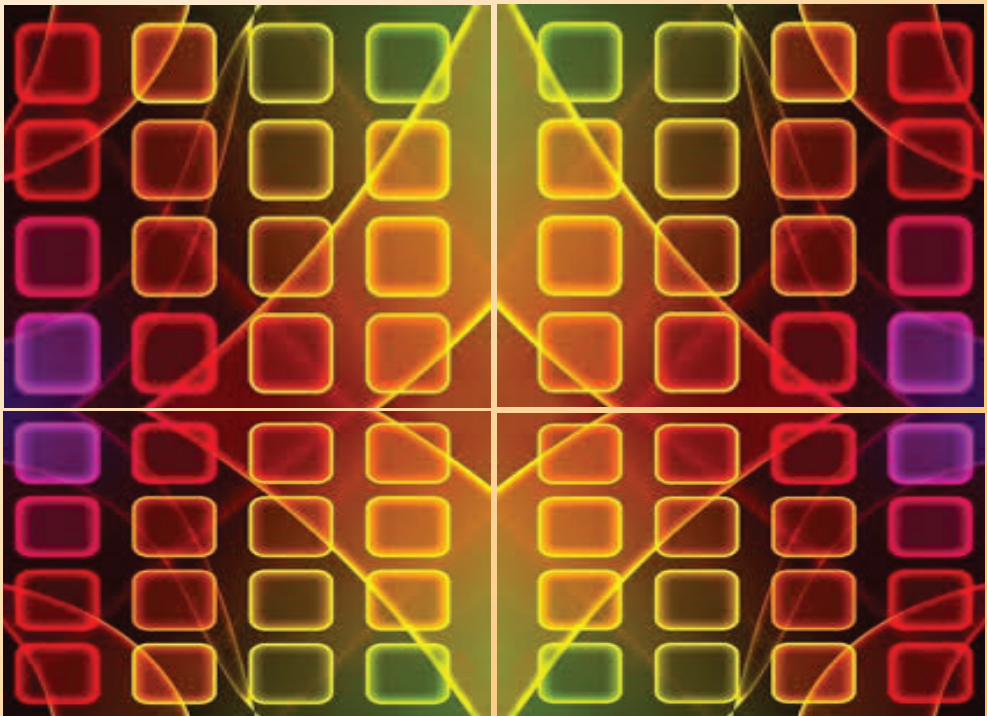# Emerging Trends

in

Information and Knowledge Management

Editors:

Tom Kwanya | Joseph Kiplang'at | Justus Wamukoya

Emerging Trends in Information and Knowledge Management

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Preface

Information and knowledge have become the key pillars of national, organisational and individual performance, excellence, competitiveness, growth, innovation and impact. While information management is concerned with the lifecycle of information, knowledge management encompasses the processes, people, techniques and tools used to enhance the intellectual capital owned by individuals, groups and organisations in terms of their know-how, ideas, expertise, competencies and experiences. Essentially, knowledge management enables entities to make the best use of their knowledge assets. The value of knowledge to sustainable development is anchored on the fact that it is limitless; grows with use; and is not easily replicable.

In spite of the fact that information and knowledge are core components of the socioeconomic structures of the modern society, many challenges still hamper their effective management, diffusion, utilisation and perpetuation. Various discourses are ongoing on how best to manage these critical resources in ways which enhance their application in the human efforts to increase economic productivity, social justice, safety and general wellbeing of people worldwide. Consequently, theories have been developed; best practices established; and lessons learnt. However, challenges still abound on how best to share, apply and validate these nuggets.

This book is an integral part of this discourse through its 40 chapters authored by academics, professionals and practitioners in information and knowledge management. The chapters are structured around ten themes: Emerging Trends in Libraries and Information Centres; Knowledge Sharing and Diffusion; Indigenous Knowledge; Records Management; E-Governance; Information and Knowledge Management Education; Role and Impact of Information and Knowledge Centres Legal and Ethical Issues in Information and Knowledge Management; Social Media in Information and Knowledge Management; Digital Trends in Information and Knowledge Management

The uniqueness of this book lies in the fact that the authors of the chapters are drawn from diverse backgrounds, experiences and geographical contexts. This has enriched the content by creating diverse voices on the current and emerging issues in information and knowledge management. This approach ensures that the readers do not end up in restrictive echo chambers where they only access content which they are already familiar with. Similarly, it gives the readers an opportunity to readily find content on all the specialisation areas of information and knowledge management in one volume.

The chapters were subjected to a rigorous scholarly publishing process to ensure that they contribute fresh and unique perspectives to the themes. In this regard, they were subjected to a plagiarism test using Turnitin software; double blind peer review by eminent scholars in the discipline; and a comprehensive copy editing. Therefore, we are convinced that they will make significant contributions to theory, practice and policy in information and knowledge management. We wish you an insightful reading.

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NAIROBI, KENYA

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Foreword

We live on the verge of a new economic order anchored on the quality, quantity, access, use and perpetuation of knowledge and generally referred to as the knowledge economy. It is characterised by a greater reliance on intellectual capabilities than on the traditional factors of production such as land, labour and capital. The knowledge economy represents a transformation which shifts the economic focus from human labour and mechanisation to production and use of knowledge through knowledge-intensive activities. This increasing value of knowledge in economic production lends credence to the sentiments that, everything that can be counted does not necessarily count; everything that counts cannot necessarily be counted.

Although there is no consensus about the proportion of economic development that knowledge contributes compared to the traditional factors of production, there is a general understanding that knowledge is steadily becoming an important cog in the economy. This view is based on the perception that all the other factors are replicable and can sometimes be substitutable. Conversely, knowledge is the only organisational asset which is difficult to replicate. Thus, knowledge is an essential competitive advantage for progressive organisations since organisations of the future will be differentiated by what they know, how they are using what they know, and how fast they are learning new things.

The knowledge area can be expected to be one of the major growth areas of the future. Considerable decisions of the political, social, and economic nature will continue to be driven by information and data. Such information and data will have to be readily available to facilitate the necessary decision making processes. This will call for availability of professionals in the field of information and knowledge management with the requisite qualifications. In order to cope with the future expectations, curricula in information and knowledge management will need to anticipate the growth of the profession into the future.

Knowledge is power. Yes, it controls access to opportunities and growth. It is at the core of all organisational assets. It is the essence of what organisations sell or buy; the real raw materials with which organisations work. However, organisations can only benefit from this power if they do not just do things differently. Instead, they must do things better, based on what they know. One of the ways organisations can create economic value using what they know is by turning information and knowledge into unique skills, services and products that the market needs and are ready to pay for, however expensive.

