# USE OF ICTS IN ACCESSING INFORMATION BY RESEARCHERS IN SELECTED PUBLIC RESEARCH INSTITUTIONS IN KENYA

BY

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## DECLARATION

**DECLARATION BY THE CANDIDATE**

This thesis is my original work and has not been submitted for a degree in any other University. All sources referred to have been duly indicated and acknowledged.

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## DEDICATION

To my father Hassan Salim Kaburu, sisters, brother and their children for their support
and
To the memory of my late mother Amina and beloved sister Farida

# ABSTRACT

Kenya Government emphasizes that ICTs are central to globalization process and that information age is an opportunity for Kenya to strategically position herself to benefit from global economy. One of the strategies the Government anticipates to employ in achieving economic growth and development is enhanced use of ICTs by researchers in accessing information in order to increase industrial productivity, creativity, innovation, service efficiency, lower disease burden, poverty reduction and job creation under flagship projects. There is need for researchers to access and use health, industrial and technological information to enhance their potential in the realization of the Kenya Vision 2030. 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 due to inadequate tools such as computers, although several initiatives like the Programme for the Enhancement of Research Information (PERI) have strengthened their efforts to avail information electronically. The aim of this study was 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 utilization at the two research institutions. The objectives of the study were: to establish the range of information required by researchers at KIRDI and KEMRI; examine information sources and services available to researchers at KIRDI and KEMRI and determine the levels of their usefulness to researchers; find out if institutional ICT policy exists and how it supports information access, sharing and exchange by researchers at KIRDI and KEMRI; establish the challenges experienced by researchers in utilizing ICTs to access information; and suggest ways of improving access to and use of information by researchers at KIRDI and KEMRI using ICTs and propose a framework for improved ICTs use in accessing information at the case study organizations. A total of 152 respondents comprising 115 researchers and 37 key informants were interviewed. The study was informed by the Diffusion of Innovation theory originated by Everett Rogers, complemented by the General Systems theory founded by Ludwig von Bertalanffy. The study employed qualitative research method using a multiple case study approach. Data was collected through semi-structured interview schedules complemented by document review. The study employed purposive sampling technique using convenience and maximum participant variation strategies. Data was analyzed using qualitative data analysis, and where necessary quantitative techniques were utilized. It was established that due to the different areas of specialization, work experience and daily research activities researchers' information needs and available sources varied. Libraries services existed, although web-based information services were found to be the most used to access industrial and health information. However, inadequate ICT infrastructure including internet connectivity hampered exploitation of electronic resources. There was no formal ICT policy to support information access in the institutions. Other challenges experienced by researchers included not being up-to-date with ICT skills to cope with advancement in technology. Overall researchers considered ICTs to be their main research tools much as they are basic and complementary working tools. The study therefore recommends an improvement on currency of information resources, development of robust ICT infrastructure, continuous training in ICT skills, and allocation of adequate budget to cater for sustainable ICT needs of researchers from the two institutions and a participatory approach that involves researchers in developing e-content and ICT policies.

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| | |
|---|---|
| AAAS | American Association for the Advancement of Science |
| AGORA | Access to Global Online Research in Agriculture |
| AHILA | Association for Health Information and Libraries in Africa |
| AIM | African Index Medicus |
| ATM | Automated Teller Machines |
| BIREME | Biblioteca Regional de Medicina |
| CCK | Communications Commission of Kenya |
| CD-ROM | Compact Disks Read Only Memory |
| DOI | Diffusion of Innovation |
| DVD | Digital Versatile Disks |
| EDSC | Engineering Development and Service Centre |
| GDP | Gross Domestic Product |
| GHL | Global Health Library |
| GIS | Geographic Information Systems |
| GST | General Systems Theory |
| HINARI | Health Internetwork Access to Research Initiative |
| HISP | Health Information Systems Programme |
| HIV | Human Immunodeficiency Virus |
| ICT | Information and Communication Technology |
| IDRC | International Development Research Centre |
| IEC | Information, Education and Communication in Kenya |
| INASP | International Network for the Availability of Scientific Publications |
| IP | Internet Protocol |
| IT | Information Technology |
| KARI | Kenya Agricultural Research Institute |
| KDN | Kenya Data Networks |
| KEBS | Kenya Bureau of Standards |
| KEFRI | Kenya Forestry Research Institute |
| KEIN | Manufacturing Industries in Kenya |
| KEMRI | Kenya Medical Research Institute |
| KENSIDOC | Kenya Scientific Information and Documentation Centre |

| | |
|---|---|
| KETRI | Kenya Trypanosomiasis Research Institute |
| KIDOS | Directory of Sources of Industrial and Technological Information |
| KIPI | Kenya Intellectual Property Institute |
| KIRDI | Kenya Industrial Research and Development Institute |
| KISTI | Korea Institute of Science and Technology Information |
| KSP | Kisumu Sorghum Plant |
| KWRC | KIRDI Western Region Centre |
| LAN | Local Area Network |
| LDC | Leather Development Centre |
| LSC | Laboratory Services Centre |
| MDG | Millennium Development Goals |
| MMS | Multimedia Message Service |
| MNP | Mobile Number Portability |
| MTR | Mobile Termination Rates |
| NCST | National Council for Science and Technology |
| NDP | National Development Plan |
| NEMA | National Environment Management Authority |
| NGO | Non-Governmental Organization |
| NIIC | National Industrial Information Centre |
| OARE | Online Access to Research in Environment |
| PAS | Public Address System |
| PDA | Personal Digital Assistants |
| PDF | Portable Document Format |
| PERI | Programme for the Enhancement of Research Information |
| PHI | Partnerships in Health Information |
| R & D | Research and Development |
| SITI | Sources of Industrial and Technical Information |
| SME | Small and Medium Enterprises |
| SMS | Short Message Service |
| SPSS | Special Programme for Social Science |
| TV | Television |
| UNCTAD | United Nations Conference on Trade and Development |
| VCR | Video Cassette Recorder |

| | |
|---|---|
| VHL | Virtual Health Library |
| WAN | Wide Area Network |
| WHO | World Health Organization |
| WWW | World Wide Web |

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**CHAPTER ONE**

**INTRODUCTION AND BACKGROUND INFORMATION**

**1.1     Introduction**

The Kenya Vision 2030 seeks to achieve an annual economic growth rate of 10 per cent in order to build a stronger industrial structure that creates an inter-connected, technologically advanced society with modern information and communication systems driving innovation, growth and social progress. The government emphasizes the fact that Information and Communication Technology (ICT) is central to the globalization process and it also stresses that the information age is an opportunity for Kenya to strategically position itself to benefit from the global economy (Kenya, Republic of, 2002-2008). Hence, the government promised to put in place a policy that will guide and target the pivotal role of ICT in the digital economy. To this effect ICT programmes will be integrated in national development planning and the country will require infrastructural investments in terms of Local Area Networks (LANs) and Wide Area Networks (WANs) in order to reap these benefits. In the general area of training for the Small and Micro Enterprises (SMEs) the government will strive to wane off current cultures and attitudes towards ICT by implementing specialized training at different levels (Kenya, Republic of, 2007).

Under the skills development strategies, the government promised to address the following:

- Developing capacity for ICT absorption and utilization including human resources,

- Attracting skilled ICT professionals to the public sector,

- Promoting the use of ICT in decision-making,

- Using ICT in the dissemination of information on the prevention of HIV/AIDS as well as the availability of low cost drugs,

- Using ICT to create employment and enhance the international competitiveness of the country, and

- Developing software applications for export.

Kenya Vision 2030 also states that the government will restructure the health delivery system and shift to promotive care in order to lower the nation's disease burden. Under the flagship projects on revitalization of health infrastructure, the government will establish strong community-based information systems to facilitate access to health-related information and outreach. More researchers will need to access and use health, industrial and technological information in order to help Kenya realize the promises outlined in Vision 2030.

The government states that the performance of the industrial sector has been on the decline, facing low capacity utilization, declining productivity and limited technological advancement ICTs included (Kenya, Republic of, 2007). It has therefore planned to integrate ICT programmes in national planning to secure maximum contribution to the country's development and poverty reduction.

## 1.2    ICTs in National Development

While giving the experience of the newly industrialized countries, Kagoda-Batuwa (1998) observed that information and communication are the engines of sustainable growth and development, provided there is a minimum technological capacity

coupled with effective co-ordination, information linkage programmes and appropriate channels of communication. On the global agenda, Mutula (2004) asserted that there was disparity in access to ICT between countries and communities resulting in digital divide caused by such factors as inadequate infrastructure, high cost of access, inappropriate or weak policy, and lack of locally created content. He observed that the high cost of access was an impediment to access to ICTs, as they have not been integrated into the development agenda in most of sub-Saharan Africa. Kenya Vision 2030 recognizes the role of science, technology and innovation in the modern economy, and goes further to state that new knowledge plays a central role in boosting wealth creation, social welfare and international competitiveness (Kenya, Republic of, 2007). Information is vital for sound planning and decision-making at all levels and in all sectors, including educational and professional development of the people. It is necessary for the management and for enrichment of peoples' day-to-day lives and in research. Thus, ICTs hold lots of opportunities for development right from international and regional, to national and rural or local levels.

Technological developments affect the behaviour of citizens and governments alike, an example of which is the effect of mobile phone technology on the behaviour of Kenyan citizens on the concept of communication. Also, the Internet sector has become a hub of information on practically every topic of interest. Websites, electronic mails, electronic bulletin boards and online databases are significant in the acceleration of research and development in various scientific fields as they provide researchers with a broad range of information services including efficiency in the management of rural enterprises and time saving in travel costs. The growth in the Internet industry has also created a wide range of activities that have resulted in

increased employment, including self-employment, which is contributing tremendously towards poverty alleviation. In 1999, the Kenya Government made efforts towards enhanced access and reduced costs by reducing Internet operating cost by seventy per cent. In the National Development Plan (2002-2008), the government stressed that there was need to address the issue of universal access to information through the Internet within the international borders in order to bridge the digital and knowledge gap (Kenya, Republic of, 2002). In a similar study on Internet adoption Odero-Musikali and Mutula (2007) observed that the Internet has been extolled for its potential in revolutionizing, 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 communication forms and new working environments among others.

On another front, intranet, an organization's private computer network that uses the Internet to share its information or operational systems with its employees securely, does not necessarily have to provide access to the Internet. However, access may be provided through a network gateway with firewall, which prohibits unauthorised external access. The gateway process involves user authentication, encryption of messages as well as virtual private network connectivity for off-site employees to access company information, computing resources and internal communications.

ICT is one of the fast growing sectors in Kenya and the government has given it recognition as the foundation for modern economic development by introducing user-driven courses and curriculum within the education and training institutions (Kenya, Republic of, 2002). As the cost of ICTs continues to fall, the country is witnessing

increased computer usage due to reduced import tariffs and fall in import prices. Hence, there is an increase in the range and diversity of computer applications in everyday activities.

The Kenya Government plans to use ICT to instil efficiency in the delivery of public services (Kenya, Republic of, 2007) under flagship projects with ICT cited as one of the strategies to be utilized. This will make the services more accessible and affordable; for example, with regards to roads, there will be computerized information maintenance management systems to fast-track the implementation of National Road Safety Action Plan.

While the ICT sector is the foundation of modern economic development, substantial demands for basic services remain unmet with disparity in the distribution of communications facilities between rural and urban areas continuing to widen. Notably, Kenya has the largest number of Internet users in sub-Saharan Africa. Having recognized the importance of ICT in development, the government plans to integrate ICT programmes in national development planning with the purpose of instilling efficiency in public service delivery to make them more widely accessible and affordable. In effect, the government will provide an enabling environment and right incentives to the sector, and make it fully responsive and growth-enhancing to the benefit of all Kenyans (Kenya, Republic of, 2002).

