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# Librarians, Research scientists and ICT adoption in research institutes in Ghana

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From the 1990s, the world was poised towards witnessing of two important revolutions: first was the fall of the Berlin wall which ended communism in Eastern Europe and Germany with a history of cold war, superpower and European integration, (Maier 1999). The second is the advent of Information and Communications Technology, which came in to impact every aspect of human endeavor. Information and Communications Technology (ICT) a general term that englobes mostly communication devices or applications including radio, television, cellular phones, computers and its networks such as the internet, satellite system and many more services associated with them. The Organization for Economic Cooperation and Development (OECD) on its part has defines ICT goods as those items:

*"intended to fulfill the function of information processing and communication by electronic means, including transmission or display, or which use electronic processing to detect, measure, and/or record physical phenomena, or to control a physical process"*.

As a result of increased communication, this era re-awakened post-colonial Africa as dictatorial regimes were set to suffer a devastating defeat to multiparty democracy, with pressure from Western donors. Consequently, some of these developing countries took bold steps toward embracing ICT as a way of doing business.

Statement of the Problem

The role of Research and Development (R&D) in a developing country is well documented. In this paper, we focus on two groups: librarians and research scientist working in research institutes in Ghana whose work have a direct bearing on R&D in their quest to contribute to

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national development. Librarians are critical players in the information industry, standing between the information creator and the user. Their actions or inactions can impact information flow positively or negatively which can have a dire repercussion on industry. In this 21st century, the least they require is the right technologies for optimum delivery. Available literature suggests Africa doubled up its research output over the last decade, a move towards knowledge based economy. Working on Africa's scholarly and research contribution, Schemm (2014) writes:

*"From 1996 to 2012, the number of research papers published in scientific journals with at least one African author more than quadrupled (from about 12,500 to over 52,000). During the same time the share of the world's articles with African authors almost doubled from 1.2% to around 2.3%."*

In a continent abundant in both natural and human resources, the role of science and technology to improve the life of the people must be a priority. Librarians and scientists play a critical role, and need to be equipped with the latest technologies for research and development. However, managing information or seeking it comes with a territory in a developing country like Ghana in terms of challenges associated with conducting library management and information-seeking functions. ICTs have the capacity to change the information landscape in Ghana's research organizations. ICTs could augment traditional library functions such as those of the online public access catalog, reference and bibliographic services, document delivery, current awareness services, and audiovisual services, which may in turn affect users' access and ability to use information. Nonetheless, there are factors that work against the increased adoption of ICTs, which hinders both information management and information-seeking process. These challenges include low funding, poor ICT infrastructure, low bandwidth, intermittent power cuts, and

bureaucracy.  These factors are not unique to Ghana but are also experienced in many other developing countries.


 Significance of the study

Studies on ICT on various sectors have received some attention in the literature, notably Atiso (2007), Badu & Markwei (2005), and Dadzie (2005).  Dadzie & Dzandu (2012) investigated the technology's impact on a single population: research scientists. This study on the other hand explores how the technology is accepted amongst our two populations: research scientists and librarians, two prominent professional groups who work together in providing and using information towards R&D in the country. In addition, this paper explores whether indicators as age or qualification have any bearing on ICT adoption on both populations in the selected institutes. The findings, it is hoped, will help Ghana's policy makers in predicting and supporting ICT availability in Ghana.


**Background**

Ghana is a sovereign state and a unitary constitutional republic since 1992. As a former British colony, the Ghanaian education system was similar to the British education system.  In 1962, the Ghana Library Association was founded as an offshoot of the West African Library Association (WALA), to help in the areas of teaching, learning, and research. The association has chalked up several success in regrouping members under one umbrella, organizing continuing education for library workers and above all, providing high level library service by providing leadership and direction for the profession.  Despite these achievements, industry professionals the sector is performing below the expected capacity in this century. Lamptey & Corletey (2011), state that

the shape of some African libraries in the recent past has not been ideal. As a developing country, funding is of course one of the main challenges. As a result, most libraries, especially rural public libraries, are limited in their abilities to effectively discharge library functions. Poor funding drives other opportunistic challenges. Libraries are unable to fully deliver services due to a lack of infrastructure and/or qualified personnel. Another serious challenge to the library and information profession in Ghana is that of image. Bani (2003) conducted an in-depth study of academic libraries in terms of their image projection in society, and he concluded that the image of libraries or librarians is pretty low. An industry with a low societal image in society has many problems, including the inability to attract highly qualified new entrants, poor remuneration and high attrition rate. Another result of low image is that fundraising becomes more difficult thereby make libraries ultimately remain dependent on central government for funding, which is almost invariably inadequate. Analysts have suggested that the availability of ICTs may help Ghanaian libraries perform at a higher capacity.

The Internet in Ghana

The origins of the Internet can be traced back to 1969, with the development of ARPANET aimed at sharing and communicating information O'Leary (1997). In 1995, Ghana was one of the first countries south of the Sahara to get an Internet connection, and since then there has been a proliferation of Internet Service Providers (ISP) in the country. The advent of the Internet has significantly impacted the way librarians and information professionals work. Internets technologies come in handy to collect, store, manage, retrieve and disseminate information (Badu et al, 2005). Abels et al (1996) believe that due to the information age, the library and the information profession is experiencing a drastic transformation whereby materials hitherto

available only in print format are now also available in electronic format. Services which were manually done can be done electronically with greater ease and greater capacity for shared labor. In sum, there is a revolution in the information landscape, which affects professionals and users alike. The only way out, is to brace up for the *'new world order'* in the new *'information age'*.


