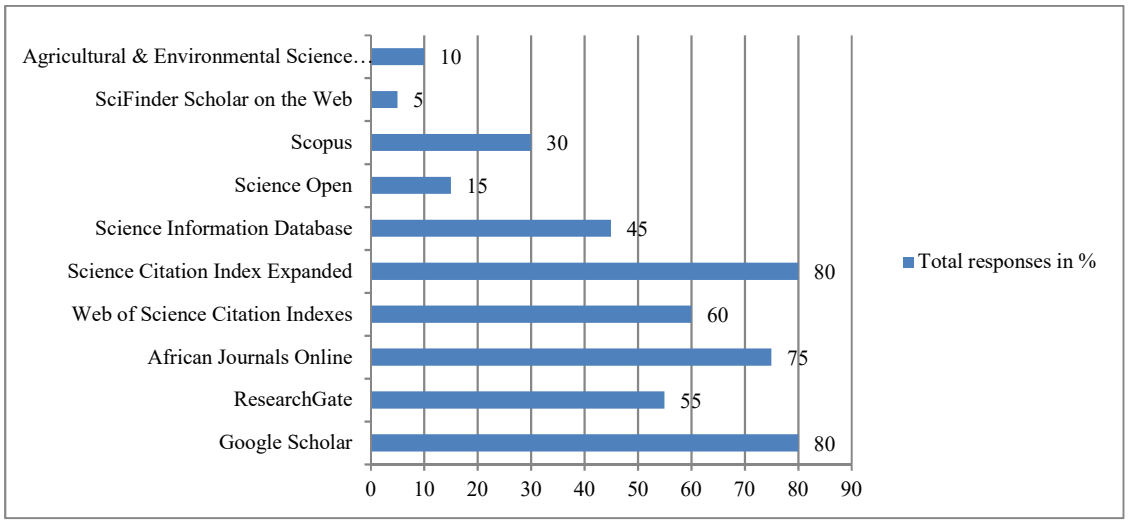

Figure 1 – Internet-related information sources in the field of science and technology

Since the respondents tremendously utilized Internet sources, respondents were also asked about the frequency that they accessed online journals from the institute's library. This was done to evaluate the library in relation to e-journal provision just as journal articles were also satisfactory rated as an information source in this study. Eighty percent of the respondents accessed online journals outside the institute's library often, 20% sometimes did and 0% indicated never. From what channel did the respondents obtain journal articles? Respondents obtained journals in this decreasing order: electronic archive (70%), Internet sources using Google and Yahoo (65%), personal subscription to online version (60%), personal subscription to print journal (45%), document delivery (5%), and library online/electronic version, library print subscription and interlibrary loan all tied at 0% (not favoured at all by the respondents). Respondents were also asked about their information sources preference from the options of print copy only, electronic copy only and both (print and electronic copy). Fifty percent favoured both print and electronic, print copy only (35%) and electronic copy only (15%).

Kinds of subject information sought by national industrial engineers

National industrial engineers were asked to indicate the kinds of subject information sought by them by the way of reporting information types that they sought (Figure 2). Information types were listed out as analytical research, food safety & quality management, laboratory management & services, polymer & textiles, electrical & electronics engineering, fabrication technology, packing technology, nutrition & toxicology, agricultural sciences, microbiology, biochemistry, baking & milling, mechanical engineering, enzyme technology and analytical marketing. Others were pulp & paper technology, production, chemical technology, project & process development, materials development & metallurgy, works & services, environmental technology, product development, product quality evaluation, waste biology & fermentation, molecular biology & genetics and prototype equipment design & specifications. Respondents were also encouraged to specify any other information types that they sought.

With multiple responses allowed, Figure 2 illustrates that respondents sought approximately 30% of all the information types. The sought subject information by the majority of the respondents was mechanical engineering (75%), product development (65%), and agricultural sciences (60%). Over one third of the respondents sought for subject information on project and process development, prototype equipment and design specification, materials

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development and metallurgy, and fabrication technology. Less than one third of the respondents sought subject information on works and services.