In view of the above, the aim of the government is to achieve competitive info-communication sector commensurate with economically and socially optimum deployment of the country's resources that will lead to high quality, cost-effective and

universally accessible services. It is however noted that expansion and modernization of ICT sector has been hampered by poor economic performance, which has slowed down development of infrastructure particularly in the rural areas thereby impeding on the growth in the use of ICTs and related services, yet it is expected to contribute significantly to the overall economic growth.

### 1.2.1 ICTs and Research

The concept of research is as old as science, but its history dates back to the 1790s. Indeed, the phrase "research and development" was first used in industrialized nations after World War II. At that time, the arms industry had expanded leading to the detection of weaknesses in technology. Basic research then referred to work of scientists and others who pursued investigations without specific goals. However, current industrial research is directed towards generalized goals like investigation of newly discovered frontiers of technology that relate to problems of a given industry.

In the developed world like Europe, United States and Japan, the concept of research and development is an integral part of economic planning both in their governments and private industry. Madhusudhan (2012) has noted that research scholars in India at the University of Delhi use social networking sites for building online communities with people whom they share interests and activities, because the sites avails to them online platform for interaction and offer opportunities for staying in contact with each other.

### 1.2.2   Use of ICTs in Accessing Information By Researchers

Information as a resource affects all disciplines globally whether scientific or social. It is therefore imperative that the relevant information be available at the right time and right format both for knowledge and development activities. Obioha (2005) asserted that as humankind developed an urge to seek for ways to better their lives, they made discoveries of ICTs in science and technology. Thus, ICT brings innovation into information seeking and knowledge acquisition.

ICTs are crucial in facilitating research activities in any country. In India Sulaiman et al. (2011) observed that although traditional ICTs such as radios, television and print media played a major role during the Green Revolution in the 1970s and 1980s, they are still used in rural areas to introduce new ideas and improved practices in development efforts. They singled out the agriculture sector where ICTs offer a key mechanism for putting research-derived ideas, information and technology into use. Several innovations in ICTs and knowledge management focus on disseminating a wide range of agricultural and rural information to producers and other knowledge intermediaries. They also noted that, in addition, researchers and other professionals use Geographic Information Systems (GIS) in planning interventions in agriculture, forestry and geology, while e-mail, audio and video conferencing are used for quick and interactive knowledge exchange. According to PROGIS web-site (www.progis.com), GIS family consists of a number of software such as WinGIS and PROGIS which offer a wide range of applications for agriculture, forestry, ecology and rural management. PROGIS comes with useful tools for logistics, community management, utility management, GeoInfotainment, precision farming and virtual farming. In addition, it has integrated online map data of Microsoft Bing Maps that

offer access to geographic data like satellite and aerial images, road maps and address databases as part of the software package. The commonly used applications or tools for rural ICTs experiments include tele-centres, web portals, Internet, call centres, mobile phones, community radio, video and digital photography.

Murugesan and Balasubramana (2011) observed that most library users in Tamilnadu used e-mail although internal databases were also created. Other resources include e-journals, e-books, CD-ROM databases, online databases and web based resources. They reiterated that the information age has made great impact on research and development libraries with most researchers having showed positive preference for ICT application. The increased use was due to considerable growth in connectivity, content and capacity within the ICT sector, and the fact that South Asian governments had "prioritized ICT deployment in development efforts". However, Sulaiman et al. (2011) observed that ICTs in general are underutilized and have not contributed effectively to the challenges of putting new knowledge into use. They also observed that they are mostly used to support traditional communication tasks like information dissemination and training, and that ICTs have the potential of getting across vast amounts of information to rural population in a more timely, comprehensive, cost-effective and interactive manner.

At the University of Delhi in India, the use of social networks, especially Facebook and Twitter as an effective channel of communication, was on the rise, advancing from face-to-face communication because educational institutions are equally available on the social networks as stated by Madhusudhan (2012). He notes that social networks mainly focus on building online communities of people with similar

interests and activities and provide opportunities for colleagues to actively connect and articulate with each other as they create online space which allows them to avail themselves.

As concerns the use of social networks Ahmad (2011) noted that researchers use 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, while creating potential users for particular information. Traditionally, reports of events, minutes of meetings, memorandums, conference proceedings and systems of filling documents by institutions were recorded on paper format for future reference. Technology has spread so fast that nowadays people talk about electronic databases, interactive tools and multimedia presentations, audio and video recordings as means of capturing, storing and disseminating information. Kaddu (2004) further notes that the unfolding technological revolution present opportunities to developing countries in areas like low-cost telecommunication systems to enhance distance learning, distance health services and better access to markets and partners for growth. ICTs have been the drivers of the knowledge society in developed countries as they deliver new and faster ways of delivering and accessing information, innovation for real-time communication and ways to do business and create livelihood opportunities. Hence, more information is being put in public domain.

Sulaiman et al. (2011) underscored the role of ICTs in putting research into use. They noted that, mobile phones, video and digital photography, web portals, GIS, e-mail, audio and video conferencing are used by researchers and other professionals for

quick and interactive knowledge exchange due to considerable growth in connectivity, content and capacity within the ICT sector. They further observed that South Asia governments "prioritized ICT deployment in development efforts" and that there are several innovations in ICTs and knowledge management that focus on disseminating agricultural and rural information to producers and knowledge intermediaries.

The Kenya Government has realized that various opportunities exist in areas like health care, education and research, which can be exploited using ICTs (Kenya, Republic of, 2002). In the manufacturing sector Omae and Adeya (2011) adds that ICT has turned the globe into an interconnected network for communication and interaction of individuals, firms, schools and governments through various channels and provides economic opportunities across all cultures and borders. He argues that Kenya has not fully embraced ICT, which may slow the process of achieving Vision 2030, especially in realizing cost reduction, increased productivity, management of complex operations and better controls for strategic decision-making. In an effort to sensitize the manufacturing sector, Omae and Adeya (2011) states that the use of ICT is necessary for the production of new products based on information content and accompanying information-dominated design and manufacturing methods. In effect, ICT provides ways to facilitate and manage the complexity of the information-intensive processes, and he further argues that well planned and calculated adoption of ICT into key areas of manufacturing ensures implementation of effective strategies that yield desired results. Among the ICT used is the wireless networks and satellite technology to access information using Bluetooth and wireless application protocol (WAP).

In the case of the medical field, there is increased use of telemedicine devices for monitoring and sensing technology, including geospatial devices used in land use monitoring and vehicle tracking. Banks (2011) talks of the power of mobile phones and Internet in data collection and information sharing in the rural communities in the developing world, and how they are transforming health, conservation and research around the world. Reporting on the use of modern technology in health care Doucleff (2012) narrates how researchers in Kenya use mobile phones to track malaria and flu season as well as mapping the junk food that people eat at night by monitoring blood sugar. He states that researchers at Harvard School of Public Health were able to track texts and calls from about 15 million mobile phones in Kenya for a period of one year and then used the data to make a map of how malaria spreads from the regions to mega cities like Nairobi. Subsequently, he proposes that sending a text message on the mobile to remind people to use a bed net or take precautions can help stop the spread of malaria.

## 1.3    Background Information

The research sector in Kenya consists of Agricultural and Allied Sciences, Physical Sciences (including chemical sciences and mathematics), Industrial Sciences, Engineering and Technology, Medical Sciences (including Pharmacology), Natural Sciences (i.e., Biosciences and Geosciences) and Social Sciences (i.e. Sociology, social studies and History).

### 1.3.1   The industrial sector

In Kenya's *National Development Plan* (2002-2008) it is stated that performance of the industrial sector had been on the decline for more than 20 years. The sector faced

low capacity utilization, declining productivity and limited technological advancement, with the worst hit being the manufacturing sector, which had dropped from 3.7 per cent of the GDP in 1996 to 1.5 per cent in 2000, yet this sector had been in existence in Kenya since the end of World War II. The decline was due to competition from cheap sub-standard and counterfeit products that constrained industrial production coupled with inadequate research and development besides lack of awareness of intellectual property rights. As a result this had constrained the technological advancement that was supposed to play a key role in the development of industry.

In order to improve performance of the industrial sub-sector, the government plans to pursue revitalization of industrial growth, maintain quality control and standards, and enhance research and technology advancement. Namhila (1998) states that research is an important component of planning, policy formulation, and project implementation; it is a component that cannot be ignored in the planning or implementation of projects. Kenya Vision 2030 outlines that manufacturing sector is expected to play a critical role in propelling the economy to a 10 per cent growth rate, creation of jobs that support the country's social development, and foreign exchange earnings through foreign direct investment. These goals can only be met by using state-of-the-art technology that is both efficient and environmental friendly in order to make Kenya a dynamic industrial nation. A growth rate of 10 per cent driven by local, regional and global markets was expected by the year 2012.

**1.3.2    The health sector**

According to the *National Development Plan* (2002-2008) the government noted that life expectancy had decreased from 60 years in 1993 to 47 years in 2000, and that unfavourable distribution of health services continued to widen with observed disparities in access and affordability across the country. In 1994, the Kenya Health Policy Framework was launched to articulate the government's commitment to improving the health of the Kenyan population. Closely following that policy was the National Health Strategic Plan for 1999-2004, which was formulated to translate the policy objectives into programmes and activities. In the *Development Plan,* the government had promised to streamline the provision of health services, including redistribution of services to the rural areas, with more emphasis on preventive and promotive health services, having realized that most of the diseases encountered at the health facility level are preventable at household and community level; hence, it stressed that the public needs to be well informed on the preventive measures. In effect, the government promised to redesign and diversify information, education and communication (IEC) materials to focus towards encouraging communities and individuals to adopt healthy practices.

The following are some of the strategies that the government plans to employ to achieve these objectives:

- Adoption of health research and education,
- Implementation of an integrated disease surveillance concept at all levels of the health care system,
- Research on control and prevention of communicable diseases,

- Epidemiological surveys on trends and risk factors of communicable diseases, and

- Provision of adequate resources for epidemic preparedness and response at the national and grassroots levels.

### 1.3.3 National research organizations in Kenya

The ability of a nation to solve problems and initiate and sustain economic growth partly depends on its capabilities in science, technology and innovation. These attributes have been identified as crucial in achieving all the Millennium Development Goals (MDGs) (Kenya, Republic of. 2005). The Science and Technology Act, Cap. 250 of the Laws of Kenya, was enacted in 1977 to provide for the establishment of national research institutes whose aim was to promote and control research activities in the country. Subsequently, the National Council for Science and Technology (NCST) was established as a statutory institution whose mandate is to advise the government on all matters relating to national science and technology, and coordinate research, innovation and experimental development.

In addition, several other national research institutions responsible for research activities in various sectors were established and they include:

- Kenya Industrial Research and Development Institute (KIRDI) established in 1979 to support industrial development and carry out research and technology development

- Kenya Medical Research Institute (KEMRI) established in 1979 under the Science and Technology Amendment Act Cap. 250 to be responsible for carrying out health science research (Kenya, Republic of. 1980).

- Kenya Forestry Research Institute (KEFRI) was established in 1986 to provide efficient development, management and utilization of forests and trees for the conservation of the environment and improvement of the welfare of the people of Kenya. It was mandated to conduct research in forestry, cooperate with other organizations and institutions of higher learning in training and on matters of forestry research, and disseminate research findings (KEFRI, 2000)

- Kenya Agricultural Research Institute (KARI), established as a semi-autonomous institution in 1979 with the mandate to effectively manage, reorganize and consolidate agricultural research within the country, after the collapse of the Community. It took over research activities from the East African Agricultural and Forestry Research Organization (KARI, 2013).