ICT research in developing countries

Since the inception of ICTs, there has been concern about the position of developing nations in relation to the technology. Whilst some studies opine that developing nations would be marginalized, other studies see a real opportunity for explosion through the technology. Indications are the technology can be a potential boon, if well managed or burden if not given the right attention. Indeed, several sources suggest that current ICTs provide a way for developing countries to leapfrog over developed countries in terms of technology adoption, skipping the middle stages of development to most recent technologies. Hilbert (2014) finds, however, that while access to ICTs is becoming more equal between developed and developing countries,the differences in infrastructure to support ICTs are critical for the digital divide. The literature on this subject continues to receive attention as Avgerou (2008) confirms what we already know: that developing countries lack the finances and infrastructure to fully incorporate ICTs. As a result, mobile telephony is the main ICT in use in most developing countries. Studying this environment, Gilward et al. (2008) state that mobile telephony is the bridge between those who have voice and those who have not. However, they also state that the situation is not the same with the internet, citing cost of communication equipment to assess this facility.

Referring specifically to Nigerian libraries, Nkanu (2007) believes the importance of ICT in libraries is no longer in doubt, but the issue is how to derive the maximum benefit from them. Nkanu argues all aspects of library activities have been affected by ICTs. In most developing nation, the issue is generally similar: the need for infrastructure to make use of ICTs, and more importantly, low funding.

The development and expansion of ICTs has had a great effect on Africa. Howells (1995) says ICTs have been instrumental in research and development, especially for international research networks as evidenced in the various national and international collaborations. Muriithi et al (2013) reveal that there is an increased productivity of scientific collaborations in Kenya as a result of ICTs. Likewise, the Global Information Technology Report of 2013 states that ICTs (tools, services, and models) have the potential for development in research. The report finds a positive correlation between economic growth, job improvement, research and development (R&D) in developing economies, Bilbao-Osorio et al. (2013). It also mentions the initial concerns about how ICTs could delocalize some activities in developing countries. However, the report affirmed that ICTs could be tapped into different aspects of life to maximize productivity in these economies. For this reason, most developing countries are doing their best to catch up with the technology. As at 2011, the global Internet penetration of the population in the Africa region was 13.5 percent annually (Quarshie and Ami-Narh, 2012). The ever growing penetration of ICTs in the developing world is shaping all its industries.

Two policies presently drive ICT developments in the Ghana's economy, ICT for Accelerated Development (ICT4AD) and the National Telecommunication Policy (NTP). These policies support an ICT-led socio-economic development process, the aim of which is to transform Ghana into an upper middle income country. ICTs have had a powerful effect on the Ghanaian economy, both directly in the ICT sector and indirectly, in fields that use ICTs as a medium. The rapid influx of telecommunication companies created a number of jobs in that industry, helping the Government of Ghana's commitment to reduce unemployment. Indirectly, ICTs have also affected the economy in various ways, including female empowerment. The marginalization of women in several sectors has been well documented as ICT came at the right time to salvage this situation. In a survey of three regions in Ghana, Kwapong (2007) found that ICTs can empower rural women in their trade. These women, who hitherto could only be dependants or housewives, could now undertake any business venture, to help their families and their economy at large. The main medium here is mobile telephony, which has become the main medium of communication amongst both rural and urban populations in Ghana.

A recent study confirms the role of ICTs and increased productivity, Akkermans (2010) studied the different ICT models for rural development and came out with interesting results. Mobile telephony is used by rural folks to share market information. The study states that there are mobile applications where farmers can text a special code and instantly get relevant information. Unfortunately, the report notes that not all rural folks can use all the application, due to illiteracy. Another successful area of ICT use, per Akkermans, is the use of rural Frequency Modulation (FM) radios to disperse agricultural information among participants. The merit here is that

participant does not need to be literate, as the medium of instruction is the local dialect. The technology has also impacted education in a number of ways. Earlier, Martey (2004) had studied the effects of ICT on distance education in Ghana. He described how ICTs could be beneficial to education in general and concludes that the medium allows participants from far and near to engage in collaborative learning, without having to be physically present.

The impact of ICT and research are not in doubt. But as is the case of most developing nations, though, the infrastructure remains a problem to be overcome in order to derive the maximum benefits from ICT adoption. Ntsiful et al, (2003) outline the potentials for ICTs in education and R&D. They outline several government and private initiatives that are aimed at bridging the digital divide, and identify low funding and poor infrastructure as a continuing challenge. Additional studies illustrate the relationship between ICT studies and research in Ghana. A survey of students and faculty in a college in Ghana found a high percentage of ICT use for information access (Dadzie, 2005). Dadzie recommended focusing on information competency as a way to increase ICT usage. Atiso (2007) surveyed students on their use of ICTs for academic work and found that Internet resources were used as a supplement to classroom notes. The technology has been used in various sectors of the country, serving not only the 'elite' but also rural folks in various endeavors.