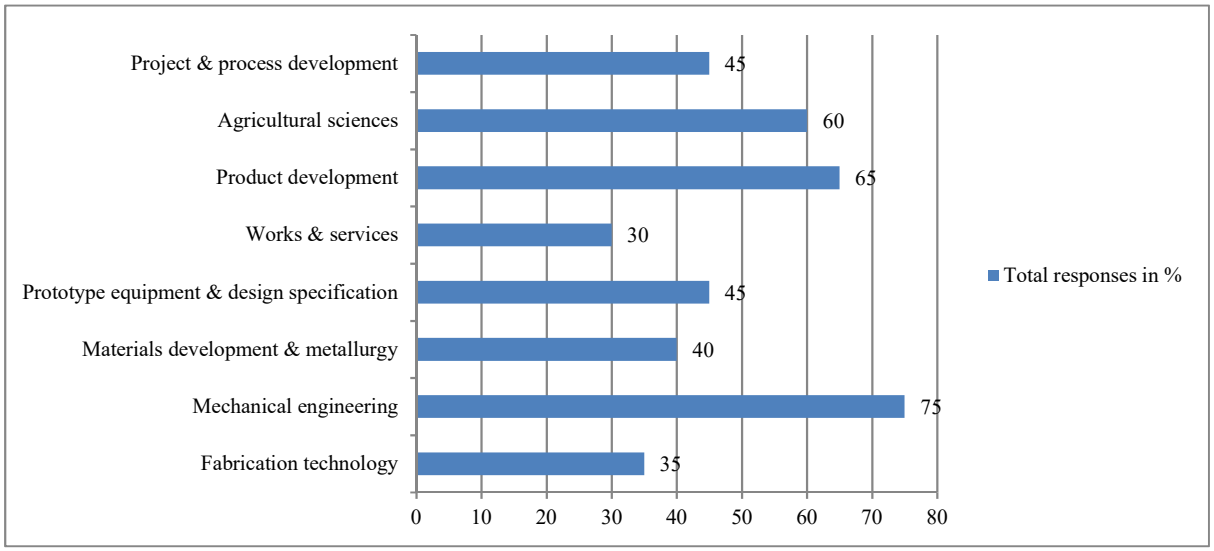

Figure 2 – Types of information

However, it is surprising that some of the areas were indicated lowly by the national industrial engineers despite being core engineering specialties (Figure 2). Also, information on other fundamental areas such as electrical and electronics engineering, computer engineering, environmental engineering, chemical engineering, and management aspect of engineering were not mentioned.

The engineers were also asked to reveal the purpose why they sought the information types. The responses were as follows: when carrying out research (100%), to solve personal needs (75%), when attending to clients' needs [consultation] (60%), for general awareness (45%), for attending to academic needs (35%), and for work related discussions (25%).

Challenges faced in accessing information

What are the challenges faced by national industrial engineers in accessing information? From the survey, eight challenges were evaluated by the national industrial engineers (Figure 3). These challenges were barriers to the pursuit of information for better engineering innovation. Although, nine challenges were initially identified at the pilot stage but at the actual survey stage, declining budgets and rising costs were not chosen by any of the national industrial engineers. Multiple responses were allowed; more than half of the challenges listed did not get favourable responses. Therefore, lack of awareness, cost of accessing information, information explosion, and library staff appeared not to be serious challenges faced in accessing information. Responses indicated that the most serious challenge was poor infrastructure (75.0%). Other serious challenges were poor research environment (65%) and lack of recent books (60%). One quarter of the responses pointed to bibliographic obstacles.