- Kenya Trypanosomiasis Research Institute (KETRI), established in 1979 to carry out research that would lead to effective control of human and animal Trypanosomiasis and effective reclamation of tsetse infested land. It was later merged with KARI in 2003.

## 1.3.4   The case study organizations

An in-depth study of two research institutions namely KIRDI and KEMRI were undertaken. The two were chosen due to their direct contribution towards the welfare of the Kenyan populace in industrial and health research respectively.

## 1.3.4.1 The Kenya Industrial Research and Development Institute (KIRDI)

As mentioned earlier, KIRDI is a national multi-disciplinary research institution established in 1979 under the Science and Technology Act with its main mandate as to conduct research and development in industrial and allied technologies including

mechanical, civil, electrical and electronics, and chemical engineering, energy, environment and commodity technologies. Moyi and Njirani (2005) noted that KIRDI is mandated to carry out technology transfer in terms of upgrading Kenya's technological and scientific capability, enhance technology transfer, adapt technology and disseminate good technology practices. This mandate is tenable because KIRDI has the information and infrastructure to design, produce and develop technology.

KIRDI's vision is to be a centre of excellence in industrial research and development, while its long term objective according to Kaane (1998), is to provide scientific and technological knowledge for the attainment of self-reliance in technology and for creating a self-sustaining industrial development process to promote industrialization in Kenya and dissemination of findings that have a positive impact on national development. This objective continues to support Kenya's ability to solve problems, and initiate and sustain economic growth, although this partly depends on the country's capabilities in science, technology and innovation, which have been identified as crucial in achieving all the MDGs (Kenya, Republic of 2005).

KIRDI hopes to achieve its mandate through the following strategic objectives:

- Establishing and maintaining an institutional and national industrial information focal point, and
- Building technological capacity and industrial information base for the Kenyan industry.

The others are:

- Undertaking industrial research and, development, and transferring / disseminating the outputs

- Developing national industrial research programmes

- Mobilizing adequate resources to achieve a sustainable financial base for the institute's activities

- Improving the institute's infrastructure to provide state-of–the-art-research and development facilities and equipment

- Providing a conducive environment for the continuous development and motivation of staff

- Endeavouring to attain and maintain higher customer base and international recognition

- Facilitating the establishment of the National Industrial Technology Fund

- Establishing and maintaining linkages and network with industry and other stakeholders

- Participating and contributing to research policy formulation and implementation

- Undertaking monitoring, evaluation and impact assessment.

In the organizational structure, KIRDI consists of two main departments, namely Department of Research and Development (the core department), and the Department of Finance and Administration. The following are the production units cum service centres:

- Engineering Development and Service Centre (EDSC)

- Leather Development Centre (LDC)

- Information and Communication Technology

- National Industrial Information Centre (NIIC)

- Laboratory Services Centre (LSC)

- Energy and Environment

- Food and Technology Division

- KIRDI Western Region Centre (KWRC) formerly Kisumu Sorghum Plant (KSP).

The Institution has established satellite branches in Homa Bay, Kisii, Eldoret and Mombasa, with another one to be established in Garissa.

Research carried out on Kenyan industries revealed that there was very little linkage between Research and Development (R & D) institutions and the manufacturing (Kaane, 1998). Examples of such institutions include the Kenya Sugar Research Foundation and Mumias, Muhoroni or Sony Sugar manufacturing companies. The same applies for KEFRI and Webuye Panpaper Mills. The majority of enterprises do not seek solutions from R & D institutions and look for technological information abroad, which is too costly to obtain and difficult to modify or innovate due to limited access to the information. This problem necessitated the creation of NIIC as a national focal point to handle information on new products and technologies, technology offers and requests, investment opportunities, joint venture opportunities, technology transfer services, and business information and training.

NIIC started as a funded project through the International Development Research Centre (IDRC) and aimed at linking KIRDI researchers with industrial information sources (i.e., databases from Africa and the rest of the world), but the project ended before this was achieved. KIRDI hopes to revive the project if it has to remain an active national industrial information focal point to serve the needs of its researchers.

Notwithstanding this setback, researchers at KIRDI are kept up-to-date with developments in their fields of interest through an alert system, current awareness and selective dissemination of information. However, these cannot go without challenges. Sustainability standards that were set by IDRC when establishing NIIC could not be maintained because of dependability on funds from the central government. This study will strive to establish whether technological advancement is one of the challenges facing researchers at KIRDI, as well as how they cope with vast information being published daily in the scientific environment.

**1.3.4.2 The Kenya Medical Research Institute (KEMRI)**

KEMRI is a state corporation that focuses on biomedical research activities. It was established in 1979 under the Science and Technology (Amendment) Act, as a national body to be responsible for carrying out health research, and apply results towards improving wellness and healthcare delivery. Before the inception of KEMRI, health related research was conducted under the auspices of the East African Medical Research Council which was established in 1957 to serve the countries of the East African Community. When the Community broke up in 1977, the Kenyan Parliament enacted the Science and Technology Act in the same year, but was amended in 1979 to provide for the establishment of research institutes.

KEMRI's mandate ((available: http://www.kemri.org), Accessed: 24/01/2009) is:

- To conduct research in human health,
- To co-operate with other organizations and institutions of higher learning in training programmes and on matters of relevant research,

- To liaise with other relevant bodies within and outside Kenya carrying out research and related activities,

- To disseminate and translate research findings for evidence-based policy formulation and implementation,

- To co-operate with the Ministry of Health, the Ministry for the time being responsible for research, the National Council for Science and Technology and the Medical Science Advisory Research Committee on matters pertaining to research policies and priorities, and

- To do all such things as appear necessary, desirable or expedient to carry out its functions.

KEMRI is governed by a Board of Management with three standing committees to help in the day-to-day running of the affairs of the institute as follows:

- Scientific Programmes Committee responsible for scrutinizing, evaluating and approving research programmes, performance and research projects output,

- Staff and Finance Committee whose mandate is to review and determine staff needs including promotion, financial and development issues, and

- Audit Committee to oversee all audit functions at the Institute.

The Board is also responsible for the creation of research centres which are expected to focus on specific areas of national or strategic importance. At the moment the Institute has 10-specialized research centres spread throughout the country. Each centre conducts research on specific mandate programme and there exists strong collaboration between the different centres.

Research at KEMRI is generally clustered into four main programmes, namely (1) infectious diseases, (2) parasitic diseases, (3) epidemiology, public health and health systems research, and (4) biotechnology and non-communicable diseases. The Institute has a library whose mandate is to provide services to the Institute's scientific staff, students of the KEMRI graduate programme, students, and individuals from other relevant research organizations looking for information on health research and other pertinent matters.

## 1.4     Statement of the Problem

All over the world, governments believe that there is a correlation between reducing digital inequalities and economic development; that, both in developed and developing countries, there is poor planning and management of ICT projects by not involving target audience, and by paying little attention to infrastructure, training and technical requirements, and deploying complex technologies and, inadequate financial resources (Mutula, 2010). In Botswana the government propagated a national ICT framework to drive social, economic cultural and political transformation. In Kenya the situation may not be any different since ICTs can be used by researchers to open new channels of service delivery, especially in the areas of e-government, education, the emerging e-health and information dissemination in the agricultural sector. There was need to establish the operation-ability of the ICTs in both organizations.

ICTs also play a key role in the industrial and manufacturing sector, bringing with it competence, competitiveness, processes and jobs. Access to relevant research information is important in increasing productivity and delivery of industrial and health care services. However, with the availability of electronic information through

a number of initiatives it is not clear whether Kenyan researchers have adequate access to and use ICTs to access information to enhance the realization of Kenya Vision 2030 through strategic decision-making.

In the agricultural sector, Kiplang'at (2003a) noted that the use of ICTs, particularly mobile phones, radio, television, Internet and computers for word processing was spreading fast among the researchers and extension workers, but there were disparities between the rural and urban researchers, with the latter having more access to ICTs. He noted that some of the problems associated with the use of ICT were that Kenya did not have an integrated ICT policy to inform and guide its diffusion and management in national development plans, and that there was lack of relevant content and technical knowhow leading to over reliance on donor funding with low sustainability levels, especially in agriculture. It was not clear whether the industrial and health sectors had fully embraced ICTs to increase productivity and service delivery as well as improve the base for strategic decision making. This made it worthy to find out the level of deployment of ICTs to access information in KIRDI and KEMRI, the adequacy of content, and its relevance to information needs of researchers. It was also important to find out whether the institutions lacked information policies or whether the information workers had inadequate skills or the researchers faced other challenges. It was worth finding out strategies put in place and also if staff at the NIIC were likely to use the Internet for accessing industrial information from websites or other sources of information for industrial research in their effort to meet researchers' information needs from foreign and local partners.

Both KIRDI and KEMRI already had websites and were able to make links with other websites to enhance researchers' access to information. However, there was need to establish the challenges that researchers experience in accessing electronic information resources (e-resources).

## 1.5 Aim of the Study

The aim of this study was to investigate the use of ICTs in accessing information by researchers at KIRDI and KEMRI, and to propose a framework to improve the use of ICT by researchers in the two institutions.

## 1.6 The Specific Objectives of the Study

The objectives of the study were to:

1. Establish the range of information required by researchers at KIRDI and KEMRI

2. Examine information sources and services available to researchers at KIRDI and KEMRI and determine the levels of their usefulness to researchers

3. Find out if institutional ICT policy exists and how it supports information access, sharing and exchange by researchers at KIRDI and KEMRI

4. Establish the challenges experienced by researchers in utilizing ICTs to access information

5. Suggest ways of improving access to and use of information by researchers at KIRDI and KEMRI using ICTs, and propose a framework for improved ICTs use in accessing information at the case study organizations

## 1.7 Research Questions

The study was guided by the following questions:

1. What are the information needs of researchers at KIRDI and KEMRI?

2. To what extent do the existing resources, systems and services at both KIRDI and KEMRI meet researchers' information needs?

3. What is the range of available ICTs at KIRDI and KEMRI and to what extent are they utilized by researchers to access information?

4. What institutional ICT policies exist at KIRDI and KEMRI and how do they enhance information access and use of ICTs?

5. What are the challenges that researchers experience in accessing information?

6. How can the use of ICTs to access and use information be improved at the two case study institutions?

## 1.8    Assumptions of the Study

Assumptions are facts that a researcher takes to be true without verifying them (Mugenda and Mugenda, 1999). They are guesses that may be true or false. They put some boundary around the study and provide vital information, which influence the way results of the study are interpreted (Mugenda and Mugenda, 2003). Kiplang'at (2004) noted that assumptions help in shaping the direction that current research takes, and are required for data analysis and conclusions. This study was carried out based on the following assumptions:

1. That although ICTs have great potential in facilitating access to information, they are not put to optimum use by researchers at KIRDI and KEMRI due to factors like inadequate ICT infrastructure

2. That use of ICTs by researchers at KIRDI and KEMRI has been hampered by inadequate infrastructure and lack of prerequisite skills

3. That the institutional ICT policies are not regularly reviewed to improve use of ICTs to access and use information

## 1.9    Significance of the Study

The outcome of this study has some implications for stakeholders of research institutions in Kenya including researchers and information workers as follows:

1. **ICTs as the main research tools**: the study has made unique contribution to knowledge by the identification of ICTs as the main research tools much as they are basic and complementary working tools for researchers in line with Kenya Vision 2030. Although similar studies on ICTs have been carried out elsewhere in the world. The study is unique to Kenyan industrial and medical research institutions, in particular, the researchers.