ICT in Research Libraries in Ghana

Ghana has made a strong commitment to science and technology as a focus for development. For Library and Information Science (LIS) professionals in Ghana, ICTs have the potential to greatly

expand access to information in diverse formats. To fulfill their missions and add value to the teaching and learning process, research libraries require powerful ICT infrastructure made up of software, hardware and high-bandwidth networks. In a study to find out the role of online tools in library operations in Nigeria, Adeleke, (2010) points out that librarians are aware of the benefits ICT has in library management, and recommends continuing education for library professionals. Looking at Ghanaian libraries, Markwei (2000) and Atiso (2007) have found similar results. Communication facilities are basic requirements of every organization, and more so for organizations such libraries, whose core function revolves around information management. The challenges facing ICT integration appear to be similar for all developing countries: Kumar et al (2010) sampled 31 college libraries in India to assess their level of ICT adoption. He concluded that these libraries were afflicted with some of the same challenges as some African libraries: low funding, poor infrastructure, and lack of skilled personnel. He recommended alternative funding source and training for personnel in order for these libraries to perform optimally.

Methods

This study has three main objectives: to identify the impacts of ICTs on high-level research and development institutions in Ghana, to explore the challenges in implementing ICTs in research institutions in Ghana, and to explore how Ghanaian librarians may be able to better serve their research scientist clientele through ICTs. To meet these objectives, the study poses three research questions:

Research questions

 1. What sorts of ICTs are used by Ghanaian research scientists and librarians?

2. What do librarians and research scientists see as the challenges that hinder the implementation of ICTs?

3. Is age, profession, academic qualification affect scientists' and librarian's use of ICT?

<u>Survey</u>

The population of the study includes two categories of professionals, all librarians and research scientists in four selected research organizations, the Animal Research Institute (ARI), Food Research Institute (FRI), Ghana Atomic Energy Commission (GAEC), and the Water Research Institute (WRI). There are approximately twenty research institutes in Ghana, and each has a library. This research project focuses on four of the most visible ones. Only one institute is selected if focus is similar. This study sought input from both librarians, the information professionals whose job is to manage the information in the libraries, and scientists, who are the main recipients and users of the information. The case study approach was carried electronically and closed August 2014 using four research institutes in the country. Librarians and scientists from the Animal Research Institute, Water Research Institute, and Food Research Institute under the umbrella of the *Council for Scientific and Industrial Research*, and the *Ghana Atomic Energy Commission* research institutions were surveyed regarding their use of ICTs to find or disseminate information. The primary investigator worked in one of the institutes previously, and had access to these populations. In this light, two electronic surveys were created via *Qualtrics* electronic survey software, one for librarians and one for scientists in research institutions the selected research institutions. These surveys were submitted to the *Institutional Review Board (IRB)* approval process to enable us distribute the new survey instruments. The survey for librarians included questions that touch on the use of ICTs, funding for ICTs, social media tools

used, and challenges in implementing ICTs. The one for scientists included questions about their eagerness to adopt ICTs, the ways they and their institutes make use of ICTs, and their perceptions of challenges in implementing ICTs.  Both surveys required background information on age, academic qualifications and profession: The surveys were sent to the electronic mailing lists of the four participation participating institutes. Because the survey was electronic, respondents were required to have online access to respond.

*Animal Research Institute*

This is one of thirteen institutes under the Council for Scientific and Industrial Research (CSIR) Ghana. The aim of the ARI is to conduct research into animal science and develop technologies related to the animal industry and to advise the government and other stakeholders in the industry. The institute has a library whose mandate is to store, manage and disseminate information related to the Ghanaian animal industry.

*Water Research Institute*

The mandate of the Water Research Institute is to research into water and related areas through the generation and provision of scientific information to support socio-economic development and to support agriculture, health, environment, industry etc.  Almost 69 percent of Ghana's population lives in rural areas whose main source of water is raw surface water from streams and rivers (Gyau-Boakye & Dapaah 2000). The WRI library is a support area that collects, manages and disseminates information for the research community.

*Food Research Institute*

Food Research Institute is mandated to conduct market-oriented applied research, provide technical services and products to the food industry as well as assist in poverty alleviation through creation of opportunities for income generation, thus contributing to food security and foreign exchange earnings.

*Ghana Atomic Energy Commission*

The Ghana Atomic Energy Commission is a leading research organization into sustainable and effective utilization of nuclear science and technology. The library serves as a resource base for information in nuclear science and technology.

**Survey results**

*Scientists:* The survey was started by 37 scientists and completed by 26. This represents at least 25 percent of the combined workforce of all scientists in the all four research institutions. Most scientist respondents were aged 31 to 40 and possessed varying levels of qualifications from bachelor's degrees to master's degrees to Ph.Ds. Eighty percent of respondents were scientists, and five were lab technologists. Most of the respondents, 56 percent, were from the Animal Research Institute. While ARI scientists represent most of the respondents, their answers were similar to those of respondents from other institutes, suggesting that the data is representative of Ghanaian scientists.

*Librarians:*

All librarians across all four institutes responded to this survey. Most of those respondents (54 percent) have a master's degree, either in information science or library science. Another 38 percent have bachelor's degrees, and one respondent had a doctoral degree. Participants' ages were distributed fairly evenly from the 20s to the 60s. Tables 1 and 2 show responses by age and qualification. Respondents aged 31-40 were the most common respondents and also form the bulk of the workforce. Table 2 shows most respondents in the two groups hold a master's degree of some sort.