They must tap into the knowledge held by their employees and other publics acknowledging that although no one knows everything, everyone knows something.

Information and knowledge management professionals have a great part to play in the realisation and sustenance of the knowledge economy. They can play this part by creating knowledge environments which foster creativity and innovation. Such environments have credible knowledge resources; technological tools facilitating anywhere, anytime access and use of information and knowledge resources; policies facilitating effective interactions, sharing and learning; as well as capacity strengthening programmes which empower users of information and knowledge to seek, identify, evaluate and select credible knowledge resources and partners. In this effort, the information and knowledge management specialists must understand that it is the connection with stakeholders and partners which makes the difference; not the collection. Similarly, there is less to fear from outside competition than from inside inefficiency, miscalculation and lack of knowledge.

This book elaborates the emerging trends in the broad professional field of information and knowledge management. There is no doubt that information and knowledge professionals will find the book useful especially as they seek to participate and contribute to the fast growing field of information and knowledge management.

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Contents

Section One: Emerging Trends in Libraries and Information Centres

Use of ICTs in Accessing Information by Researchers in Selected Public Research Institutions in Kenya

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Abstract

Although several initiatives and efforts have been made to assist researchers in accessing information in public institutions in Kenya, they are still disadvantaged because of limited access and use of ICTs to facilitate research activities and improve the base for strategic decision making. The aim of this chapter is to investigate the use of ICTs in accessing information by researchers at the Kenya Industrial Research and Development Institute (KIRDI) and the Kenya Medical Research Institute (KEMRI) and suggest a framework to improve ICT utilisation at the two research institutions. The use of ICTs in accessing information by researchers in public research institutions in Kenya remains under-researched. This study was designed as an investigative research using a multiple case study approach. The respondents were selected through purposive sampling. Data were collected through semi-structured interview schedule. Data were analysed through a combination of qualitative and quantitative techniques. The study highlights information needs of researchers, resources available to them; utilisation of ICTs and challenges experienced while accessing information using ICTs. The authors suggest a framework for improved ICT diffusion and utilisation. ICTs contribute to globalised economy by enhancing access to information and knowledge which are critical elements in research. This chapter provides practical considerations on the utilisation of ICTs to access information in public research institutions in Kenya. The findings are expected to be of help to top management of public research institutions to inform decision making so as to improve access to information by researchers and other stakeholders.

Keywords: *ICTs, information access, researchers, Kenya*

Introduction

Information Communication Technologies (ICTs) have become drivers of economic development. Their access and application enable information generation, manipulation, processing, utilisation and application. Kagoda-Batuwa (1998) observed that information and communication are the engines of sustainable growth and development, while Mutula (2004) observes there was disparity in access to ICTs between countries and communities resulting into a digital divide in the development agenda in Sub-Saharan Africa. In Botswana mobile telephony phenomena was improving lives of rural communities by enhancing entrepreneurship (Mutula, 2008).

The Government of Kenya emphasises that ICTs are central to the globalisation process and calls upon Kenyans to utilise the opportunity of information age to strategically position themselves to benefit from global economy (NDP, 2002-2008). The government anticipates that the use of ICTs would increase industrial productivity, creativity, innovation, service efficiency, lower disease burden, poverty reduction and job creation. The intention is to establish strong community-based information systems to facilitate access to health-related information and outreach programmes under flagship projects on revitalisation of health infrastructure. Researchers need to access and use health, industrial and technological information to help Kenya realise its Vision 2030. The government promised to integrate ICT programmes in national development planning to secure maximum contribution to the country's development and poverty reduction.

The Kenya Vision 2030 (GoK, 2007) recognises the role of science, technology and innovation in modern economy. New knowledge plays a central role in boosting wealth creation, social welfare and international competitiveness. Information is vital for sound planning and decision making at all levels and in all sectors including educational and professional development of the people. ICTs hold lots of opportunities for development at all levels.

In the National Development Plan (NDP, 2002-2008), the Government of Kenya stressed the need to address universal access to information through the Internet in order to bridge the digital and knowledge gap (GoK, 2002). The internet is a reservoir of information on practically every topic of interest. Websites, emails, electronic bulletin boards, and online databases are significant in the acceleration of research and development in scientific fields as they provide researchers with a broad range of information services including efficiency in the management of rural enterprises and saves time and travel costs. In a similar study Odero-Musakali and Mutula (2007) observed

that the Internet has been praised for its potential to revolutionise learning and research processes. They argue that it paves the way for new methods of information accessibility, as well as providing new instructional approaches, new forms of communication and working environments among others.The Government of Kenya plans to use ICT as a strategy to instil efficiency in the delivery of public services (GoK, 2007) in order to make the services more accessible and affordable.

Kenya has several research organisations serving various sectors. The public research institutions are funded by the government, and are established under the Science and Technology Act, Cap. 250 of the Laws of Kenya which was enacted in 1977 to provide for the establishment of national research institutes. The National Council for Science and Technology (NCST) was established as a statutory institution to advise the government on all matters relating to national science and technology, and coordinate research, innovation and experimental development. They include KIRDI, KEMRI, Kenya Forestry Research Institute (KEFRI), Kenya Agricultural Research Institute (KARI), and Kenya Trypanosomiasis Research Institute (KETRI). KIRDI and KEMRI were chosen for in-depth study due to their direct contribution towards the welfare of the Kenyan populace in industrial and health research respectively.

Rationale

Many governments believe that declining digital inequalities and economic development are inter-related, giving indications of poor planning and management of ICTs resulting from non-involvement of target audiences, inadequate infrastructure, training and technical requirements. In Kenya the situation may not be different since the use of ICTs by researchers can open new channels of service delivery in e-government, education, e-health and information dissemination in the agricultural, industrial, manufacturing and health sectors. Although several initiatives and efforts have been made, many researchers in the country are still disadvantaged because of limited access and use of ICTs to facilitate research activities and improve the base for strategic decision making.

The specific objectives of the study were to:

1. Establish the range of information required by researchers;

2. Examine information sources and services available to researchers;

3. Determine the levels of their usefulness to researchers;

4. Find out if institutional ICT policy exists and how it supports information access; and

5. Establish the challenges experienced by researchers in utilising ICTs to access information and propose a framework for improved ICT diffusion and utilisation.