2. **The proposed framework:**  the findings of the study generated a useful framework that will assist the top managers in informing decision making that would improve access to information by researchers

3. **The research institutions**: recommendations made are likely to assist the two research institutions (KIRDI and KEMRI) reap full potential of their researchers as well as support the use of ICTs in research activities.

4. **Researchers**: The study has made useful contribution to the improvement on the use of ICTs to access information by researchers and will enhance their creativity and innovativeness. This will assist in the realization of Kenya Vision 2030.

5. **Information workers**: It is hoped that the results of this study will be used in identifying weaknesses in technical and reference sources of information with

a view to recommending weak areas for expansion or improvement so as to meet information needs of the researchers.

6. The results of this study are expected to serve as a model for information professionals to enable them offer improved services to researchers. They will also be useful in setting up any other industrial or medical information centre in future. The findings will help information workers in establishing linkages with other health and industrial research institutions, especially in the areas of application of ICTs in the library, information and expertise exchange so as to share information and learn from one another.

7. It is expected that the findings of this study makes researchers and top management at KIRDI and KEMRI aware of the range of information services and resources available at the NIIC and KEMRI's information centres. The results would form a reference point for conducting user education on the usefulness of the information services, with the focus being on the use of ICTs to access information by researchers and the significance of ICTs in improving output and quality of research and as it impacts on people in the society. Recommendations have been made for user education and awareness to be continuous and the need for a computerized information retrieval system that is user friendly. To this effect, the study identified the role of industrial or medical information in research, and especially by researchers using ICTs in helping Kenya realize the promises made in Vision 2030 and the unmet targets or promises in the MDGs for economic recovery, job creation, reduction in mortality rate, the reduction of poverty, and promotion of innovation by Kenyan researchers.

8. The study re-examined issues related to technology transfer, especially the extent to which information networking using ICTs is being carried out at KIRDI since this was one of the three main programmes that were identified for implementation by the Institute (2000/2001), a concept that is also observed and spelt out in KEMRI's mandate under collaborations. The importance of networking or linkages will be re-emphasized, as it is vital to industrial researchers, research and the manufacturers of industrial products.

9. The beneficiaries of the outputs from this study also include the Kenya Government, research institutions, researchers and information workers. Specific highlights were made in areas where the use of ICTs by researchers to access information immensely contribute towards the mission, goals and objectives of KIRDI and KEMRI as the government's extended arm for lowering the nation's disease burden, economic recovery, growth and industrial research sector in Kenya including that of the health sector.

## 1.10    Scope of the Study

The study focused on the use of ICTs by researchers in public research institutions. It was limited to use of ICTs in accessing information by industrial and medical researchers at KIRDI and KEMRI, as well as factors that enable or obstruct effective access to relevant information by researchers. The findings include views from researchers and informants who comprised top management, information workers and ICT staff of the two institutions.

## 1.11    Limitations of the Study

This study was limited to the perception of the researchers at KIRDI and KEMRI, and what they could recall on their usage of ICTs to access information. The opinions expressed by participants in this study reflect the opinion of the entire population of researchers in the two institutions. Any conclusions on the opinions expressed herein should be drawn cautiously. The findings may not be generalized to represent the entire population of researchers in public institutions in Kenya.

Most of the interviews were carried out within Nairobi given that the headquarters of the two institutions are located in Nairobi. A few satellite stations of both institutions were visited due to the inadequate facilities and poor ICT and communication infrastructure in the regions where the stations are located countrywide. These stations were also fairly new with limited staffing; and whatever goes on at the headquarters was replicated at the satellite research stations, such that omitting them did not make any difference nor did it change the result of the study.

## 1.12    Summary

This chapter has given light on the importance of ICTs by emphasizing that they have become central to globalized economy through enhancing access to information and knowledge via efficient and effective communication networks. The Kenya Vision 2030 recognized the role of science, technology and innovation in modern economy and highlighted the role that new knowledge plays in wealth creation, social welfare and international competitiveness. In national development, there are disparities in accessing ICTs among countries and communities, and this results in digital divide in terms of inadequate infrastructure, high cost of access, inappropriate or weak policies, and lack of locally created content. The context of the study covered the use of ICTs

by researchers in accessing information globally for development, with a section on two public research institutions in the industrial and health sector in Kenya. This chapter also discussed the statement of the problem, aim and objective of the study, research questions and significance of the study.

## 1.13    Definition of Terms

The following terms have been defined according to the British Computing Association (2005), and the Oxford Advanced Learners Dictionary (1995):

**Access** - To gain entry, right or permission to use information including physical access to hardware, software, interaction with resources and service

**Case study** - A research methodology involving in-depth investigation of a phenomenon within its set-up

**CD-ROM** - An acronym for Compact Disc Read-Only Memory, and usually contains data or programs accessible but not writable by a computer

**Communication** - An interactive process of transmission and reception of ideas and information through symbols agreed upon and understood by concerned parties

**Communication channels** - Means by which messages e.g., for innovation are transmitted among members of a social system

**Computer** - A machine that processes data. It takes data in digital form, processes it automatically before output in some way. It has the ability to manipulate data according to instructions

**Connectivity** - The use of computers to link information resources through a process of linking or connecting to large computers over the Internet

**Database** - A collection of data items and links between them, structured in a way that allows it to be accessed by a number of different applications programs. The term as

used in this context refers to structured collection of records stored in a computer system

**Development** - Improvement or growth

**Diffusion** - A process by which knowledge is spread. It refers to communication processes by which ideas, practices or products are spread through certain channels, over time, among members of a social system.

**Digital economy** - A form of business based on electronic production of goods and management process where interactions with partners and customers and transactions are conducted through the Internet using web technology

**Download** - The process of transferring and receiving electronic data between two computers or similar systems from a remote or central system like web server or mail server

**Economic development** - Attempts to improve economic wealth of a nation for the well-being and quality of life

**Economic growth** - An increase in the value of goods and services produced by a country

**Effectiveness** - Making changes either positively or negatively

**Electronic mail (e-mail)** – Sending messages from user to user through computer communication. The mail is composed, sent, received and saved over electronic communication systems

**Element** - Any identifiable entity, like the characteristic part of something

**Equifinality** – Term used in open systems to explain how a given end state can be achieved by many potential means or paths.

**Eradicate** - Put to an end, eliminate or destroy something

**Globalization** - Transformation of national economies into the international economy through trade, foreign direct investment, capital flow, migration and the spread of technology

**Hardware** - Physical components of a computer system encompassing the processor, storage, input and output peripheries among others

**Industrial research** - Investigates and helps develop industrial products including information for the manufacture of the products

**Industrial researcher** - One who carries out industrial research either in a research institution or a manufacturing firm

**Information** - Data, facts or relevant knowledge that contributes towards conducting successful research in support of the society, irrespective of the form it is encrypted in

**Information age** - An era where the focus has shifted from the production of physical goods to the manipulation of information

**Information technology** - Includes computing, telecommunications and office systems as a means of handling information

**Information and Communication Technology (ICT)** – This is the application of appropriate (enabling) technologies to information processing. They include computing, telecommunications and digital electronics (British Computing Society, 2005)

**Infrastructure** – Formal and informal channels of information communication technology

**Innovation** – A new idea, practice or object as perceived by members of a social system and seen as an act of making changes or coming up with new products

**Internet** – Inter-connection of computers worldwide using telecommunications systems such as telephone lines. It allows for communication between people, transfer

of data between computers and the distribution of information between computers using common technical standards, common identification system for computers and common naming system

**Intranet** – A communication system that provides services similar to the Internet within a particular company or organization. It provides an organization with services that are accessible only by authorized users and has good security for confidential information including secure e-mail communication and distribution of information via technology similar to World Wide Web (WWW). However, it may use the Internet to allow access by its authorized users anywhere in the world

**Local Area Network (LAN)** – A network in which the computer systems are situated relatively close to each other, and usually cover a small area network like an office or building(s). The inter-connection is normally by wire cables like fibre-optics

**Manufacturers** – People who use tools and labour to make or produce goods for use or sale

**Poverty** – A condition of deprivation of common necessities that determine the quality of life including food, clothing, shelter, water, etc.

**Poverty reduction** – A process of reducing or lowering level of poverty

**Research** – To investigate, inquire or explore to a logical conclusion

**Researcher** – A person who is involved in scientific, technological or engineering research

**Science** – This is about discovery and increase of human knowledge and understanding of how the world works

**Software** – Consists of computer programs, routines, procedures and documentation that perform tasks on a computer system

**Sustainable growth** – Generation and use of resources to meet human needs while preserving the environment

**System** – Related patterns of elements that justify attention and identified by their structure

**Technology** – Technological skills or know-how which enhances work tasks and make it understandable

**Use** – Apply, utilize or employ

**Website** – A collection of web pages, images, videos and other assets hosted on one or more web servers to be accessible over the internet. Websites are an effective way of distributing information such as advertisements, technical information, comments and ideas. They can be accessed through their full address or web page and may give links to other web sites

**Wide Area Network (WAN)** – A network in which the computers are geographically remote. The computer network covers a broad area and the communication may be across cities, region or national boundaries using a range of connection methods mostly public telephones links, undersea cables and communication satellites.

## CHAPTER TWO

## LITERATURE REVIEW

### 2.1    Introduction

This chapter reviews relevant literature to the study and also provides theoretical framework of the study. The review enables the researcher to critically analyze earlier research works so as to eliminate duplication during the research process. It also familiarizes the researcher with both known and unknown facts of the study.

Literature review is important during the research process since it gives insights into what has been previously published on the study area. The main purpose of literature review is to determine what has been done already related to the research problem being studied (Mugenda and Mugenda, 1999). It gives insight into the existing problem and also points out any existing gaps. It equips the researcher with facts on a given study and helps in the formulation of the research questions as well as pointing towards answers to the research questions. This review was guided by the study objectives given in Chapter One, which helped in setting up the context of the study.

The reviewed literature in this chapter focused on the use of ICTs by researchers in industrial and medical research institutions, and included relevant journal articles and books in print as well as in electronic format, which enabled review of different theories related to the study.

The chapter is structured into three sections. The first section provides theoretical framework based on the Diffusion of Innovation (DOI) theory complemented by the General Systems (GS) theory. The second section presents an overview of literature

on global information programmes, particularly those pertaining to industrial and health information. The third section discusses the use of ICTs to access information, and also presents the different types of ICTs. At the end of the chapter is a summary.

## 2.2    Access to Information by Researchers

Researchers seek access to a wide range of material comprising books, journals, artifacts, sound and image files, and data produced by other researchers, by commercial companies and by public bodies (Research Information Network, 2009). They seek access from various access points such as from their libraries, laboratories, office or home, on their desktops and in person. Despite continued increase in the amount of licensed content, especially the electronic journals to which researchers have ready access, no library or institution can provide access to all the resources that meet all the information needs of a researcher. Hence, the researchers have to resort to sources other than those available directly through their institution in order to gain access to a wider range of relevant content for research.

In Kenya, industrial information services are generally marginalized, inefficient and ineffective (Odini, 1998). A study by Gatero (2010) revealed that the problems in health-care services are due to lack of access to adequate and reliable information; there is little evidence that health care professionals in the country have better access to adequate and reliable information. This is due to unsystematic harnessing of ICTs in bringing improvement and quality health care services. The main problem is access to ICTs themselves.

## 2.2.1  Theoretical Framework

A theoretical framework comprises concepts or ideas based on theories and supported by data or evidence that is meant to form a basis around which a study like this one rotates while giving their interrelations. Kombo and Tromp (2006) noted that theoretical framework provides a generalized explanation to an occurrence and clarifies why things are the way they are. Maxwell (2005), in his contribution, adds 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.