*Table 1. Responses by age*

| Profession | 21-30 | 31-40 | 41-50 | 51-60 | 60+ |
|---|---|---|---|---|---|
| Scientists | 8% | 72% | 12% | 8% | 0% |
| Librarians | 31% | 15% | 23% | 23% | 0% |

*Table 2. Respondents and qualification by percentage*

| Profession | PhD | MA/M.Phil./ M.Sc. | BA BSc | Other |
|---|---|---|---|---|
| Scientists | 12% | 68% | 8% | 0% |
| Librarians | 8% | 54% | 38% | 0% |

Table 3 indicates respondents' attitudes toward ICTs. Scientists generally had a positive view of ICTs. Most (63 percent) thought of themselves as early adopters of technology. Younger

scientists were generally more apt to try new technologies than older scientists, suggesting a definite correlation between age and ICT adoption. Most librarians, 82 percent, also considered themselves to be early technology adopters. Internet access and speed influence views of ICTs and willingness to adopt those technologies. Most (72 percent) of the scientists are connected to the Internet via a modem, as opposed to cable, Wi-Fi, dial-up or satellite, and 71 percent reported having a fast or somewhat fast connection. However, they also reported disruptions to internet services such as their universities and research institutions switching to different Internet Service Providers (ISPs) more often. This may account for those scientists who started the survey and did not finish it; researchers may prefer to use their limited Internet access for their research first, ahead of answering a survey. Seventy percent of librarian respondents had Internet access through wired Ethernet cables to the library's local area network. Some libraries had wireless Internet service in their buildings, which may or may not be adequate to meet their users' demands. Librarians report a "somewhat" fast Internet connection, and use ICTs primarily for library functions such as cataloging.

*Table 3. Adoption of Technology*

| Profession | Early adopter | Wait to see if technology works well before I use it | I avoid new technologies, I only use tried and tested technologies |
|---|---|---|---|
| Scientists | 63% | 32% | 5% |
| Librarians | 82% | 9% | 9% |

*Table 4. Respondent's use of foreign database*

| Profession | AGORA | HINARI | OARE | AJOL | Other |
|---|---|---|---|---|---|
| Scientists | 62% | 37% | 18% | 25% | 12% |
| Librarians | 85% | 71% | 57% | 14% | 42% |

Database use is thoroughly integrated into the Ghanaian research industry. Table 4 indicates which foreign databases are used by scientists and librarians in Ghana's research institutes, while Table 5 indicates which local databases are used. Access to Global Online Research in Agriculture (AGORA) was the most important database for librarians, but they reported using many other databases to meet the needs of their jobs. Most of the scientist respondents used foreign databases, particularly AGORA, Health InterNetwork Access to Research Initiative (HINARI), and Online Access to Research in the Environment (OARE). However, one local database was also highly used by respondents, the Agricultural Research Information Service (AGRIS). Despite being produced locally, these databases are still web-based and respondents have to access them online. This table established a trend, with the exception of AJOL, librarians records higher percentages in the use of foreign databases compared with scientists. This trend is not difficult to understand because the core function of librarians is to make resources available to their clients; as a result, they would go every length for sources of information, to make available to clients. This probably explains the higher percentage. The trend is similar in Table 5 where the same characteristics: librarians got higher responses. So with these statistics, we can easily conclude that librarians are more proactive in database use than their colleague scientists.

*Table 5. Respondents' use of local database*

| Profession | AGRIS | eRAILS | ARILIB | CARLIGH | Other |
|------------|-------|--------|--------|---------|-------|
| Scientists | 58% | 0 | 16% | 0 | 0 |
| Librarians | 40% | 20% | 20% | 20% | 0 |

*Table 6. Social Media and ICT use*

| Profession | Email | Twitter | Facebook | LinkedIn | Other |
|------------|-------|---------|----------|----------|-------|
| Scientists | 100% | 0 | 47% | 65% | 18% |
| Librarians | 100% | 9% | 36% | 9% | - |

Table 6 presents scientists' and librarians' use of social media for work and research-related communications. Scientists used a variety of tools for work and research-related communications. E-mail was used by 100 percent of the scientists, as well as librarians. Almost half of scientists and a third of librarians are on Facebook. Scientists also used LinkedIn, Facebook, Pinterest, and YouTube. No scientist reported using Twitter. Librarians were less proactive than scientists in the use of social networks. While email and Facebook use were common in both groups, librarians were less likely to use other social media.

Table 7 looks at the challenges of implementing and benefits from ICTs, while Table 8 looks at scientists' and librarians' views of solutions for those challenges. Most respondents believe that funding is the main challenges, and funding challenges also show up in other challenges such as

low bandwidths and lack of training. One respondent stated if funding were made available, all other challenges could easily be dealt with. Some respondents suggested alternative sources of funding outside the regular central government source. Scientists reported that their institutes were responsible for funding databases and ICT projects, and 68 percent of the respondents said that funding is the biggest challenge for increased ICT adoption. Another 68 percent of respondents mentioned that bandwidth problems hindered increased ICT adoption.