Overview of Literature

Information as a resource affects all disciplines globally whether scientific or social. Obioha (2005) asserts that as humankind developed an urge to seek ways to better their lives, they made discoveries of ICTs in science and technology; brought innovation into information seeking and knowledge acquisition as they are crucial in facilitating research activities in any country. Sulaiman, Hall, Kalaivani, Dorai and Reddy (2011) observed that traditional ICTs like radios, television and print media are still used in rural areas to introduce new ideas and improve practice in development efforts, particularly the agricultural sector where ICTs offer a key mechanism for putting research-derived ideas, information and technology into use. They noted that researchers and other professionals use Geographic Information Systems (GIS) in planning interventions in agriculture, forestry and geology, while they use email, audio and video conferencing for quick and interactive knowledge exchange.

Odini (1995) observes that to stimulate the use of information, there is need for improved access to information and for the availability of information at the right time and in an appropriate format. He adds that one of the hindrances to information access is the underutilisation of information owing to inappropriate analysis of needs of users and communication process for any group of users. He identified four groups of information users, namely (1) professionals in various fields (who include scientists, engineers and lawyers working in government organisations, private sector and industry); (2) students, teachers and technicians; (3) policy makers, planners and administrators; and (4) farmers and rural communities. He suggests that to stimulate information use, the information service should as far as possible be built around users and the environment in which the communication process takes place.

Murugesan and Balasubramana (2011) observe that most library users in Tamilnadu use email, internal databases, e-journals, e-books, CD-ROM databases, online databases and web based resources. They reiterated that the information age has made a great impact on research and development

libraries since many researchers showed preference for ICT application. Ahmad (2011) notes that researchers use social networks like blogs to establish online communities and provide information about their networks and business. According to Kaddu (2004) ICTs provide an ideal bridge for matching demand and supply of information by helping recipients in locating strategic information. Banks (2011) mentions the power of mobile phones and Internet in data collection and information sharing in the rural communities and how they are transforming health, conservation and research around the world. Doucleff (2012) narrated how researchers in Kenya used mobile phones to track malaria and flu seasons as well as monitor blood sugar by mapping junk food that people eat at night. He stated that researchers at Harvard School of Public Health tracked texts and calls from about 15 million mobile phones in Kenya and used the data to make a map of how malaria spreads from the regions to mega cities.

Theoretical Framework

Theory supported with data or evidence raises hopes about past concepts or ideas meant for a study. Kombo and Tromp (2006) noted that it provides a generalised explanation to an occurrence and clarifies why things are the way they are. Maxwell (2005) affirmed that it is a model of what is out there that a researcher plans to study including what is going on with the things and why. Information as a concept takes different forms at different levels. Wilson (2002) noted that information should not be taken as a unitary concept on its own, but as having different levels around which different theories are built and practices evolve.

The authors combined the General Systems Theory (GST) and Diffusion of Innovation (DOI) to interrelate how KIRDI and KEMRI as institutions are systems that depend upon ICTs to meet information needs of their researchers. DOI theory provides a good tool for descriptive research and has potential for application in information technology concepts. It has been used to study the adoption of ICTs in organisational and instructional technology. According to Minishi-Majanja and Kiplang'at (2005) DOI is a social process of communication in which innovation in the form of new ideas, practices, objects or products is spread. The study used GST and the DOI theory to illustrate and interrelate how KIRDI and KEMRI as institutions deal with different research disciplines, while maintaining some information systems, either generated from within or acquired from without. They depend upon ICTs to effectively meet the information needs of their researchers for development and applied research activities carried out by humans.

Methodology

An in-depth study of KIRDI and KEMRI was undertaken. The two institutions were chosen due to their direct contribution towards the welfare of the Kenyan populace in industrial and health research. The study employed qualitative research method using a multiple case study strategy because it allows in depth and detailed study of more than one study that can be looked at as a whole. Yin (1984) affirms that the approach gives meaningful characteristics of real-life events like individual life cycle, organisational and managerial processes, neighbourhood change, international relations, and maturation of industries. Purposive sampling technique was used in identifying respondents. Data were collected through face-to-face interviews using a semi-structured interview schedule, observation and document review.

The study population consisted of top managers, researchers and information workers. A total of 152 respondents comprising 115 researchers and 37 key informants were interviewed. A combination of qualitative and quantitative techniques was used to analyse data. The study was limited to selected public research institutions; therefore some of the results may not be generalised to other research institutions including international ones.

Findings and Discussions

Presented hereunder are results on the use of ICTs in accessing information by researchers in the two study organisations based on the study objectives. In certain instances the data for each case is separately presented in order to highlight issues raised by researchers. Some statistical data are presented in tables and figures. Table 1 illustrates the wide range of areas of specialisation by researchers in one of the study organisations. The pattern although in health sciences is similar in both cases. The term researcher referred to those working in the departments as shown in the table below.

Table 1: Distribution of Respondents at KIRDI (n=60)

Departments / Centres	Title	Number of Respondents	Percentage (%)
Engineering Design and Services Centre	Researcher	6	10
Leather Development Centre	Researcher	8	13
Ceramics	Researcher	2	3
Laboratory Services Centre	Lab. Technologist	2	3
Energy and Environment	Researcher	7	12
Food Science and Technology	Researcher	15	25
Textile	Researcher	3	5
Law	Head of Intellectual Property	1	2
Water Quality Control and Management	Technologist	1	2
Mechanical Engineering	Researcher	4	7
Industrial and Allied Technologies	Researcher	5	8
Food and Technology Division (Western, North Eastern & Regions)	Researcher	6	10
Total		**60**	**100**

The respondents from KIRDI were spread across several commercial service centres and divisions. They were drawn from three main departments: Technology Transfer, Innovation and Extension Services; Research and Development; and, Finance and Administration. The Department of Research and Development had six divisions, namely (1) Food Technology, (2) Engineering, (3) Leather and Textile Technologies, (4) Mineral Resources, (5) Environmental Management.

KEMRI which was the second study organisation had a total of 55 respondents who comprised of researchers, technologists, medical officers and coordinators. Table 2 provides a summary of categories and distribution of respondents.