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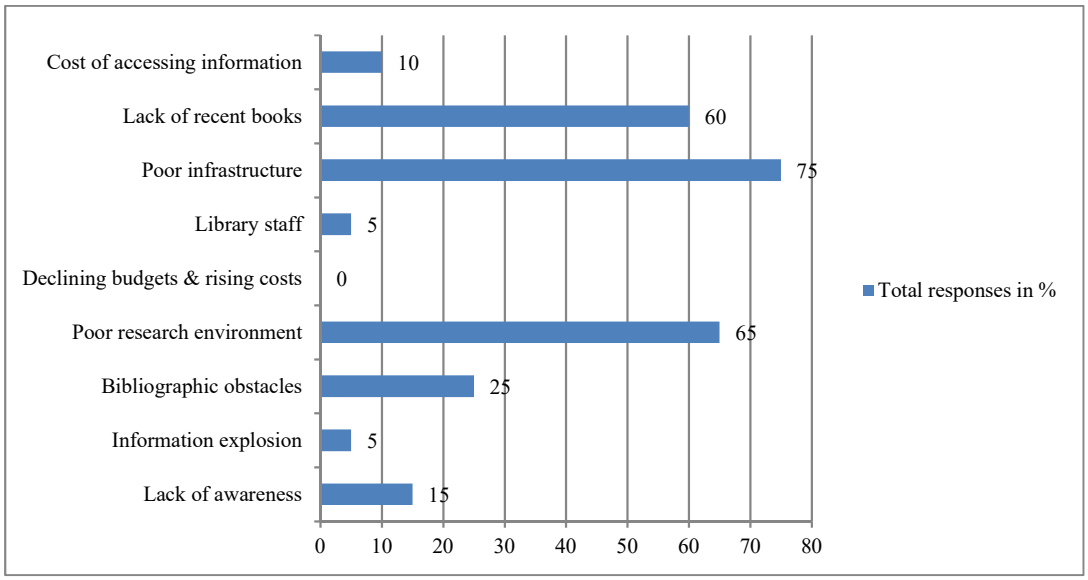

Figure 3 – Challenges faced in accessing information

Discussion

As mentioned earlier, experts as human beings are expected to exhibit different kinds of information behaviour – national industrial engineers in this study will not be an exception. National industrial engineers in the face of either a scarcity or an overload of information are expected to reveal their own kind of information-seeking behaviour. This will impact information provision to this group of experts in view of important resources, services and systems that will be made available to them after understanding their needs. This study investigated these needs by considering, utilized information sources, sought kinds of subject information, challenges faced in accessing information, among other things. Regarding the circumstances of findings from previous works, our results mutually exhibit connections and variations.

The eighteen different groups of information sources in our study were well utilized in terms of usage frequency by the national industrial engineers. This result is in line with the studies of Kwasitsu (2003), Ansari and Kumar (2010), Chaudhry and Al-Mahmud (2015), Abdulsalami (2013), Nwagwu and Segilola (2013), and Edonkumoh *et al.* (2015); and even recent studies such as Wellings and Casselden (2019) and Phillips *et al.* (2019). This result establishes the fact that national industrial engineers just like non-academic engineers consult a variety of information sources for their works. It is worth mentioning that in our study, all the listed information sources were used at varying high levels of frequency by these engineers unlike prior studies. This clear observation suggests that all the information sources are important to national industrial engineers. Our result is also consistent with the studies of Hertzum and Pejtersen (2000),

Chaudhry and Al-Mahmud (2015), Wellings and Casselden (2019), Abdulsalami (2013), and Lundin and Eriksson (2018), where their findings showed that non-academic engineers used a combination of human and non-human information sources in obtaining information. In contradiction with some earlier findings, our result do not agree with the studies of Kwasitsu (2003), Court (1997), Edonkumoh *et al.* (2015), and Ellis and Haugan (1997) that tilted towards human information source utilization in the form of personal knowledge, communication with colleagues, communication with experts and consultation with

librarians/library staff. Also, our result refutes the studies of Allard *et al.* (2009), Kaufman *et al.* (2019), Phillips *et al.* (2019), Robinson (2010), and Nwagwu and Segilola (2013) that favoured non-human information source exploitation as non-academic engineers engage in their undertakings. Overall, these characteristics suggest that librarians and information professionals, information systems experts and administrators must put all these used information sources into consideration when planning for information provision for this category of engineers – a holistic information-provision-strategy must be adopted.