*Table 7. Challenges of ICT*

| Profession | Funding | Low Bandwidth | Training | Other |
|---|---|---|---|---|
| Scientists | 68% | 58% | 21% | 0 |
| Librarians | 91% | 55% | 0 | 0 |

*Table 8. Solution to ICT Challenges*

| Profession | Adequate funding | Periodical Training | High Bandwidth Internet service |
|---|---|---|---|
| Scientists | 100% | 100% | 100% |
| Librarians | 100% | 100% | 100% |

Ninety percent of librarian respondents indicated funding of database subscriptions as a challenge. They also mentioned the need for uninterrupted access to the Internet: scientists need access to materials and to a stable internet connection that allows them to access those materials. Users suggested increased government funding and a user levy, both solutions which imply policy changes to stabilize access. Librarians saw funding (91 percent) and low bandwidth (55 percent) as the two biggest problems hindering ICT adoption. Switching ISPs was also a problem, with one respondent reporting an entire month offline as a result of an ISP switch.

Discussion

What sorts of ICTs are research scientists and librarians using?

The results of this survey indicate that ICTs are completely integrated into the work life of Ghanaian R&D personnel (scientists and librarians). Ghanaian scientists are keenly aware of such technologies, though they are not taking full advantage of most of all of them. All scientists use the internet to access databases, both foreign and local. In fact, most scientists have home internet access in addition to work access, which speaks to how greatly they have adopted this technology. Though their use of ICTs could be expanded, these have become a routine part of scientists' and librarians work. All librarians have internet and database access, and all make use of those technologies to enhance their library work. Librarians thought the most important contributions of ICTs to their libraries were enhanced access to resources and the promotion of data sharing. More insight as to potential uses, by way of continuing education, would be an appropriate way to expand that awareness. Continuing education in ways that ICT use can promote information access and transfer will allow the library community to serve their users

better. Because ICTs are in constant evolution, this continuing education will allow all personnel to stay current in the latest technologies.

Does profession, age, or qualifications influence the use of ICTs?

*Age.* Studies on age and ICT use in general are novelty in the literature. However this study found it necessary to look again what kind of impact that could have especially with different professions. Over the years, governments and voluntary organizations have conducted national surveys to determine who is participating in the digital world. In one such study, Kabbar and Crump (1996) found that age, among other things, had an inverse relation with ICT use, i.e. the younger the age, the easier the adoption of the technology. In a similar study on social media and mobile internet use among teens and young adults, Lenhart et al (2010) found that online activity has a negative correlation with age, ie the smaller the age, the higher the chances of online activities. The survey found the following statistics for the age brackets indicated. *Ages 12-17, (93%), 18-29 (93%), 30-49(81%), 50-64(70%)* and *65+ (38%).* This trend corroborated our findings in this study, where the higher the age the less likely to adopt the technology. This online survey saw a response rate dwindle with age. Scientists aged 40-50 had a 12 percent return rate, 51-60 had an 8 percent return rate, and no scientist aged 60 or over returned the survey which confirms the fact that ICT is age sensitive.

*Academic Qualifications.* Throughout the survey, academic qualifications did not appear to impact ICT adoption. Once again the main concentration was found within the age group 31-40. Scientists in this group recorded 68 percent response rate, leaving librarians at 54 percent. Noticeable here is the highest qualification; Ph.D. recorded 12 percent for scientist and 8 percent

for librarians. Per this survey, it can be argued that there is no relation between academic qualifications and ICT response rate.

*Profession.* Throughout the survey, it was not clearly noticeable that a profession (being a scientist or librarian) had any significant effect on ICT adoption. The figures swayed from time to time towards both groups. There was not a clear cut line to the advantage of the other. The conclusion could be that professional status did not have any effect on adoption. Most librarians and scientists who participated in the survey say they are early adopters. This only means ICTs have become part of the working life of these professionals, without which research activities and information management are seriously impaired. Despite challenges in connection and bandwidth, both librarians and scientists held steadfastly to the benefits of ICTs. As Ghanaian scientists and librarians do use ICTs for so much of their daily work, we conclude that these technologies are effective in their communication roles. Both librarians and scientists show a high willingness to use ICTs. The efficiency of these technologies still has some room for improvement. Challenges such as funding and connectivity issues act as barriers to efficient ICT use. Respondents reported changing Internet Service Providers a number of times, due to inadequate service. The major challenges raised by librarians and researchers was funding and training. Questions about social networking produced an interesting response. Whereas some of the platforms saw similar usage amongst librarians and researchers, there were also differences. The most used social network is the electronic mail (email) which recorded 100 percent for both librarians and researchers. However, scientists and librarians differed on their second most-used social medium. Researchers made more use of LinkedIn, a network used mostly for professionals. On the other hand, librarians' second most-used social medium was Facebook,

which tends to be more socially-oriented. Twitter was not used by any research scientists, though it was used by some library respondents. On the other hand, other social media such as Pinterest, YouTube, and blogs were used by scientists but ignored by librarians. This difference suggests that librarians and scientists may not be communicating optimally to reach the other group. This also suggests potential for exploiting social media to promote scholarly communication.