Table 2: Distribution of respondents at KEMRI by department (n=55)

Category of Respondents	Title	Number of Respondents	Percentage (%)
Centre for Microbiology Research	Researcher	8	14
Centre for Clinical Research	Researcher	5	9
Clinical Trials Facility	Coordinator	3	5
Epidemiology	Researcher	1	2
Climate and Human Health Research	Technologist	8	15
Centre for Virus Research	Researcher	2	4
Centre for Traditional Medicines and Drugs Research	Researcher	6	11
Centre for Biotechnology Research and Development	Technologist	4	7
Centre for Public Health Research	Researcher	5	9
Entomology	Researcher	9	16
Grantsmanship or Research Funding	Researcher	1	2
Centre for Vector Biology and Control Research in Kisumu	Researcher	2	4
Centre for Geographic Medicine Research in Kilifi at the Coast.	Researcher	1	2
Total		**55**	**100**

The respondents from KEMRI were also spread across several centres in the country as shown in Table 2 above. The main department of focus was Research and Development the centres were mainly concentrated within that department, which has representation in coast and western regions of the country. In effect, most of the respondents were drawn from this department.

Information Needs of Researchers

The findings indicate that researchers from the two organisations were involved in various specific research areas within medical and industrial environment, hence needed a wide range of specialised information which was influenced or determined by their daily research activities. Their information needs include current and relevant information on their area of specialisation for carrying out their daily activities. They include information on donor and funding agencies, food processing technologies, chemicals and analysis equipment including protocols, conventions and standard operating procedures. The finding concurs with Leckie, Pettigrew and Sylvain (1996) who noted that the numerous work roles assumed by engineers could lead to different information needs. It also confirms the findings of a study by Haines, Light, O'Malley and Delwiche (2010) in which they established that researchers and clinicians, even those in the same college, often have very different information needs, with clinicians requiring quick, concise information and researchers requiring more in-depth information. Similarly, Odini (2005) found that engineers select sources for information searching and in the ways in which information was used. His results confirm investigations carried out by Otike (1997) on the information needs of lawyers, where he established that their information needs were greatly influenced by the nature of the work they do.

Information Sources and Services Available to Researchers

The study sought to establish the various types of information sources available and consulted by researchers in the two research institutions. The results from separate multi-responses indicate that researchers at KIRDI (Figure 1) consulted various sources. The Internet emerged as the most consulted source as stated by 56 (93%) of those interviewed. It was useful in consulting e-journals databases like Online Access to Research on Environment (OARE). The journals were reportedly consulted by 48 (80%), magazines and newspapers by 29 (48%), while patents were consulted by 22 (37%). The books were found to be the popular source of information among 49 (82%) of the respondents, with only 39 (65%) stating that they consulted directories.
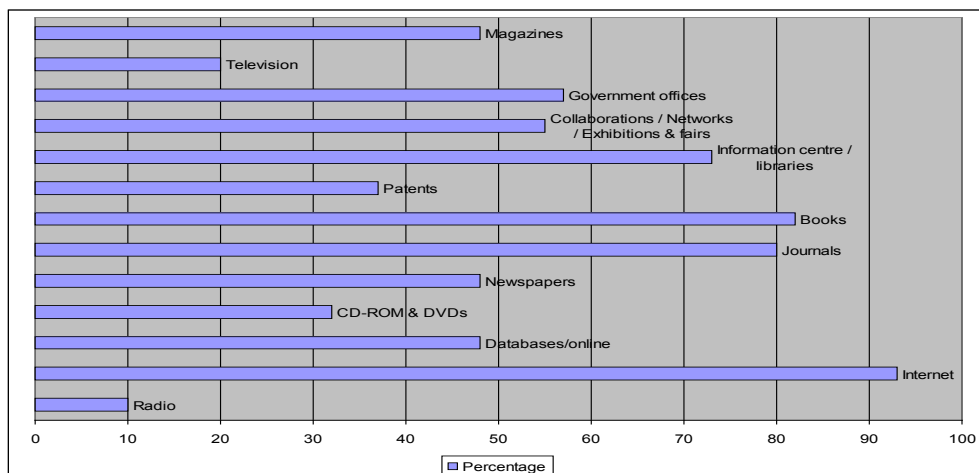
Figure 1: Information sources consulted by researchers at KIRDI (multi-responses)

Source: Authors (2016)

With regard to information services, 44 (73%) of the respondents reported that they visited libraries and information centres.

At KEMRI (Figure 2), again the results indicate that Internet is the most popular information source consulted by 50 (91%) of the interviewed respondents. Respondents used the Internet to access electronic medical and health journals to know what had been published, and to keep in touch with peers and friends through emails and social networking sites like Facebook and LinkedIn. Journals were consulted by 43 (78%) of the respondents who reported using journals such as African Index Medicus (AIM), the International Index to African Health Literature for research. Out of the interviewed respondents 10 (18%) consulted newspapers for news update, while 4 (6%) used magazines to explore topical issues. Another 5 (8%) utilised the radio for current affairs and news items. Only 4 (6%) consulted patents during research.
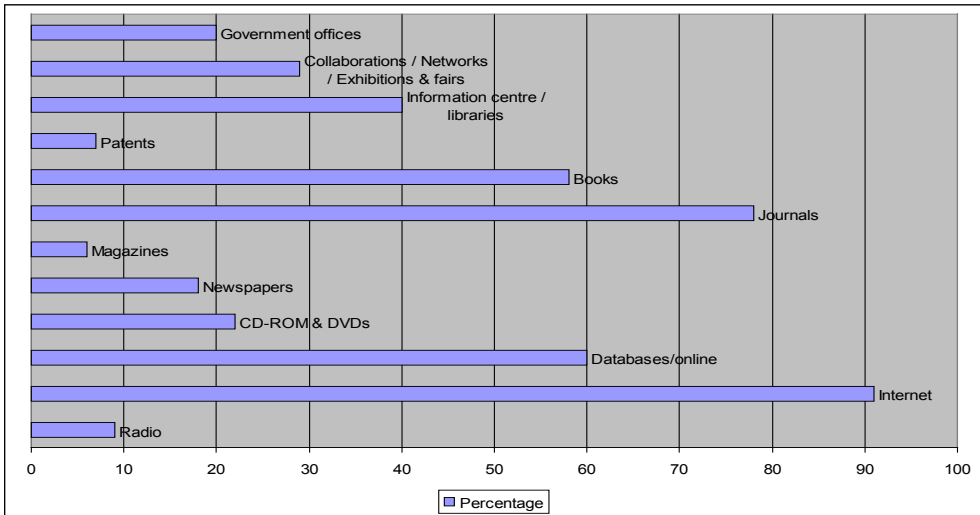
Figure 2: Information sources consulted by researchers at KEMRI(multi responses)

The findings indicate that the major sources of information consulted by researchers include primary and tertiary sources consisting of journals, reports, notes, information on protocols, conventions, and standard operating statistical procedures. Journals were the most consulted and the findings are consistent with those of Zawawi and Majid (2001) who investigated information needs and seeking behaviour of the IMR Biomedical Scientists in Malaysia and established that biomedical scientists use a variety of information sources to satisfy their information needs and that journal articles were the preferred information source. The researchers needed and used reference materials like textbooks, almanacs, directories, encyclopaedias, patents, reviews, manual, reports and the Internet. Mishra (2011) established that scientists preferred to use periodicals. Similarly, Nelson and Adams (1973) found that journals and professional colleagues were the main source of scientific information. Gatero (2008) established that physicians' information needs were catered for through a variety of information sources like professional colleagues, textbooks and journals, Internet resources and pharmaceutical representatives.