Researchers use and share philosophical assumptions about the nature of the world to situate research work. Babbie (1994) referred to fundamental points of view that characterize science as its paradigms. Maxwell (2005) noted that Thomas Kuhn, the historian of science, also referred to these assumptions as 'paradigms'. Paradigms include specific methodological strategies that are linked to the assumptions, and the help to identify particular studies that exemplify the assumptions and methods. Philosophical positions such as post-positivism (evolved from positivism), constructivism, advocacy/participatory and pragmatism are examples of such paradigms, although each one holds different views about reality and how knowledge about it can be gained.

## 2.2.2  Relevance of Theory

Information as a concept takes different forms at different integrative levels. According to Wilson (2002) information on its own should not be taken as a unitary concept, but as having different levels around which different theories are built and practices evolve. Wilson (2000) adds that, in any context, the concept of information

needs is central to user studies. It does not make sense studying each separately. The post-positivist's view was adopted in data collection from researchers and other informants at their working environment in order to know, discover and apply laws of cause and effect. Whereas in some disciplines information is seen in terms of strings of symbols, librarians see it in terms of macro containers like books, reports, journals and electronic documents of various kinds that require higher level of organization and dissemination.

The Work System Theory (WST) was reviewed. It was found to be a system in which humans as participants and machines perform work including processes and activities using information, technology and other resources to produce specific products or services. In special cases work system include information system, service system, project, supply chain, self-service work system, and automated work system. Work system cannot operate without information system, yet information system has little significance outside of the work system. The theory was not used in this study because it was centred on a natural unit of analysis for thinking about systems in organizational settings. The system is useful for describing and analyzing an IT work system because of its elements of processes and activities, participants (in this case researchers), information and technologies.

The Technology Acceptance Model (TAM), proposed by Fred Davis in 1985 was reviewed. Literature review on TAM revealed that system use is a response which can be explained by user motivation, influenced by three factors: perceived ease of use, perceived usefulness and attitude towards using the system. Attitude is influenced by perceived usefulness and perceived ease of use which directly influences usefulness

and determines whether or not a user will use or reject the system. The Model is centred on user acceptance of technology and an adaption of Theory of Reasoned Action in psychology. The model is good and befitting, however, it was not used in this study for the same argument as Chuttur (2009) that although TAM is widely accepted in Information Science (IS) studies, research in TAM lacks sufficient rigor and relevance that would make it a well established theory for the IS community.

Therefore, literature review did not point to one theory that is applicable to Information Science research; however, the use of a combination of theories was suggested as applied to this study. In this study the General Systems Theory and Diffusion of Information Theory were combined in order to interrelate how KIRDI and KEMRI, as institutions, are systems that depend upon ICTs to meet information needs of their researchers for development. Without information, research is not viable.

### 2.2.3   Diffusion of Innovation Theory

Review of relevant literature revealed that there are a good number of theories in existence that can be applicable to this study. However, Diffusion of Innovations (DOI) theory provides a good tool for descriptive research and has potential for application in information technology concepts, besides its applicability to artefacts and techniques since it is a combination of a number of theories. The theory has been used to study adoption of such innovations as the Internet and other ICTs.

Diffusion is a process of communicating innovation through some channels to a social group within some duration of time. It is built on four major elements, namely innovation, communication channel, time and social system. The theory has the ability and flexibility to communicate innovation in form of a new idea to members of a social system through channels like ICT in a given period of time. The recipient's adoptability of an innovation is influenced by the following five attributes:

a) Relative advantage that makes a new idea better than the superseding one in terms of economic, prestige, convenience or satisfaction. The greater the advantages the faster the adaptation,

b) Compatibility in terms of consistency with existing values, past experience and needs of potential adopters,

c) Complexity has a negative influence on adopters, since most prefer simpler ideas that are easy to understand and do not require very high skills and pre-existing knowledge of the new idea before it can be used,

d) Trial-ability, which allows experimenting with the innovation, makes it more easily adoptable and removes uncertainty in potential users of the innovation, and

e) Observability of the innovation, which is very important as visibility stimulates peer discussion and authenticates the significance of an innovation.

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 theory is widely used to study the adoption of ICTs in organization and instructional technology. Although DOI provides a good tool for descriptive research, it does not provide a basis for predicting outcomes or guidance

for accelerating adoption rates nor extent of refutable hypothesis, and neither does it focus on funding, expertise, politics and culture. The theory elements are also specific to a culture; that is, the North America culture, where it was born in the 1950s by Rogers and Scott.

The objectives of this study comprise such elements as mapping and auditing ICTs at KIRDI and KEMRI, ascertaining information needs of industrial researchers, and identifying information sources and services available (i.e., their nature, types distribution and extent of use in communication of industrial information). DOI was chosen for this study because, as a combination of a number of theories from other disciplines, it has the ability to handle all these. The strength of the theory is that adopters and non-adopters of an innovation may be studied to identify factors that influence their adoption behaviour. These include the nature of the innovation, communication channels, and characteristics of social groups, institutions or organization.

Problems associated with access and use of adequate industrial and health information by researchers is what prompted this study. The problems have resulted in unemployment in the country due to limited implementation of ICTs; researchers are not getting adequate support for accessing reference materials like journals and databases to support research.

**2.2.3.1  Application of DOI theory to this study**

DOI is applicable to this study through the Perceived Attributes Theory where it states that an innovation will experience an increased rate of diffusion if potential adopters perceive that the innovation: (a) has an advantage relative to other innovations, (b) is compatible with existing practices, (c) is not too complex, (d) can be tried on limited basis before adoption, and (e) offers observable results (Surry, 1997). These attributes are discussed below:

**a) Relative advantage:** This refers to the degree to which an idea is perceived as better than the superseding one, as well as hastening the adoption of that idea. Researchers' use of ICTs like OPAC in accessing information saves them time as opposed to perusing through card catalogue (manual system). The speed of information access or location is faster, thus influencing adoption and demonstrating convenience. Sharing of research information in hard copy is no longer an easy task since it involves postage cost and time. Librarians or information workers can use emails to send documents as attachments in MS Word or PDF to researchers. This confirms that ICTs have advantage over manual systems, especially when one thinks in terms of interlibrary loans in order to satisfy user needs. The speed of information delivery promotes the diffusion of ICTs as an idea or innovation that improves on the existing practice of information access (i.e., from manual to electronic access).

**b) Compatibility:** An idea that is consistent with existing values, past experience and needs of researchers who are the potential adopters has influence over diffusion of ICTs. Ability of researchers to access information for research with minimal skills, even with change of technology, enhances diffusion including the fact that the organization supports the use of ICTs, making the diffusion rate faster in line with the organizational practice.

**c) Complexity:** Complex innovations have negative influence on researchers as adopters because they prefer ideas that are easy to understand, and do not require very high skills and pre-existing knowledge of the new idea before it can be used. Most ICTs have considered this aspect in advance and they have come up with user manuals for implementation. Software information that is embodied in technology, including the help menu, serves to reduce uncertainty about the cause-effect relationships involved in achieving a desired outcome (Rogers, 1983) from the use of ICTs to access information.

**d) Trial-ability:** The ability to try or experiment with an innovation on a limited basis makes it more easily adoptable and removes uncertainty of the innovation to potential users. Technology that can be tried at a piecemeal will generally be adopted more quickly or faster than one that is rigid; hence, when it comes to ICTs, the users influence each other on its adoptability given the fact that vendors always give guarantee or warranty period. This aspect enhances diffusion as users are assured of maintenance should anything go wrong during that period (guarantee or warranty period). That assurance to the customers makes them have confidence on the innovation, while promoting diffusion and removing uncertainty to those considering it for adaptation. On the information side, one finds that software always come with trial period (e.g.. 30-days), after which one has to purchase the software. On the dissemination of research information there are programs like Online Access to Research in Environment (OARE) which are free to developing world, just like was AGORA and HINARI of which a minimum fee used to be paid through Programme for the Enhancement of Research Information (PERI) to access. The arrangement has promoted the use of e-resources by researchers because they have interacted with the

resources and seen the advantages they have over hard copy not forgetting the time saved when searching for information.

**e). Observability of the innovation:** A visible result of an innovation stimulates peer discussion and authenticates its significance as an innovation and promotes its adoption and diffusion, especially among friends and neighbours and in social systems like KIRDI and KEMRI. A good example is when equipment needs to be purchased; a lot of consultation is done with specification being sought from IT experts, or colleagues who have similar equipment.

Rogers (1983) observed that, generally, innovations that are perceived by receivers as having the above attributes will be adopted more rapidly in the same way as those that allow re-invention (i.e., change or modification) in the process of adoption or implementation. This means that once the management supports an innovation in an organization (i.e., ICTs), its adoption is more or less automatic. IT experts will be the first point of referral followed by early adopters of an innovation, in this case the researchers, when it comes to issues of ICTs.

### 2.2.3.2 General Systems Theory

General Systems Theory (GST) is a philosophy of science concerned with recognition of parallel approaches or methods in various disciplines. It was developed by Ludwig von Bertalanffy in 1936 to guide researchers in related disciplines focus their research and theory development efforts to identify laws and principles which apply to many systems in terms of wholeness, differentiation, order, equifinality and progressions. Bertalanffy's aim was to come up with a common framework that scientists could use

to communicate their findings, while building upon each other's work and whatever discovery they made over time would be applicable to life in general.

Systems incorporate many concepts in everyday language, like health care system, a family system, body system, and information systems. Weckowicz (2000) noted that the theory provides the needed conceptual framework for the basic unity of human knowledge, and that it is applicable to other disciplines, especially those concerned with humans. Rapoport (2003) defines a system as an entity that can maintain some organization in the face of change whether from within or from outside and states that it presents the idea of the whole situation as more than the sum of its parts. The theory recognizes that every system, living or mechanical, is an information system that needs analysis on how symbols are used for information transmission. Laszlo and Krippner (1998) posit that system theory contributes to the study of perception. In his contribution Walonick (1993) stated that Systems theory provides a universal approach to all sciences, a consistent framework for classifying and evaluating the world and a scholarly method of evaluating a situation.

### 2.2.3.3 Application of GST to this Study

According to Bertalanffy (1968) GST is a logico-mathematical discipline, but it is applicable to all sciences that are concerned with systems. The theory is applicable to this study due to its capability to handle vast amounts of knowledge and information generated daily by the two case study institutions, and the fact that it is not easy to know everything without some order in the everyday encounters so as to avoid information overload. Systems allow focus on small areas of knowledge that can effectively bring desired change in the workplace rather than try to comprehend the whole.

Google Groups (2008) reveals that several empirical studies have been done for analyzing the impact of information technology at individual level, but there is no conclusive evidence that these results would be consistent at the organizational system level. They state that whether or not individual performance implies organizational effectiveness, this remains uncertain. The theory is therefore useful in this study because of its potential in synthesizing and analyzing complexity in living organizations like researchers and the use of ICTs, which they use in the generation, processing, storage and dissemination of information for product development or healthcare in both industrial and medical research institutions. In GST, systems are characterized by an assemblage or combination of parts whose relations make them interdependent, but the parts must function together for the systems to work. If one part fails, then nothing works. This can be compared with lack of information and the success of research.

The framework proposed in this study includes the use of information technology (IT) as the primary element that organizations use to anticipate, react and respond to environmental change and customer demands. In this case, the examples of systems are KIRDI and KEMRI. The researchers or scientists are the objects, while the characteristics of individual scientists represent attributes and their interactions form relationships among the other scientists. The environment is represented by KIRDI and KEMRI as the arm of the government that is responsible for the implementation of policies and regulations to ensure maximum utilization of ICTs in an industrial or medical research institution. Nevertheless, although GST was relevant to this study it does not encompass all issues that the study addressed.