Also, it should be noted that all the national industrial engineers used the Internet at the highest frequency level of often meaning that they intensely used the Internet to find information. Regarding this high usage in our study, our result is in good agreement with the earlier studies of Allard *et al.* (2009), Kwasitsu (2003), Kaufman *et al.* (2019), Wellings and Casselden (2019), Phillips *et al.* (2019), and Nwagwu and Segilola (2013). This is an indication that national industrial engineers as non-academic engineers also follow the trend of information technology revolution where ease and adaptability are attached to obtaining information. This is also supported by another result in this study, where the engineers appreciably used a variety of Internet-related information sources. Contrariwise, half of the respondents favoured the combination of both print and electronic copy in relation to information sources preference. This paper has not confirmed previous studies of Kaufman *et al.* (2019) and Wellings and Casselden (2019), where non-academic engineers were more inclined to electronic sources. It is worth noting here that the respondents desire physical contact with information sources (despite contemporary attachment to electronic sources). Therefore, library/librarians should work effectively in the provision of recent hard copies of journal articles, books, research reports, technical reports, standards, and so on, and not just electronic sources. The two sources should be complementary.

With respect to the library, it is visible that the institute's library is not well utilized by the respondents. Studies such as Kwasitsu (2003), Wellings and Casselden (2019), Phillips *et al.* (2019), Nwagwu and Segilola (2013), and Edonkumoh *et al.* (2019) point to the fact that non-academic engineers used the library in sourcing for information to carry out their works even if it was at different levels of usage. Results in our study that revealed poor utilization of the institute's library included: just a tenth of the respondents used librarian/library staff information source; respondents' homes were mostly the location where Internet-based information sources were accessed; majority of the respondents accessed e-journals outside the institute's library; library online/electronic version, library print subscription and interlibrary loan were not indicated at all by the respondents as channels for obtaining journals; and major problems to information access included poor infrastructure and research environment and the lack of recent books. These stated impediments also hint at erratic or lack of provision of Internet connection in the library and the institute. Interlibrary loan and its related service of document delivery were not sufficiently used by the respondents. The institute's management, librarians and information professionals should consider these services as viable means of reawakening the library to render quality information services to the respondents.

Non-academic engineers have been found to seek for information that relate to the mandate of the organization where they work - it is also true concerning our survey respondents. But, they sought for a few of the subject information listed in our questionnaire. To a greater extent, the sought subject information: works and services, fabrication technology, materials development and metallurgy, prototype equipment and design specification, and project and process development were not sufficiently sought the way they should (considering the low

Jewel Journal of Librarianship
ISSN: 2141-3908 (Print); ISSN: 2736-0881 (Online)
Volume 16, Issue 2; Published: June, 2021
https://www.jeweljournals.com

percentages). Also, information on other fundamental areas in industrial engineering research such as electrical and electronics engineering, computer engineering, environmental engineering, chemical engineering, and management aspect of engineering were not mentioned by the respondents. The poorly indicated subject information and the fundamental areas that were not mentioned should be of utmost importance to national industrial engineers working at a national industrial institute. This is a pointer to the poor utilization of information that could be as a result of: poor interaction among the engineers, the library lacking updated information sources, librarians and information professionals not doing enough to understand engineers' information needs, and lastly, engineers not adequately linking up with librarians and information specialists. Quarterly survey can be done in order for librarians and information specialists to understand engineers' information needs. Ultimately, this will greatly assist in collection development and management.

All the engineers (100%) sought for research information and two third of the respondents sought for consultation information (for attending to clients). This is corroborated by the studies of Allard *et al.* (2009), Kaufman *et al.* (2019), Abdulsalami (2013), Nwagwu and Segilola (2013), and Edonkumoh *et al.* (2019), where non-academic engineers sought information for: research, knowledge update and better job performance. This is not surprising as national industrial engineers who are not in academic settings are expected to do a lot of research and get involved in consultancy work where they sell innovations and relate their research findings to clients. This is also supported in the study by the demographic information of the respondents where majority of them possessed master and doctorate qualifications and were also found in the higher work experience categories. Another thing to look into is that just a quarter of the respondents sought information types for the purpose of work-related discussions. This translates into why a few of the respondents never used blogs/webinars/discussion fora as information sources. The librarians and the respondents can tackle this information gap by the creation of intellectual discussion fora in a library space or an office space. This can also be done electronically with the revitalization of Internet connection.