In Iran, Hasoomi, Abbasi and Toudar (2011) revealed that 69.7 per cent of researchers mainly use articles for conducting research projects and updating their field-related information. They asserted that differences in information needs are caused by difference in job and field of activity. These findings are consistent with Leckie *et al*. (1996) that information need is not constant

and can be influenced by a number of factors like age, nature of profession, specialisation, career stage, working environment and type of task the individual performs. Similarly, Otike (1999) found that experience had a considerable influence on the information needs of lawyers, while Odini (2005) argued that information seeking should be viewed mainly from the perspective of the engineer and his work tasks which are responsible for generating information needs which can be best satisfied through personal contacts and informal documentation. In this study the respondents who had worked for a period of up-to 4-years indicated that the available sources of information guided their development of research concepts and review of knowledge. The sources met between 50% - 95% of most researchers' information needs.

Availability and Extent of Use of ICTs

The authors sought to establish the range of available ICTs that researchers used and to state which of them best met their information needs. The results revealed the existence of a wide range of ICTs used by researchers to carry out their daily research activities, although still inadequate, accessed from their offices and other designated points within the organisations. When asked to state their perception on value and use of ICTs to access information, and how useful ICTs were in terms of their research information needs, the multiple responses shown in Figures 3 and 4 for respondents from KIRDI and KEMRI respectively show similarities.
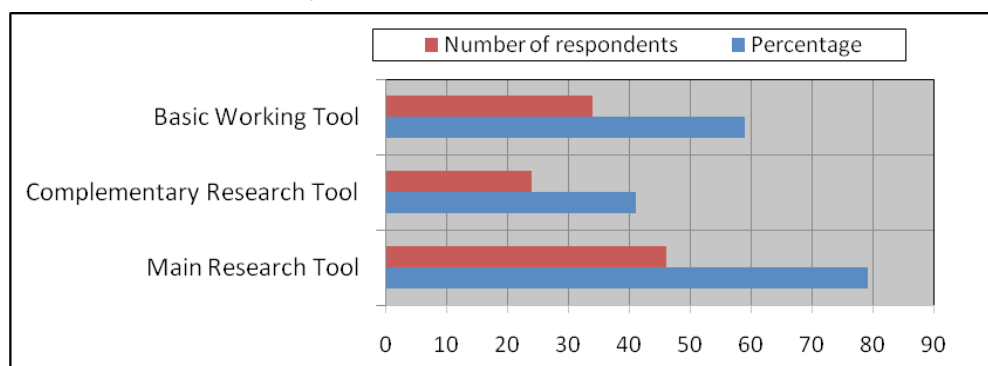
Figure 3: Researchers perception on use of ICTs at KIRDI (Multiple responses)

Figure 3 indicates 46 (79%) of the respondents regarded ICTs as their main research tools. Another 34 (59%) stated that ICTs were their basic working tools, while 24 (41%) considered ICTs as their complementary research tools.

The study revealed that most researchers highly regard the use of ICTs in their search for information for research. This is confirmed from 39 (67%) of the respondents who said that ICTs were:

> "Very effective in accessing industrial information although some industries were not ICT compliant, thus secretive with their information."

> "Important when searching for information outside Kenya especially on suppliers of equipment, although there was minimal local content."

Some of the respondents stated that ICTs were:

> "Fairly effective research tools in reviewing existing knowledge"

> "Better than other sources of information"

> "Effective as they give most of the information one desires"

The results from KEMRI repeated the same pattern as shown in Figure 4.
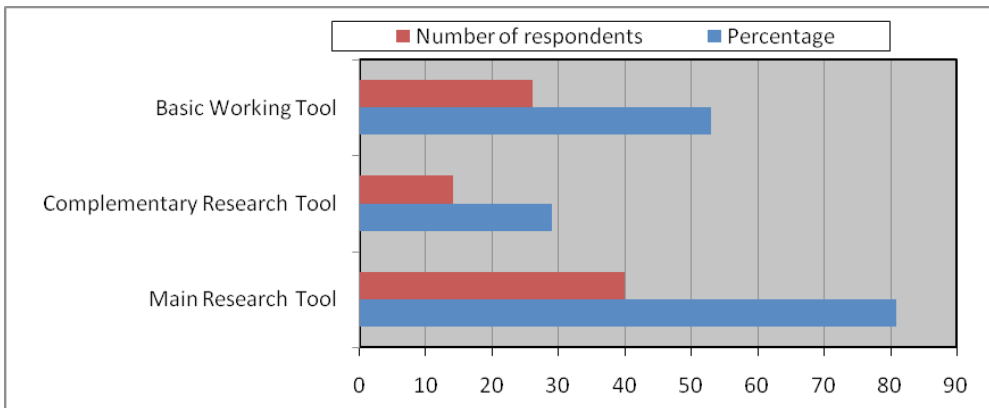
Figure 4: Researchers perception on use of ICTs at KEMRI (Multiple responses)

The majority 40 (81%) of those interviewed regarded ICTs as their main research tools. Another 26 (53%) stated that ICTs were their basic working tools, while 14 (29%) felt that ICTs were their complementary research tools.

The results indicate that researchers use ICTs mainly to carry out research work and regard them as their main working tools for research. This was a major finding common to researchers from the two institutions. Both organisations had a department of IT and ICT laboratory, an indication that

the decision-makers were concerned with the subject of ICT utilisation. A deliberate attempt was made by the two case study organizations to provide researchers with some computer facilities or incentives such as interest free loans to purchase them.