### 2.2.4 Integration of DOI and GST Theories

The reviewed literature pointed out the possibility of combining theories to get a desired position of argument, applicable to Information Science research. The GST and the DOI theory were used in this study 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. However, both of them depend upon ICTs to effectively meet the information needs of their researchers for development and applied research activities carried out by humans. DOI theory is acceptable in descriptive research since it is applicable in IT concepts like ICTs. It has been used to study adoption of such innovations as the Internet and other ICTs.

The reason for using ICTs to access information tended to overlap over the two institutions. Therefore, DOI was employed to cater for how much or how widespread ICTs were used in the two organizations for the case studies. To approach the two different and distinct disciplines, the GST was employed due to its capability of interdisciplinary applications and the interrelations of human beings as well as its ability to handle vast amounts of knowledge and information generated by researchers of the two case study institutions. The theory provided a platform for looking at the researchers in two institutions and their interaction with ICTs to access information for their daily research activities, while DOI demonstrates the effect of using ICTs in accessing information which is a requirement for research to be completed. It is a part of 'whole', as stated in GST, while the use of various ICTs act as elements that equally affect information transmission in the system.

**2.3     Information Programmes**

The importance of information has been over emphasized in Chapter One. What remains now is how to accelerate the transfer of information from the producer to the consumer and to stimulate the use of information by the latter. Odini (1995) observed that in order to stimulate 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. One of the hindrances to information access as observed by him is the underutilization 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, lawyers, etc. working in government organizations, private sector and industry), (2) students, teachers and technicians, (3) policy makers, planners and administrators, and (4) farmers and rural communities. He emphasized 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.

**2.3.1   Industrial Information Programs**

Choi (2007) refers to the industrial information program as a network that allows users in industrial fields to have easier access to necessary information whenever and whatever they want by linking information and knowledge related to industrial sectors. He defines it as an entity that brings together a wide range of industrial assets including primary source materials, digital materials, learning objects, information services, document supply and databases in a structured and managed way. These have broadly been classified as industrial databases, industrial portals, blogs and

online communities, mobile services, industrial document supply services, and electronic commerce-based document supply service.

The overview of industrial information program from Korea highlights the fact that there are many activities and projects with respect to industrial information programs majority of which provide databases and services developed by government or public institutions. The programs include Korea Electric Power data network (KDN) charged with the implementation of industrial information network, Korea Institute of Science and Technology Information (KISTI) operating various industrial information services like Business Innovation Network (InnoNet), Nano network, the National Digital Science Library and the Korean Electronic Site License Initiative. The government has heavily invested in the new media such as mobile Internet and electronic commerce. Choi (2007) emphasized the fact that industrial information programs should improve their collection and services with an understanding of information-seeking behaviour and environment of users. In a similar study on researchers and their information needs Gannon-Leary et al. (2007) affirmed that there is need to understand who they are, their needs and working context, and especially their information seeking behaviour.

Chiware (2007) citing Hussein and Priestly noted that opportunities and obstacles for producing journals vary due to diverse and complex conditions in Africa, as most scientists and publishers face problems in accessing research information as well as gaining visibility for their own publications and national research output. The result is loss or unavailability of scientific information to the international scientific community. The Programme for the Enhancement of Research Information (PERI)

which was coordinated by the International Network for the Availability of Scientific Publications (INASP) ended in March 2013 (INASP, 2013). It aimed at reinforcing local efforts to produce, disseminate and gain access to scholarly information and knowledge in developing countries in order to strengthening research capacities as well as communication skills training for researchers and librarians among others.

Since April 2013, some aspects of PERI were continued under a new INASP flagship programme dubbed Strengthening Research and Knowledge Systems (SRKS). Flagship refers to the most important programme among others. The programme focussed on "strengthening organisational performance and the capacity to design and deliver training programmes that meet the changing needs of key sectors of the research information and knowledge system", "strengthening networks through resource sharing opportunities, clear advocacy messages, peer support, experience sharing and continuing professional development opportunities" and "strengthening national or regional bodies active in the research information and knowledge system". SRKS works with partners and network countries to create effective enablers of information access, and to ensure that both researchers and policy makers are informed by the latest research generated within their country, region and globally (www.inasp.info/en/work/what-we-do/programmes/srks).

With regard to industrial information in Kenya, Odini (1998) quoting Odini (1993) observed that, as information services are generally marginalized, inefficient and ineffective in serving user communities, whenever economic pressures become intense in any way of the industries, the libraries are the first to be abolished. This he attributes to the fact that many information systems are designed without regard to the

information needs of the industrial user community, their information seeking behaviour and shortage of qualified manpower needed for the proper management of industrial information. However, in drawing guidelines to the type of information service required by an organization, Odini (1993) pointed out the importance of knowing something about the organization itself, its size, objectives and nature of its business in addition to subject areas of its activities; hence, the service should be built around users. In this regard the government commissioned NCST to integrate scientific information in the overall development plans of the country with the specific objectives of NCST information services being:

- To strengthen the existing scientific information activities in selected top priority areas identified in current development plans (agriculture, health, industry, energy, environmental planning)
- To put a mechanism and appropriate tools for the identification of the sources at the disposal of planners, researchers and those involved in training, where scientific information needed by them can be found
- To provide information on research institutions, research programmes/projects in progress, and research results
- To develop national, regional and international linkages and information exchange programmes with scientific information agencies, libraries, documentation and information centres, databanks/bases, research institutions and organizations.

In recognition of the importance of information, the government noted in the National Development Plan (1997-2001) that information channels play an essential role between researchers and innovators and that well-organized and accessible

information data bases are a requisite in technology adaptation and adoption. Towards this end even the Kenya Scientific Information and Documentation Centre (KENSIDOC), which was set up by NCST for the provision of scientific information referral services and development of scientific information resource centres, was unable to adequately perform that role due to human and financial capacity. This resulted in researchers exploring alternative sources of information for industrial and development activities.

Odini (1998) observed that, in East Africa, conventional methods of acquiring, storing, managing and retrieving information fall behind the rapid developments in information technology. He recommended the need to promote an understanding of the benefits which arise from investing in information technology. This was a step forward compared to observations by Cyamukungu (1996) that the existing small-scale African computer network infrastructure was installed taking into account the strategies and interests of aid providers due to lack of internally generated resources for network provision. This in many ways has resulted in proliferation of standards and networks which do not match the needs of African users and suggested the use of existing full Internet nodes in Africa as regional nodes which can be used as gateways. This statement no longer stands since Kenya's Vision 2030 has recognized ICTs as drivers of development.

One of the hindrances pointed out by Odini (1998) is shortage of qualified manpower needed for the proper management of industrial information. Cameron (1994), while contributing on professional development in an industrial library, stated that the usual company excuses that limit sponsored professional development is lack of money and

constraints on company time because information in an industrial unit needs to be delivered within short deadlines and one is often under extreme pressure. He affirmed that many small industrial libraries are not allocated enough money to buy even the most fundamental resources such as journals, while training is seen as a luxury unless it is crucial to one's subject area.

Job experience is regarded as an important component in professional development of an industrial information specialist. However, possession of managerial skills is a requirement, but rarely are industrial information specialists given formal development in this area, yet when it is not forth-coming a negative image is built and lack of recognition created resulting in low or poor status of the information profession, shortage of staff as a result of job security.

Cameron (1994) observed that information professionals working in special libraries have shorter shelf life, particularly in time of recession as compared to their counter parts in other sectors like universities. They are quite often required to be jack of all trades (i.e., manager, library assistant, secretary, financial manager, salesperson, publicity officer, educator, negotiator, etc.) and not limited to specific functions like their counter parts in academic libraries.

### 2.3.2   Health Information Programmes

In the health sector there are a number of information programmes globally that help improve access to information for healthy people. The World Health Organization (WHO) was set up in 1945 by 53 delegates from member states worldwide as a global health organization for the attainment by all peoples of the highest possible level of

health. The programme is charged with improving access to life-saving or health promoting interventions including activities aimed at health development especially in the attainment of the MDGs through harnessing research, information and evidence. WHO generates authoritative health information, in consultation with experts, to set norms and standards, articulate evidence based policy options and the evolving global health situation. It has partnered with many organizations including United Nations agencies, international organizations and donors, civil societies and the private sector, where their role is to use the power of evidence to encourage partners in implementing programmes within countries in order to align their activities with the best practices within the respective countries' priorities.

Other than providing leadership, WHO helps shape the research agenda and stimulates the generation, translation and dissemination of valuable health knowledge in addition to setting norms and standards, promotion and monitoring their implementation including information related issues. For example, in 2001, the KEMRI librarian, through WHO, managed to convince six of the leading corporate journal publishers to provide developing nations with open access to the electronic editions of their medical journals. WHO also established the Health Internetwork Access to Research Initiative (HINARI) to provide free or low cost online access to major journals in biomedical and related social sciences to local, non-profit institutions in developing countries.

Global Health Library (GHL) was launched in 2005 by WHO during the World Congress on Health Information and Libraries (ICML9) and the 7th Regional Congress on Health Sciences Information (CRICS7) held in Salvador, Nahia, Brazil. Its aim is

to strengthen, promote and develop worldwide networks on the collection, organization, dissemination and universal access to reliable health sciences information. The main objectives is to contribute towards increasing access to information and scientific evidence on health, particularly in developing regions, and to maximize cooperative activities in networks and minimize duplications. GHL is designed to create the global space that promotes and progressively connects local, national, regional and international flows of information on health.

Biblioteca Regional de Medicina (BIREME) is a specialized Latin American and Caribbean Center on Health Sciences Information. Its objective is to strengthen and broaden the flow of scientific and technical information and to support the development of health education, research, promotion and care. In its implementation, BIREME promotes and coordinates the networking of institutions and individual who produce intermediate and use health sciences information around common products, services and events operated under common model and space known as Virtual Health Library (VHL). VHL is BIREME's technical cooperation model and framework for scientific and technical information. It is a common and public space to converge the cooperative networks of institutions, which are producers, intermediaries and users of health information.

Mclean (2008) observed that there are a number of initiatives around the world that promote the health of people in developing countries; for example, in the United Kingdom, the Partnerships in Health Information (PHI), registered as a charitable organization, promotes the health of people in developing countries with a special focus on health libraries. PHI aims at building capacity of health librarians to be able to provide modern, responsive and proactive services within the constraints of what is

technologically possible. It targets population groups with the greatest need for essential health information, especially at primary care level. In support of PHI's contribution Cheeseborough (2009) reports of the numerous capacity-building workshops held which included Biomedical information retrieval, African Index Medicus, HINARI, Authorship skills and Web authoring. Among the outstanding papers contributed during the workshops are 'Use of ICT for promotion of health information at rural communities in Africa' and 'Education and training of health information professionals'.

In South Africa, there exists Health Information Systems Programme (HISP), which started as a pilot project in Cape Town before 1994. HISP now has a global network covering South-South-North network with 15 countries or states involving over 200 million people in Africa and Asia coming from universities, Ministries of Health, NGO and companies. HISP's main focus is the development and implementation of integrated health management for routine data, semi-permanent data and survey data, which are designed to support health workers and managers at all administrative levels with strong emphasis on using information for local action.

Kenyan health libraries have formed partnerships with a number of such initiatives including the South West Strategic Health Authority, which formed partnership with the KEMRI Library on behalf of other health libraries in Kenya. The aim of the partnership is to improve the opportunities for professional development of health librarians in Kenya and to increase the distribution of information relevant to the needs of Kenyan health professionals. The library partnerships seek to improve health through the dissemination of timely, relevant and reliable health care information.