*What do librarians and research scientists see as the challenges that hinder the implementation of ICTs?*

Despite positive sentiment and eagerness to adopt, the challenges to ICT adoption and expansion in Ghana are many. These range from poor funding to lack of training to institutional and bureaucratic bottlenecks. Lamptey and Corletey (2011) have outlined some of the problems militating against the library profession in general in Ghana, including poor funding and low status of librarians. Other contributory problems include a poor ICT infrastructure, limited ICT resources, an over-dependence on free Information and Library Systems (ILS) such as CD-ISIS and bureaucracy. Another challenge for Internet service in developing countries is download speed, or how fast a user can download a document or other information resource. "world wide web" becomes "world wide wait," as users need to wait 'forever' to upload and download their resources. Without adequate bandwidth, data transfer may be slow or impossible, and users may quit before their transfers have finished. This can challenge research activities, as some databases need a relatively fast connection just to access them.

Conclusion

Collectively, our investigations reviewed and confirmed the usefulness and adoption of ICT among research scientists and librarians in selected research organizations in the country to help further our understanding of online behavior among professionals. Our results show that most librarians and researchers are conversant with the role of ICTs, and these technologies are the primary media through which Ghanaian information professionals perform their routine work, despite access challenges. It also shown that age is a definite indicator of ICT adoption, with most active users aged 31 to 40. Among the two professional bodies, librarians and scientists, there was not a clear link between professional status and ICT adoption. The last indicator, qualification did not appear to affect ICT adoption as well. ICTs are the medium through which most current businesses operate. Now ICT use and access has become part and parcel of most, if not all business – especially information-centric businesses such as research and information management. In a developing country such as Ghana, there are some barriers that have yet to be overcome. To address those, we conclude with some suggestions for improvement.

*Additional Funding.* Funding is the main challenge raised by both groups of respondents. While additional funding is desired everywhere, even in the most advanced countries, there are some strategies to ameliorate this situation. If direct funding from the central government is an issue, as the respondents suggested, it may be possible to find donor organizations whose aim align with those of the various research institutes. Librarians and scientists should develop a good proposal and make a case for funding. Many research projects in the developing world have been funded by donor communities. Depending on the focus of the project, there are numerous organizations looking for partnership in third world countries. Clearly, funding from central

government alone will not do the trick, so it may be necessary to look elsewhere to supplement government efforts.

*Outsourcing.* A notable area worth mentioning is outsourcing. Hill (2009) suggests outsourcing some library functions can aid in solving problems in modern day libraries. Libraries generally are in the business of managing information and not the infrastructure that carry it. Therefore functions such as maintaining or developing ICT infrastructure or building maintenance are outside of librarians' areas of expertise, and they may not be effective at managing these auxiliary activities. If Ghanaian research institutions could offload some auxiliary library functions to a third party, this could allow the librarians to concentrate on their core specializations. For example, all study participants indicate that Internet service is important; however, none is very satisfied with the service they receive. Contracting a company solely to manage Internet service and infrastructure could ensure better service for end users.

*Continuing Education.* Another challenge raised was lack of training for both users and librarian. Continuing education programs should be conducted at regular intervals for both users and facility managers. Some respondents mentioned particular training topics, such as Web 2.0 and social media applications. Social networks form an important medium for information exchange, not only for private purposes but business related activities. In service training on using social media for work-related issues will go a long way to boost ICT use and integration for both scientist and librarians.

Our respondents also indicated challenges associated with bureaucracy, common to many third world countries. Haruna (2001) says that long bureaucratic chains of approval are the post-independence challenge of many developing nations. In this bureaucratic system, a particular request has to go through a number of layers or committees before it is approved. This process can breed not only waste but corruption. Directly or indirectly, this affects ICT integration, as upper levels seem to drag their feet, in a salient apparent rejection of new technologies. Providing training and access to new technologies to senior administrators may benefit this process, as once they become conversant with these technologies, approvals for implementing these technologies may be hastened.

The records indicate and ever increasing research output on the African continent with a new re-awakening in post-colonial Africa, with many nations poised to solve major problems with well-trained professional in a technologically oriented environment in the 21st century. This study confirms the readiness of research scientist and librarians to contribute their quota. Though the study indicates an environment stymied by some challenges, with our recommendations they could be surmountable to give way to increased R&D in the country. Local and international support would offset funding challenges. Continuing education is necessary not only for librarians and researchers, but also for institutional administrators whose acceptance of technologies may accelerate their adoption. If these hurdles are overcome, ICTs have great potential to expand the Ghanaian research and information industries.

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**Appendix 1: Survey for Librarians about Institutional Repositories**


Part 1. Demographic Information


1. What is the name of the Institution at which you work?

❍  ARI

❍  WRI

❍  GAEC

❍  Food Research Institute (FRI)

2. What is your educational background?

○ PhD

○ MA/MSc/MPhil

○ BA/Bsc

○ Diploma/Other


3. What is your age?

○ 21 - 30

○ 31 - 40

○ 41 - 50

○ 51 - 60

○ 60 +

Part 2. Use of ICT

1. Please indicate your level of comfort with Information and Communication Technologies (ICT).

❍ I am an early adopter - I use new technologies, read blogs, and enjoy innovation.

❍ I tend to wait and see if new technologies work well before I will use them.

❍ I avoid new technologies. I prefer using tried-and-true methods to communicate or deal with information.