Researchers used the Internet for research and to access information and to know what has been published and to keep in touch with peers and friends through emails and social networking sites like Facebook and LinkedIn. The Internet was the most useful in accessing electronic journals, both current and retrospective, although print copies are also still used. This finding concurs with the views of Royall, Schayk, Bennett Kamau and Alillio (2005) who observed that the Internet constitutes a new and attractive channel for accessing the latest in scientific information as it offers researchers and students an immediate access to a wide variety of research publications.

The available ICTs included computers (both desktop and laptops) and Internet for accessing online databases and websites. This finding is consistent with a related study by Papzan and Yaghoubi (2008) who established that faculty members used electronic information sources, especially those skilled in computer use and Internet surfing. Similarly, Royall *et al.* (2005) established that the Internet constitutes a new and attractive channel for accessing the latest in scientific information.

Devices used for storage and capture included Personal Data Assistants (PDAs), external/flash disks, CDs/DVDs and servers. They were used to avoid loss of research data, which could be caused by virus attacks and power outages. Cameras were also found to be useful in capturing research events and pictures for illustration. The results revealed that the use of mobile phones for scientific and social communication was on the increase and that phones were popular for communication among colleagues and peers. It was established that researchers at KIRDI use mobile phones to monitor fish catches and market prices, while those at KEMRI used them to monitor malaria cases with patients and partner interaction like pharmaceuticals for news alerts and monetary transactions such as payment of field allowances or per diems to research assistants using mobile transfer services such as Mpesa or Airtel Money. Similarly Tewari *et al*. (2008) established that mobile phones were used to capture a dysrhythmia occurring intra-operatively in a patient for the consultant in charge, and argued that mobile phones are an inseparable companion for doctors worldwide.

The findings further indicate that radios, television and video technology were used for recording and watching documentaries and as sources of current information on topical issues.

The respondents indicated that the available sources of information met between 50% - 95% of their information needs. The available sources included the library, Internet, external databases like OARE, HINARI, and Pubmed, journals, books, notebooks and patents among others.

Institutional ICT Policies, Information Access and Use of ICTs

The findings indicate that although the institutions were at the point of drafting ICT policies, their existence were not known to the majority of their researchers, yet they were aware of some restrictions on use of ICTs to access information. The findings further indicate that researchers were required to employ committal signatures on fair use of ICTs or use of passwords and that only staff had access to them for official use and equally expected to protect their Internet and email accounts when accessing and exchanging information with peers. They were expected to visit only authorised sites on the Internet. The policy also required researchers to scan their flash disks to protect their data from viruses. These facts had both positive and negative effects on researchers. On one hand they encouraged researchers to make use of ICTs without security fear on account of hacking and data loss. On the other hand, restriction on unauthorised sites such as Facebook limited researchers from social interaction with their peers and colleagues.

Challenges Experienced by Researchers in Accessing Information

The study findings established that access to needed information was not always an easy task for researchers. Whereas most researchers had no problems with accessing the required information, some did not get access with ease. The results revealed that some researchers needed assistance to access information using ICTs. This was due to lack of proper ICT skills and training. Researchers also experienced the challenge of pay per use on electronic resources which turned out to be too expensive; and required constant subscription to e-journals coupled with denial of full access to use e-books.

Other challenges include inadequate or lack of Internet connectivity frequent cases of server down time and unpredictable Internet connectivity, poor infrastructure, ICT capacity and low bandwidth. Slow speed of the Internet hampered their ease of communication since services could not be resumed in

good time after interruption. The researchers also complained of experiencing frequent blackouts or power outages resulting in loss of data.

The institutional ICT policies had challenges ranging from establishment, implementation, enforcement and frequent revision involving the researchers as users of ICTs. The researchers' complaints about a number of restrictions levied on them such as restrictions on the use of social networking and other sites during working hours.

Use of ICTs to Improve Information Access and Use

The study findings indicate that computers and accessories should be made accessible to researchers and other staff including those in rural stations since ICTs are main, basic and complementary research tools. The researchers singled out Internet connectivity and accessibility as an area that is to be improved and be made available 24 hours. They preferred the use of fibre optic cable technology to improve connectivity and bandwidth, supported by wireless connection. The findings also indicate the need for the use of Internet connection through mobile phones to improve access to and use of information, and that the management should spearhead the use of ICTs and facilitate interconnection beyond the office through modems and purchase of airtime. This finding confirms Marcus, Ball, Delserone, Hribar and Loftus (2007) who established that researchers depend largely on online resources and rely upon libraries' online presence both at work and at home.

The findings also indicate that research institutions should avail the needed resources when they are required, and desire to have subscription renewal to electronic resources like journal and books done including those that give free access like AGORA, HINARI and OARE, among others, for easier access to quality information.

The findings also indicate that ICT competency was one of the impediments to the access and use of information and suggested that there is a need for investing in continuous training in the form of seminars, workshops or conferences for researchers and other users to enhance their ICT skills.

One of the findings indicated that the budget needed to be adjusted upwards to ensure the provision of sufficient ICTs and up-to-date facilities for enhancing information access and use particularly subscription to e-resources and updating the obsolete information resources.

Furthermore, the findings also indicate that anti-virus software and other applications be provided for researchers as a solution to data security or automated data protection to reduce risks and operation costs. Marcus *et al.* (2007) echoed echoed the findings and stated that researchers are usually frustrated by the lack of a standard to guide their quest to make data more accessible.

Conclusion

Researchers' information needs vary due to their different areas of specialisation. They use a wide range of ICTs to carry out their research activities. They recognise ICTs as their main working tools. They should therefore be made available to them to enhance their information access. This would assist research institutions in the diffusion of ICTs among researchers, as well as the use of cloud computing for archiving and storage services. Low ICT literacy skills in some instances hampered ease of access to information. The results herein clearly resolve that continuous training to upgrade literacy skills and the use of Internet as an alternative for improvement.

Recommendations

Based on the study findings, the following recommendations were made as suggestions for a framework to improve ICT diffusion and utilisation:

Policy makers

To carry out an ICTs training needs assessment in order to map out the necessary skills required by researchers in the two study organisations to enable them cope with the dynamism of ICTs in view of the fact that ICTs have become basic as well as main working research tools for the researchers and hence the need for improvement on access to information required by researchers for their daily research activities. The issuance of loans to purchase laptops should be emulated by other research institutions as they help in the adoption and diffusion of ICTs.