Kamau and Godbolt (n.d.) affirmed that timely and relevant information is crucial for efficient delivery and administration of health care services, conducting and management of research. The Association for Health Information and Libraries in Africa (AHILA) is an example, where a Kenyan branch (Ken-AHILA) has been established as an NGO with membership from various professions (Grey and Kadiev, 2004).

## 2.4     Use of ICTs to Access Information

Although ICTs bring with them opportunities and challenges Kiplang'at (2003b) observed that there has been an increase in the use of ICT in the recent years in most sectors of the economy, particularly the agricultural production sector, regardless of problems like access/connectivity, literacy, content and costs. The sector depends on information exchange between and among researchers, extension workers and farmers. At the same time, he noted that there was disparity in access to and the distribution of communication facilities between rural and urban areas in Kenya.

Roy (2005) affirmed that ICTs are overwhelmed by a new vision of exchanging information across borders and creating the scope of unique forms of human relationships. The use of a wide range of ICTs encompass the collection, capture, processing, storage, retrieval and transmission of information, embodying text, data, sound (audio), vision (video) and graphics in relation to a range of applications, be it in scientific, social, economic, political, public or private institutions. He adds that concrete policies on ICTs are essential to stimulate innovation, production and diffusion with emphasis on efficiency, productivity, employment and training. ICTs

arouse both optimism and pessimism, and he stresses the significance of knowledge or information gaps as a development constraint. It is hoped that access to these technologies will help reduce the North-South gap by, among others, accelerating growth, agricultural and industrial productivity.

United Nations Conference on Trade and Development states that ICTs are not a panacea for development or a replacement for real-world processes (UNCTAD, 2003). If an enabling environment is flawed, deficient or absent, ICTs cannot make good, or make up, for the deficiencies. Similarly, if processes of a government or an organization are bureaucratic, complicated and subject to delays, moving it online will not make it any better. In this sense ICTs should not be seen as a substitute but rather as effective tools which can be used to reorganize, reshape and restructure working methods including sectors where they are used. This is so because ICTs allow information sharing, communication and knowledge accumulation, dissemination and application and offer efficiency in processes including collaboration and networking, by pooling resources, knowledge and experience between previously isolated individuals. They can be used to transform work and research methods by enabling group interactions, based on central reserves of shared knowledge.

The United Nations Development Pragramme asserts that the use of ICTs for development is a new and evolving field (UNDP, 2003). People are users and providers of information and knowledge, and ICTs can be used to enhance information sharing and linkages with the global society and economy. It states that ICTs facilitate access to creation and sharing of information and knowledge as well as help streamline work, expand opportunities and ease participation in decision-making

by people locally and globally irrespective of distance. They help people acquire and share knowledge, be creative and participate in social, economic and political life of a community, thus building human capabilities as well as empowering people (UNDP, 2003). It further affirms that ICTs expand choices that people have to lead lives that they value, while in the economic sphere they create new activities and industries as well as improve market efficiency and reach global network economy and new forms of organizing work including information work, leisure, enhanced creativity and productivity.

In Botswana Mutula (2008) observed that mobiles phones phenomena was improving lives of rural communities by enhancing entrepreneurship.

### 2.4.1   Different types of ICTs

The advancement in technology has brought about various types of ICTs. ICTs are currently classified in terms of conventional and emerging. Conventional ICTs encompass media and broadcasting equipment like radios, televisions, public address systems, video deck and video-cassettes. Emerging ICTs encompass recording media used in information generation, access, capturing, storage, processing, sharing, managing and preserving or archiving (e.g., magnetic disk/tape, optical disks (DVD/CD), flash disk, diskettes, external hard drive or zip drive). They also include technology for communication through voice and sound or images. In relation to computing hardware ICTs comprise personal computers (desktop and laptop or notebook), servers, mainframes, scanners, printers and networked storage like websites, databases linked with an array of software technical protocols. Emerging

ICTs also include handheld personal gadgets like Personal Digital Assistants (PDAs), mobile/cellular phones or smart phone.

Recording media include devices for information generation, access, capturing, storage, processing, sharing, managing and preserving or archiving. The following are some of the various types:

- *Magnetic Disk/Tape -* These are devices used to store computer data as well as audio and video signals like VHS tapes and, diskettes, which are on the verge of being phased out, and also include radio cassettes, microfiche, film reels and slides. They are used for storing digital data. A hard disk is a good example of magnetic disk and is used for the storage of data including scientific data.

- *Optical Disks -* Optical disks are circular flat disk for sequential information storage in continuous spiral tracks. They comprise Digital Versatile Disk (DVD) and Compact Disks (CD). According to Wikipedia (Wikipedia, n.d.) a CD is used for the storage of digital data as is the case for CD-ROM, although originally it was used for storage and play back of sound recording only. According to American Association for the Advancement of Science (AAAS, 1993) CD-ROM is greatly used by African scientists to store databases or to carry out literature searches and retrieve information from databases stored in them. A good example is the Commonwealth Agricultural Bureaux International (CABI) databases on CD-ROM, which improved national sufficiency in the dissemination of scientific agricultural information in developing countries. In 1987 AAAS (1993) provided African research

libraries with subscription to over 200 journal titles in the sciences and humanities, while promoting CD-ROM usage.

- *Flash Disks* - Flash disks are usually removable re-writable devices for moving working files from one computer to another. They offer potential advantages as they operate faster, have more compact shape, hold more data, have a more durable design, and operate more reliably. They are basically used as temporary storage for data and information files to be transferred to another computer for permanent storage.

- *Portable Hard Drives (Disks)* - Zip drive is an example of a removable disk storage device and includes external hard drive. At the moment their storage capacity ranges from 100 MB to over 1-Terrabyte. They are generally re-writable and replaceable. They are used for high density recording mostly for data and information back-up, and are used for permanent storage of files.

Communication is a process of generation, capturing, transmission or receiving of information using verbal or non-verbal methods including ICT. It allows exchange of information from one individual to another without changing its original meaning as sent by the sender or originator and results in exchange and understanding of ideas in a given context. The following are some of the technologies:

- *Public address systems* - A public address (or "PA") system is an electronic amplification technology consisting of a mixer, amplifier and loudspeakers. They are used for reinforcing a given sound like a person making a speech, pre-recorded music, or message, and distributing the sound to the general public. Researchers use them during workshops, conferences, teleconferencing and presentations.

- *Cameras* - These record images, either as still photographs or as moving images (known as videos or movies). Holmasen (1977) noted that cameras are used for a variety of nature photography. They generally consist of enclosed hollow with an opening (aperture) at one end for light to enter, and a recording or viewing surface for capturing the light at the other end. Almost all published research outputs are illustrated. The Research Center Camera Use Policy of the Chicago History Museum states that researchers may take photographs of collection materials like manuscripts and published materials for study purposes, and may be used for personal reference and research (Chicago History Museum, n.d.). This study confirmed that researchers use cameras to capture images during data collection, which they use for illustrating their research output in form of published images. Book scanners also use cameras to capture book images or information for preservation and ease of sharing research findings. They are used in the conversion of print to digital format using a computer. More recent camera models are also used for capturing movies as they have in-built recorders.

- *Fixed line telephone* – This is a telephone line which travels through a solid medium, either metal wire or optical fibre. A fixed phone line (one that is not a mobile phone line) can be hard-wired or wireless. Sillars (1988) states that a telephone is a vital method of communication which can be used to discuss a business document like research findings. Researchers use telephones for conference calls, which involve three or more participants with connections of relevant lines. Conference calls help in saving time and distance where a full-scale meeting is not possible.

- *Video cassette recorder* – This is commonly referred to as VCR, uses removable videotape cassettes containing magnetic tape for recording audio and video content from television broadcast for later play back. In most cases, they have their own tuner for direct TV reception and a programmable timer for unattended recording of a certain channel at a particular time. They are mostly used for recording capturing documentaries and movies.

- *Internet* – Internet is a global interconnection of computer networks. It is commonly referred to as a network of networks. It consists of millions of private, public, academic, business and government networks ranging from local to global scope. Ogbomo and Ogbomo (2008) observed that the Internet has become the solution to many information problems of exchange and marketing. The Internet conveys various information resources and services, such as electronic mail (e-mail), online chat, file transfer and file sharing, online games, hypertext documents and World Wide Web (WWW). Ouma (2001) noted that as a worldwide collection, the Internet provides information for researchers on nearly every topic, in addition to publishing on the Internet as well as collating researchers into newsgroups for information or news alerts. According to Gamage and Samarajiva (2008) Internet can be used to assess knowledge capacity and locate knowledgeable individuals in any field or country. They argue that its search engines can enable identification of individuals and organizations that don't produce knowledge as part of their daily work or connected to academic knowledge networks to receive exposure for their work. A good example is the Google scholar, which can give current information on citation impact of documents available on the Internet. In their debate on crossing the digital divide, Royall et al (2005) stated that the

Internet constitutes a new and attractive channel for accessing the latest scientific research and offers researchers and students' immediate access to a wide range of research publications. Ahmad (2011) observed that the Internet is used for social networking. The use of collaborative technologies and social networking sites leads to immediate online community like Researchgate, Facebook, Twitter, Flickr and LinkedIn.

- *Intranet* – This is a network or communication system that provides an organization with services that are accessible only by authorized users. It uses Internet technologies to securely share any part of an organization's information or operations systems with its employees, and ensures them of good security for confidential information including secure e-mail communication and distribution of information via technology similar to World Wide Web. It may use the Internet to allow access by its authorized users anywhere in the world. In summary, it is a focal point for internal communication and collaboration usually built from the same concept and technology as client-server computing and Internet Protocol Suite. It provides services similar to the Internet within a particular company or organization.

The technology for broadcasting is concerned with the distribution of audio and/or video signals, which transmit programmes to an audience through radios, televisions or other means for reception by the public (Kenya, Republic of, 2008).

- *Radios* – These are used for communication, including dissemination and information update. Research findings can be disseminated through radio to reach mass population. Kituyi-Kwake and Adigun (2008) noted that in research, radio provides genuine information about rural communities to decision-makers and is used by women for current affairs, entertainment (e.g.,

music and socially enriching lives), communication with family members or friends, and to follow up on some news features. Radio is a cheap means of disseminating key information, as a platform for dialogue and debate between developmental stakeholders, and as a tool for awareness-building and social mobilization.

- *Television* – Also referred to as TV set, it is a telecommunication medium for transmitting and receiving moving images, usually accompanied by sound. It is a common communications receiver in homes, businesses and institutions, particularly as a source of entertainment and news. It can be used for viewing recorded and broadcast material. Kituyi-Kwake and Adigun (2008) noted that TV and radio help women stay in touch with current events within and beyond the Kenyan borders. Researchers use television when watching specialized documentaries like medical documentaries, which are produced for the dissemination of specialized information.

**2.4.2   Computing hardware**

Computing hardware includes personal computers, servers, mainframes, scanners, printers and networked storage.

- *Personal computers (PCs)* – A PC may be a desktop computer, a laptop or a tablet. They are primarily used interactively by one person at a time. Minishi-Majanja (2003) noted that a computer is a research enhancer and that researchers use it for faster and accurate computation and processing of data. With the use of software like PowerPoint, computers offer effective presentation and dissemination of findings. Contributing on effective literature searching for research Gash (2000) stated that a computer can manipulate a search to locate individual reference. Ogbomo and Ogbomo (2008) noted that scientists use computers for calculating numbers, statistics, commonly used for writing letters, reports, printing books, newspapers and magazines, drawing pictures and diagrams, handling financial records, and sending messages worldwide.

- *Servers* – A server is a software program or computer on which that program runs. It provides a specific service to client software running on the same computer or other computers on a network. On a network, a server is used for providing resources that can be used by authorized client stations. Most institutions maintain file servers that act as central disk storage for their internal clients where different users can store, maintain and access data. There are various servers depending on institutional needs such as mail servers, file servers and database servers.