2. What kind of Internet connection do you have?

❍ dial-up

❍ DSL

❍ cable

❍ modem

❍ other: _____

3. How fast is your Internet service?

Very slow          Slow                Don't know        Fast              Very fast

4. What do you use the Internet and Communication Technologies (ICT) for?

○ Integrated library system

○ Cataloging and classification

○ Serial control

○ Database management

○ Acquisitions

○ Research

○ Other _____

5. Who funds ICT projects in your institute?

○ The institute

○ Government

○ Internally generated funds

○ Foreign funding

○ other _____

6. What are the biggest problems that your institute faces regarding ICT?

○ Funding

○ Training

○ Low bandwidth

○ Acceptance

○ Other _____

7. Can you describe how you think your problems might be solved? )For example: Funding? Through a sustainable measure? A foreign donor? A local donor? The local government?

8. Has your Institute changed Internet Service providers? If so, how many times have you had to change? Did this disturb your work flow, and for how long?

9. Which foreign databases do you use, and how relevant are they to your work?

Check here _____ if you do not use any foreign databases.

| | Highly relevant | Relevant | Slightly relevant | Not relevant |
|---|---|---|---|---|
| AGORA | ○ | ○ | ○ | ○ |
| HINARI | ○ | ○ | ○ | ○ |
| AJOL | ○ | ○ | ○ | ○ |
| OARE | ○ | ○ | ○ | ○ |
| Others: | ○ | ○ | ○ | ○ |

| _____ | | | | |
|---|---|---|---|---|
| _____ | ○ | ○ | ○ | ○ |

10. Who pays for the foreign databases?

○ The Government

○ International Organizations

○ Internally generated funding

○ the Institute

○ Other _____

11. Which local databases do you use, and how relevant are they to your work?

Check here _____ if you do not use any local databases.

| | Highly relevant | Relevant | Slightly relevant | Not relevant |
|---|---|---|---|---|
| AGRIS | ○ | ○ | ○ | ○ |
| ARILIB | ○ | ○ | ○ | ○ |
| erails | ○ | ○ | ○ | ○ |
| Carligh | ○ | ○ | ○ | ○ |
| Other(s): _____ _____ | ○ | ○ | ○ | ○ |

12. Which communication methods or social networks do you use for your work?

○ Email

❍  Twitter

❍  Facebook

❍  LinkedIn

❍  Other _____

13. ICT and Library Services are used by the scientists and researchers in the Institute that I work for the following reasons:

|  | Daily | Often | Occasionally | Never |
|---|---|---|---|---|
| To enhance access to resources. | ❍ | ❍ | ❍ | ❍ |
| To promote new types of resources | ❍ | ❍ | ❍ | ❍ |
| To encourage new forms of peer review | ❍ | ❍ | ❍ | ❍ |
| To aid in institutional information management | ❍ | ❍ | ❍ | ❍ |
| To promote data sharing | ❍ | ❍ | ❍ | ❍ |
| For the preservation of digital resources | ❍ | ❍ | ❍ | ❍ |

14. Please indicate to what extent you agree with the statements below.

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Repositories should contain peer reviewed articles. | ❍ | ❍ | ❍ | ❍ | ❍ |
| Repositories should contain books and journal articles. | ❍ | ❍ | ❍ | ❍ | ❍ |
| Repositories should contain a wide variety of electronic resources such as images, datasets, and software. | ❍ | ❍ | ❍ | ❍ | ❍ |
| If everything is allowed in the repository, it will be difficult to navigate and filled with junk. | ❍ | ❍ | ❍ | ❍ | ❍ |

| Someone should maintain strict control over what goes into the repository. | ○ | ○ | ○ | ○ | ○ |
|---|---|---|---|---|---|

15. How problematic do you perceive the following issues to be in relation to institutional repositories?

| | Very Likely | Likely | Somewhat Likely | Undecided | Somewhat Unlikely | Unlikely | Very Unlikely |
|---|---|---|---|---|---|---|---|
| Copyright | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Theft | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Scholars' knowledge about, or trust of, the repository | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Preservation of digital resources | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Funding | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

16. Who do you think should manage an institutional repository?

○ A librarian

○ Scholars

○ A committee

○ Users

○ Other(s):

_____

_____

17. Do you provide education to scholars about Institutional Repositories?

○ Yes, we provide quarterly or bi-annual training (please describe if you would like).

_____

○ We provide annual or irregular training (please describe if you would like).

_____

○ No, this is not something that we are interested in or are able to do.

18. Do you discuss or work with other librarians who are interested in institutional repositories?

○ Yes, informally.

○ Yes, at conferences or through formal collaborations.

○ No.

19. What kind of education do you think you or the scientists and researchers at your institution need to be able to most effectively share their data, findings, and papers?

_____

_____

_____


20. How would you like to see institutional repositories monitored? You can choose more than one answer. Please also describe why you chose your answer.

❍ Server transactions

❍ Google analytics

❍ User surveys

❍ Download history

❍ Other:

_____

_____


21. Is there anything else that you would like to say about ICT or IR either in general or in your institute? Please continue onto the back of this paper if you would like.

**Appendix 2: Survey for Scientists and Researchers about Institutional Repositories**

Part 1. Demographic Information

1. What is the name of the Institution at which you work?

○ CSIR – Animal Research Institute (ARI)

○ CSIR – Water Research Institute (WRI)

○ CSIR - Food Research Institute (FRI)

○ Ghana Atomic Energy Commission (GAEC)

2. What is your educational background?

○ PhD

○ MA/MSc/MPhil

○ BA/Bsc

○ Diploma/Other

3. What is your age?

○ 21 - 30

○ 31 - 40

○ 41 - 50

○ 51 - 60

○ 60 +


4. What is your profession?

○ Scientist

○ Other: _____

Part 2. Use of ICT

1. Please indicate your level of comfort with Information and Communication Technologies (ICT).

❍ I am an early adopter - I use new technologies, read blogs, and enjoy innovation.