Allocation of adequate budgets to cater for ICT needs of researchers at the two institutions to enable ICT personnel to acquire adequate ICTs for use by all researchers and other staff working in satellite stations. Concerning data storage, loss and security, it is recommended that research institutions should secure large servers from the allocated budget while considering cloud computing. The budget should be adequate to cater for the training of the ICT personnel and continuous training in ICT skills for researchers and support staff, improved ICT infrastructure in line with the modern trends, software updates and renewal of various licenses.

The authors recommend a participatory approach in the development of ICT policy by involving researchers since the policy document directly affects their information access. The policy should act as a general guideline on the use of ICTs while enhancing information access and use of ICTs within the institution. The use of social networking sites should be positively received since researchers use the sites as invaluable sources of research information. They should also subject the policy to constant review and strengthen it on the use of ICTs.

Information Workers and ICT Personnel

Traditionally researchers communicate their research findings as peer reviewed articles in both local and international scientific journals. However, with the dynamism of technology there is need for improved communication between researchers or end users of research products. It is therefore important that information workers and ICT personnel explore opportunities of developing online communication tools to meet these needs. Whereas information workers strive to hold face-to-face training with the researchers on the use of e-resources, the ICT personnel should upscale the practice through introduction of e-learning via the institutions' websites or do-it-yourself kits that may be given to researchers to practice on their own from the labs or offices.

Information workers need to provide required information by making subscriptions to relevant information sources including electronic databases like OARE, HINARI and PubMed. Research institutions libraries should join /or renew membership to existing information consortia in order to reduce or review costs for access to the various pay per use electronic information resources such as e-journals and e-books. This would go a long way to increase access to information resources, encourage the use of ICTs and enhance the diffusion of ICTs.

The information workers do a commendable job on training researchers on how to retrieve print and electronic resources. However, it is recommended that the trainings should be continuous so as to ease access to required research information. The training can be done quarterly so that researchers can make the training part of their daily work to improve their skills in the retrieval of specialised information for research in the research institutions.

The ICT personnel should carry out improvement on the web-based infrastructure like the Internet, including the bandwidth, to reduce downtimes on the service and thereby enhance the reliability of the facility.

The institutional ICT support should ensure that researchers have unlimited Internet connectivity for 24 hours a day 7 days a week by tapping onto the fibre optic cables, while considering cloud computing for information storage.

Data security is quite an issue in research as highlighted by researchers. ICT personnel should provide updated antivirus software and also provide application software to researchers in order to protect data either on the network or in the storage, while reducing risks and operation costs.

Researchers

Having made a strong case that ICTs have become basic and main working research tools, researchers should explore more innovative ways of using ICTs to get credible results in research. They should publicise the use of ICTs to other researchers and the general public in order to enhance their diffusion and use among the general population as well as communicate from the same platform.

Based on the findings of this study researchers need to raise their voices on issues that hold them back them from positively using ICTs to access information for research. They need to consider undertaking continuous training in computer skills in addition to their professional skills upgrading in order to improve their access to specialised information in the case study organisations.

Researchers should consider depositing their data and published articles from peer reviewed journals in the institutional repositories. This would enable them to share their findings with others and to contribute to the development of the institutional information data-banks or archives.

Researchers working in thepublic research institutions should push for a participatory approach towards the involvement of ICT policies in order to advise and share their concerns on scientific issues like responsibility, conformity, privacy, disposal of (equipment including e-waste disposal) which is determined by various factors. The researchers should use social sites responsibly in order to convince the administrators that such sites are an invaluable source for research information.

Practical implications

These results are expected to be of help to information professionals, top management and various stakeholders of research institutions to inform decision making so as to enhance the diffusion of ICTs and improve access to information by researchers.

References

Ahmad, A. (2011). A Short Description of Social Networking Websites and Its Uses. International Journal of Advanced Computer Science and Applications, 2 (2), 124-128.

Banks, K. (2011). Mobile phones and the Power of Data Collection. Retrieved November 28, 2012, from http://www.newswatch.nationalgeographic.com/2011/11/17/mobile-phone.

Doucleff, M. (2012). How Cellphones Helped Researchers Track Malaria in Kenya. Retrieved November 28, 2012, from http://www.npr.org/blogs/health/2012/10/10/162643881/how-cellp.

Gatero, G.M. (2008). Utilization of Information and Communication Technology for Accessing Health Information by Medical Professionals in Kenya: a Case Study of Kenyatta National Hospital. Unpublished PhD Thesis, Eldoret, Moi University

Haines, L. L., Light, J., O'Malley, D., & Delwiche, F. A (2010). Information Seeking Behaviour of Behaviour of Basic Science Researchers: Implications for Library Services. *J. Med. Libr. Assoc. 98(1), 73-81*

Hasoomi, T., Abbasi, R., & Toudar, S. (2011). Identification of Nanotechnology Researchers' Information Needs and Information Retrieval Behaviour in Iran. *American Journal of Scientific Research, 18, 83-86*

Kaddu, S. (2004). Application of Information and Communication Technologies (ICTs) in Knowledge Management (KM): Case Study of the Centre for Basic Research Library and the Privitation Unit Library in Uganda. The 16th Standing Conference of Eastern, Central and Southern African librarians (SCECSAL). Kampala.

Kagoda-Batuwa, S. (1998). Challenges of information and communication in consolidating development of the East African Cooperation in the next millennium. Information for sustainable development in the 21st century: proceedings of the 13th Standing Conference of Eastern, Central and Southern African librarians (SCECSAL), Nairobi, July 27-31, 1998 (pp. 15-25). Kenya Library Association.

Government of Kenya (1980). Laws of Kenya: The Science and Technology Act Chapter 250. Government Printer, Nairobi, Kenya

Government of Kenya (2002). National Development Plan (NDP) 2002-2008: Effective Management for Sustainable Economic Growth and Poverty Reduction. Nairobi, Government Printer

Government of Kenya (2007). Kenya Vision 2030: a Globally Competitive and Prosperous Kenya. Nairobi, Ministry of Planning and National Development and the National Economic and Social Council (NESC), Office of the President

Kenya Industrial Research and Development Institute (1998). Sources of Industrial and Technological Information in Kenya Directory. Nairobi, KIRDI, National Industrial Information Centre (NIIC)

Kenya Medical Research Institute (KEMRI). Available: http://www.kemri. org/ Accessed: 24/01/2009

Kombo, D. K., & Tromp, D. L. A. (2006). Proposal and Thesis Writing: an introduction. Nairobi: Paulines Publications Africa

Leckie, G. J., Pettigrew, K. E., & Sylvain, C, (1996). Modelling the Information Seeking of Professionals: a General Model, Derived from Research on Engineers, Health Care Professionals and Lawyers. *Library Quarterly*, *66(2), 161-193*

Madhusudhan, M. (2012). Use of Social Networking Sites by Research Scholars of the University of Delhi: a Study. The International Information and Library Reviews, 44, 100-113.