An academic social network, academic search engines and some science and technology databases were all mentioned among Internet-related information sources used by the respondents. In fact, Google Scholar (an academic search engine) and ResearchGate (an academic social network) had favourable responses from the engineers. These results substantiate previous findings in the literature [such as Allard *et al.* (2009), Kaufman *et al.* (2019), Wellings and Casselden (2019), and Phillips *et al.* (2019)], where academic social networks and search engines were used by non-academic engineers in accessing information. In addition, the studies of Phillips *et al.* (2019) and Wellings and Casselden (2019) are in complete agreement with the national industrial engineers in our study with them using science and technology databases for their works. It should be emphasized that there are a few collections of science and technology databases used by the respondents and half of them were poorly utilized by the respondents. Again, our results show that the respondents rely heavily on Google and Google Scholar. These findings are not good pointers to the enjoyment of quality information for engineering research by the respondents and also not a good sign of the robustness of the library in providing research information. How do respondents utilize and enjoy invaluable materials that are not on Google Scholar? Obviously, it will be difficult. Google should be an initiation point in obtaining information and many specialist databases should be in place among the proven services provided by the library.

As earlier stated, poor infrastructure, poor research environment and lack of recent books are the topmost challenges faced in accessing information. These challenges in obtaining quality information were also revealed in the earlier works of Phillips *et al.* (2019), Abdulsalami (2013), and Edonkumoh *et al.* (2019). Remarkably, these challenges apply to most research libraries in developing countries. Mentioning this might look like too much criticism of an issue that has been well discussed in the literature. But it should be reiterated, that infrastructural development, excellent research environment, and recent publications are key to the provision of the right kind of information services for the national industrial engineers. It is important to highlight that it is surprising that the costs of accessing information were rated among the least challenges faced in accessing information even with the greater part of the respondents accessing Internet-based information sources from their homes. This occurrence should have cost implication since most civil servants complain of poor pay. In addition, a quarter of the respondents pointed to bibliographic obstacles. This implies that the training and retraining of librarians/library staff in bibliographic technicalities and the respondents in bibliographic rudiments should be prioritized. Also, bibliographic reorganization of the institute's library should be done to increase accessibility to publications by the respondents.

Conclusion

This article presents a broad view of current information-seeking behaviour and information-access challenges of national industrial engineers. The intent is to contribute our quota to a mutable subject in the library and information science research literature, therefore, opening up further research on this group of experts since they are major players in national industrial development. However, the results of this study must be well-thought-out within the perspective of its limitations. Among the limitations of this study are inadequate funding, insufficient time (not allowing wider coverage of national industrial engineers) and the adoption of a small and non-probabilistic sample. Nevertheless, our results show that national industrial engineers can utilize many human and non-human information sources at significantly high levels at the same time and the major location where they access information is their homes when they seek information for their tasks. This study's discovery is expected to trigger further research and discussion now and in the future.

Nevertheless, the results of this study should be an addition to existing knowledge rather than taken entirely as a new knowledge especially as it relates to engineers working in national institutes that their research focus is on industrial development. Even more, this study should stimulate library and information professionals to research and deeply know the information behaviour of national industrial engineers. The goal is to satisfy this specialists group's information needs (relating to information sources/services provision) in order to enhance their productivity and in turn, national economic development.

Recommendations

The following are recommended based on the findings from the research questions:

- Librarians and information professionals, information systems experts and administrators must ensure that wide-ranging and sufficient information sources are provided to the national industrial engineers since all the listed information sources are used at high levels of frequency.

- The institute's management, librarians and information professionals should consider electronic library services as viable means of promoting or stimulating the library to render quality information services to the engineers.
- Since there are pointers to poor utilization of information, librarians and information professionals must do enough to understand and make provision for engineers' information needs. This can be done by frequent surveys to know engineers' information needs, and creation of information need profiles for different engineers.
- The management should endeavour to improve library infrastructure by providing good research environment in the library and provision of recent print and non-print resources.
- The national industrial engineers exhibit both similarities and differences in terms of their information-seeking-behaviour attributes compared to previously studied non-academic engineers. By and large, all information sources must be provided to the engineers in an objective manner based on their current information need demands. This calls for a constant research on national industrial engineers' ever-changing information-seeking behaviour.

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