❍ I tend to wait and see if new technologies work well before I will use them.

❍ I avoid new technologies. I prefer using tried-and-true methods to communicate or deal with information.


2. What kind of Internet connection do you have?

❍ dial-up

❍ DSL

❍ cable

❍ modem

❍ other: _____


3. How fast is your Internet service?


Very slow          Slow                Don't know        Fast                Very fast



<————————————————————————————————————————————————————————————>

4. What do you use Internet and Communication Technologies (ICT) for?

○ The library system (local resources in my library)

○ Databases

○ Sharing my research

○ Other _____

5. Who funds ICT projects in your institute, to the best of your knowledge?

○ The institute

○ Government

○ Internally generated funds

○ Foreign funding

○ other _____

6. What are the biggest problems that you think your institute faces regarding ICT?

○ Funding

○ Training

○ Low bandwidth

○ Acceptance

○ Other _____

7. Can you describe how you think your ICT problems might be solved? )For example: Funding? Through a sustainable measure? A foreign donor? A local donor? The local government? Please feel free to continue your responses on another sheet of paper if you would like.

8. Has your Institute changed Internet Service providers? If so, how many times have you had to change? Did this disturb your work flow, and for how long?

9. Which foreign databases do you use, and how relevant are they to your work?

Check here _____ if you do not use any foreign databases.

|  | Highly relevant | Relevant | Slightly relevant | Not relevant |
|---|---|---|---|---|
| AGORA | ○ | ○ | ○ | ○ |
| HINARI | ○ | ○ | ○ | ○ |
| AJOL | ○ | ○ | ○ | ○ |
| OARE | ○ | ○ | ○ | ○ |

| Others: | ○ | ○ | ○ | ○ |
| :--- | :--- | :--- | :--- | :--- |
| _____ | | | | |
| _____ | ○ | ○ | ○ | ○ |

10. Who pays for the foreign databases, to the best of your knowledge?

○ The Government

○ International Organizations

○ Internally generated funding

○ the Institute

○ Other _____

11. Which local databases do you use, and how relevant are they to your work?

Check here _____ if you do not use any local databases.

| | Highly relevant | Relevant | Slightly relevant | Not relevant |
| :--- | :--- | :--- | :--- | :--- |
| AGRIS | ○ | ○ | ○ | ○ |
| ARILIB | ○ | ○ | ○ | ○ |
| erails | ○ | ○ | ○ | ○ |
| Carligh | ○ | ○ | ○ | ○ |
| Other(s): | ○ | ○ | ○ | ○ |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |

12. Which communication methods or social networks do you use for your work?

❍ Email

❍ Twitter

❍ Facebook

❍ LinkedIn

❍ Other _____

13. ICT and Library Services are used by the scientists and researchers in the Institute that I work for the following reasons:

| | Daily | Often | Occasionally | Never |
|---|---|---|---|---|
| To enhance access to resources. | ❍ | ❍ | ❍ | ❍ |
| To promote new types of resources | ❍ | ❍ | ❍ | ❍ |
| To encourage new forms of peer review | ❍ | ❍ | ❍ | ❍ |
| To aid in institutional information management | ❍ | ❍ | ❍ | ❍ |
| To promote data sharing | ❍ | ❍ | ❍ | ❍ |
| For the preservation of | ❍ | ❍ | ❍ | ❍ |

| digital resources | | | | |
| --- | --- | --- | --- | --- |
| | | | | |

*The next five questions refer to institutional repositories. These are databases of scholarly work used and maintained by the institution.*

14. Please indicate to what extent you agree with the statements below.

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Repositories should contain peer-reviewed articles. | ❍ | ❍ | ❍ | ❍ | ❍ |
| Repositories should contain books and journal articles. | ❍ | ❍ | ❍ | ❍ | ❍ |
| Repositories should contain a wide variety of electronic resources such as images, datasets, and software. | ❍ | ❍ | ❍ | ❍ | ❍ |
| If everything is allowed in the repository, it will be difficult to navigate and filled with junk. | ❍ | ❍ | ❍ | ❍ | ❍ |

| Someone should maintain strict control over what goes into the repository. | ○ | ○ | ○ | ○ | ○ |

15. How problematic do you perceive the following issues to be in relation to institutional repositories?

| | Very Likely | Likely | Somewhat Likely | Undecided | Somewhat Unlikely | Unlikely | Very Unlikely |
|---|---|---|---|---|---|---|---|
| Copyright | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Theft | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Scholars' knowledge about, or trust of, the repository | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Preservation of digital resources | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Funding | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

16. Who do you think should manage an institutional repository?

○ A librarian

○ Scholars

○ A committee

○ Users

○ Other(s):

_____

_____

17. What kind of education or training would help you to be able to most effectively share your data, findings, and papers?

18. Is there anything else that you would like to say about ICT or IR either in general or in your institute? Please continue onto the back of this paper if you would like.