Majid, S., Eisenschits, T. S. & Anwar, M. A. (2000). Information Needs and Seeking Behaviour of Agricultural Scientists in Malaysia. *Library and Information Science Research, 22(2), 145-163*

Marcus, C., Ball, S., Delserone, L., Hribar, A. & Loftus, W. (2007). Understanding Research Behaviours, Information Resources and Service Needs of Scientists and Graduate Students: a Study by the University of Minnesota Libraries. Report of the University of Minnesota Libraries. Available: http://lib.umn.edu/about/scieval Accessed on 12/5/2012

Maxwell, J. A. (2005). Qualitative research design: an interactive approach (2nd ed.). London: Sage Publications

Minishi-Majanja, M. K., & Kiplang'at, J. (2005). The Diffusion of innovation theory as a theoretical framework in Library and Information Science Research. South African Journal of Libraries and Information Science, 71 (3), 211-224

Mishra, Rabinarayan (2011). Information Use Patterns by Scientists: a Case Study of NEISt, Jorhat, North East India. *Library Philosophy and Practice (July Issue). Available at: http://unllib.unl.edu/LPP/ accessed 4/28/2012*

Murugesan, N., & Balasubramani, R. (2011). Application of ICT Based Resources and Services in Research and Development Libraries in Tamilnadu: an Analytical Study. European Journal of Social Sciences, 23 (1), 154-161.

Mutula, Stephen (2004). IT diffusion in Sub-Saharan Africa: Implications for Developing and Managing Digital \linrsries. *New Library World, 105(1202/1203), 281-289.*

Mutula, S.M. (2008). Comparison of sub Saharan Africa's e-Government Status with Developed and Transitional Nations. *Information management and Computer Security, 16(3), 235-250*

Mutula, S.M. (2010). Deploying Development Informatics in Bridging the Digital Divide: Challenges & Opportunities. In Proceedings of DLIS 11th Annual Conference, 2nd – 3rd Sept., Richardsbay, University of Zululand, South Africa, p.197-214

Nelson, C.E. and Adams, C.V.W. (1973). Continuity of Research Effort and Sources of Scientific Information by Educational Researchers. *Educational Researcher*, *2(6), 13-15*

Obioha, J. (2005). The Role of ICT in Information Seeking and Use Amongst Research Officers in Research Institutes in Nigeria: The Nigerian Institute for Oceanography & Marine Research Institute Experience. The International Information and Library Review, 37 (4), 303-314.

Odero-Musakali, D., & Mutula, S. M. (2007). Internet Adoption and Assimilation in Kenyan university Libraries. Library Review, 56 (6), 464-475.

Odini, C. (1995). Stimulating the use of information in Kenya. New Library World, 96 (119), 23-25.

Odini, C. (2005). Information Seeking and Communication Behaviour of Kenya Railways Engineers. University of Dar es Salaam Library Journal, 7(2): p.98-111.

Otike, J. (1997). Legal Information Needs of the General Public with Special Reference to Developing Countries. *Library Review, 46(1), 28-33*

Otike, J. (1999). The Information Needs and Seeking Habits of Lawyers in England: a Pilot Study. *The International Information & Library Review*, 31(1), 19-39

Papzan, A. H., & Yaghoubi, J. (2008). Identifying Electronic Information Needs of Agricultural Faculty Members. IAALD AFITA WCCA 2008 World Conference on Agricultural Information and IT. Available at: www.cabi.org/GARA/FulltextPDF/2008/20083298079 Accessed: 12/4/2011

Royall, J., Schayk, I. van, Bennett, M., Kamau, N., & Alilio, M. (2005). Crossing the Digital Divide: the Contribution of Information Technology to the Professional Performance of Malaria Researchers in Africa. *Africa Health Sciences, 5(3), 246-254*

Sulaiman, R. V., Hall, A., Kalaivani, N. J., Dorai, K. & Reddy, V. (2011). Necessary But Not Sufficient: Information and Communication Technology and Its Role in Putting Research Into Use. Discussion Paper Series. Retrieved May 21, 2012, from www.researchintouse.com

Tewari, A., Oberoi, R., Garg, S., Kaur, H., Sood, D., & Katyal, S. (2008). Use of Multimedia Message Service Technology in the Operation Theatre: a Case Report. *Indian Journal of Anaesthesia, 52(1), 93-95*

Wilson, T. D. (2002). Information Science and research methods. Retrieved December 10, 2008, from http://informationr.net/tdw/publ/papers/slovak02.html

Yin, R. K. (1984). *Case study research design and methods*. London: Sage.

Zawawi, S., & Majid, S. (2001). Information Needs and Seeking Behaviour of the IMR Biomedical Scientists. *Malaysian Journal of Library & Information Science, 5(1), 25-41*

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Technology is constantly changing the way people seek information, communicate and collaborate. Consequently, information users in the modern era have embraced new information seeking behaviour as well as expectations for better usability, faster response times to their needs, and constant access to unrestricted information services. These expectations and the challenges therein have triggered new conversations on how to discover, invent and/or share knowledge in this age. These conversations have led to a drastic change in the environment in which libraries and information centres currently work.

This publication is a collection of invaluable experiences and ideas from information and knowledge management specialists on how best to manage and thrive professionally in the emerging infosphere. It postulates the different ways in which information and knowledge workers continue to collaborate with their stakeholders to create and sustain an information universe that facilitates the effective creation, collection, validation, organisation, sharing, usage and perpetuation of knowledge in a dynamic knowledge economy.

This book has 40 chapters covering the following themes:

- Emerging Trends in Libraries and Information Centres;
- Knowledge Sharing and Diffusion;
- Indigenous Knowledge;
- Records Management;
- E-Governance;
- Information and Knowledge Management Education;
- Role and Impact of Information and Knowledge Centres;
- Legal and Ethical Issues in Information and Knowledge Management;
- Social Media in Information and Knowledge Management; and
- Digital Trends in Information and Knowledge Management.