- *Mainframes* – Mainframes are computers used by organizations for running critical applications, typically bulk data processing such as census or industry

for consumer statistics, Enterprise Resource Planning and financial transaction processing. According to Sillars (1988) they are capable of storing and processing large amounts of data, run very complex programs like design and require highly qualified personnel to maintain them.

- *Scanners* – This is a device for the conversion of printed format, handwritten, image or an object to a digital format. They include the desktop or flatbed scanners, hand-held scanners, tower book scanner and 3D scanners. They scan documents, whether text or graphic, and sends the image to the computer. Researchers scan documents where authenticated signature for contracts or proposals is required and then sends them through emails. Scanners are useful for sharing information and preservation of information in digital format.

- *Printers* – A printer is a computer peripheral that reproduces text and/or pictures on paper or other kind of printable surface. Printers are used as output devices for the production of characters or graphics on paper. Researchers sometimes prefer to look at their findings on paper as drafts for discussions before sharing out with their peers.

- *Networked storage* – A networked storage is a place on a network where files are safely stored or shared with others. It appears as another drive on the computer on a networked storage connection like websites and databases.

**2.4.3   Handheld personal gadgets**

These are computing devices with display screen with touch input or a miniature keyboard. They include PDA, Mp3 players, and mobile or cellular phones.

- *Personal Digital Assistant (PDA***) – PDAs** are used by researchers for data collection including verification and management from a multi-site study like was the case of AIDS stigma study in rural South Nyanza. According to Tegang et al. (2009) PDAs are more frequently used for clinical research where health care professionals use them to access real or near real time patient information and evidence based resources at the point of care. The concept of using PDA software for survey data collection started in 1990s, but it is not widespread in sub-Saharan Africa since paper-based questionnaires still remain data collection tool as concluded from two USAID-funded surveys of paper-based questionnaire and PDA to compare their strengths in two provinces in Kenya (Tegang et al., 2009). PDAs enhance levels of patient care in medical environment and also ease access to patient records. They speed up data collection, much as quality of data is high and complete. They are an example of a handheld palmtop computer. Some of the distinctive features include colour screen for entering data or audio capabilities. A PDA can be used as a mobile phone (smart phone), web browser to access the Internet, intranet or extranets via Wi-Fi, wireless wide-area networks or USB cable to connect to a computer or portable media player. Most PDAs employ touch screen technology, and have Bluetooth wireless connectivity popular with mobile phones. They can synchronize data with a PC, and allow users simultaneous access to same information on host computer and PDA. Therefore, PDAs are used to store information that can be accessed at anytime

and anywhere. Business and government organizations use Rugged PDAs (i.e., Enterprise Digital Assistants) for mobile data applications, chain management in warehouses and package delivery. The most outstanding feature for information workers is the integration of Data Capture devices like Bar Code, RFID and Smart Card Readers. Leading companies like Pendragon and Syware provide tools that can be used in conducting research with mobile devices with ability to connect to the central server. The user can enter data into a centralized database using their PDA.

- *Mobile / Cellular Phones or Smart Phone* – Mobile phone, which are sometimes referred to as wireless phones, cell phone or cellular telephones are electronic devices used for mobile voice or data communication over a network of specialized base stations known as cell sites. They support many services, and accessories, such as SMS for text messaging, e-mail, packet switching for access to the Internet, games, Bluetooth, infrared, camera with video recorder and Multi-media Message Service for sending and receiving photos and video. They have ability to connect to a cellular network of base stations and to the public switched telephone network. Ogbomo and Ogbomo (2008) states that mobile phones are important in reshaping and revolutionizing communication globally and can play a significant role in the collection and dissemination of global information for planning and decision-making. Gikenye (2012) observed that mobile phones are used as cameras and for the transfer of money like is the case of Mpesa, AirtelMoney, which have simplified financial transactions by saving time and money. In Kenya Mobile Termination Rates (MTR) have been high until the Presidential directive was issued in June 2011 to review the rates downward in order to encourage

competition, increase mobile penetration and reduce mobile charges (Consumer Federation of Kenya, 2011). The Communication Commission of Kenya (2010) indicated that there were 4.7 million data subscribers of which 98 per cent were from mobile service providers. Service providers like Safaricom, Airtel (formerly Zain) and Yu drastically reduced communication and connectivity cost. The most positive was the introduction of data bundles into both MB and GB, with the purchase of unlimited monthly connectivity ranging from Kshs. 250 to 3,990. There were proposals for service providers to agree on Mobile Number Portability (MNP), where a subscriber can retain or migrate with their number to another service provider at a minimal connection fee of Kshs. 200. The impact of MNP has not been felt, and there is a possibility that the administrative process and consumer education could have done a lot better since only 0.18 per cent of mobile subscribers ported their numbers immediately after the launch of MNP.

## 2.5    Summary

It is evident from the literature review that there exist various information systems, which are essential for carrying out research activities whether locally generated, managed or disseminated. However, there exists a gap in the availability of local content for carrying out research activities both in the industrial and in the medical research institutions. Countries like the United Kingdom that had experienced challenges posed by ICTs came up with various initiatives like the PHI to promote the health of people in developing countries with focus on health libraries. They did this by turning the challenges into opportunities for development through building capacity of health librarians to provide modern, responsive and proactive services

within the constraints of what is technologically possible. WHO also promotes access to health intervention activities for purposes of health development for the attainment of MDGs through harnessing research, information and evidence. There is need to tap onto ICTs for use in accessing information that is contained in various sources for decision-making and national development plans, and in particular in the areas of sharing, creation and information exchange across borders in various forms.

**CHAPTER THREE**

**RESEARCH METHODOLOGY**

**3.1     Introduction**

This chapter discusses methods that were adopted in achieving the objectives of this research, which include research design, study population, sampling techniques and data collection instruments, data collection procedures, and data analysis. The preliminary task involved visits to the directors of the two organizations that were studied to establish their suitability for carrying out the research.

The chapter begins with a discussion on choice of research design and the case study strategy, with details on philosophical stance, including interpretivist philosophy and the qualitative research method. The chapter finally gives details on data collection techniques, analysis and ethical considerations as applied in this study.

**3.2     Philosophical Stance**

A research philosophy determines the way research is conceptualized, the research strategy employed, and the data collection instruments used to achieve the study objectives and central solutions to the research questions. The philosophy is belief on method of collecting, analyzing and use of data about a phenomenon. Consideration is made between what is known to be true (epistemology) and what is believed to be true. The researcher makes the choice of the strategy that is appropriate to apply since there are various research methods.

Social research uses various approaches to research as envisaged by different scientists on how social reality should be studied. The approaches are linked to the various viewpoints maintained by social scientists on how nature should be studied, including theory and research, whether it is for testing or for building research. Lin (1998) argues that the differences in interpretivist and positivist qualitative work lies in the questions one asks of the data and the types of conclusions drawn. The two major known research philosophies are positivism (scientific) and interpretivism (anti-positivism).

### 3.2.1 Positivism

Positivism is the philosophical doctrine based on the belief that reality is independent of the observer, informed through experience, objectively given, perceived by one's sense and represented by thoughts and language. The argument that in quantitative research or positivism, reality is stable, repeatedly observable and can be described from one's viewpoint with no interference on the phenomenon being studied was supported by (Sulaiman and Kura, 2012). Positivist researchers traditionally believe that they can fully understand a phenomenon based on experiment and observation. The belief is shared with Corbetta (2002) in a statement that positivism is the study of social reality using the conceptual framework, that they use the techniques of observation and measurement. They make predictions based on previously observed and explained realities and inter-relationships, while their research strategy is mainly by experimental inquiry and surveys.

Positivists collect statistical data on predetermined instruments. They believe that science is about what can be observed and measured with a view of analyzing casual relationships between variables. They draw inferences about a phenomenon from the sample to a stated population. According to Sale, Lohfeld and Brazil (2002) science is characterized by empirical research and all phenomenon can be reduced to empirical indicators to represent the truth. Positivists' position is that reality exists independent of human perception and that knowledge is about describing the phenomenon that is experienced. Stahl (2003) noted that positivists believe in an objective world independent of human intervention and their research results attempt to gain understanding of the real world. The most distinctive part of positivism is that of subject and object, where the observer is the subject and tries to get as objective, impartial and exact view of reality as possible.

### 3.2.2 Interpretivism

Interpretivism is a collection of approaches that are non-positivist and claim to be based upon or use phenomenological thoughts. Andrade (2009) observed that interpretive approach provides deep insight into the complex world of lived experience from the view point of those who live it. Miles and Huberman (1994) stated that researchers are not detached from their objects of study. Epistemological stance on interpretive approaches is that reality depends on the observer and knowledge is gained only through social constructions like language, consciousness, shared meanings, documents and tools. The researcher becomes the vehicle by which reality is revealed through their interpretations bringing such subjectivity to the open. Orlikowski and Baroudi (1991) stated that people create and associate their own subjective and inter-subjective meanings as they interact with the world around them.

Interpretive researchers attempt to understand phenomena through accessing the meanings that participants assign to them and reject possibility of objective or factual account of events and situations. Generalization to a population is not made from a single setting.

Klein and Myers (1999) noted that qualitative research is not synonymous with interpretive research. Qualitative research may or may not be interpretive depending upon the underlying philosophical assumptions of the researcher. However, it is important for qualitative researchers to be aware of the influence of philosophical assumptions on research strategies. According to Crewell (2003) researcher collect open-ended, emerging data with the primary intent of developing themes from data. Several arguments have emerged on philosophical positions and how they influence qualitative research, which can be classified as positivist, interpretive or critical. According to Orlikowski and Baroudi (1991) interpretivism is a valuable approach to studying Information Science in organizations and is a better method than positivism. Villiers (2005) took the position that interpretive approach is an effective approach in information systems research, particularly on the human aspect of design and development of personal computing applications especially interactivity and inquiry processes, which is due to the underlying theoretical and methodological frameworks that offer unifying thread, cohesion and internal consistency to the study.

 Kelliher (2005) noted that, although interpretive research results are often criticized in terms of validity, reliability and ability to generalize especially in a single case scenario, it is recognized for promoting the value of qualitative data in pursuit of knowledge and concurs with interpretivists' belief that reality is socially constructed,

not objectively determined. Therefore, there is greater opportunity of understanding the perception people have of their own activities by placing them in their social contexts, contributing to the underlying pursuit of contextual depth.

Kaplan and Maxwell (1994) observed that in interpretive research there are no predefined variables; it focuses on the complexity of human sense making as the situation emerges and a phenomena is understood through meanings assigned by people in the social contexts where they are constructed. It allows the researcher to discuss issues of influence and impact of context like 'why' and 'how'. Given that interpretivism revolves around the study of Information Science from different cultural context and taking account of different perspectives of professionals in different organizations. This study examined and analyzed the issues underlying industrial and health information access and the utilization of ICTs by researchers using interpretive paradigm.

## 3.3    Qualitative Research

Qualitative research is a study process that investigates a social human problem where the researcher conducts the study in a natural setting and builds a whole and complex representation through descriptions and explanation and examination of participants (Andrade, 2009). It can be used to explore, discover and understand people's beliefs, experiences, attitudes, behaviour and interactions, with the researcher being the instrument or tool of research. It enables Information Science researchers to understand human thought and action in social and organizational context.

According to Myers (1997) qualitative research allows the use of qualitative data like interviews, documents and participants observation in order to understand and explain social phenomena. Creswell (2007) asserted that the assumptions that lead researchers to choose qualitative research include nature of reality (ontology), how a researcher knows what they know (epistemology), role of value in research (axiology), language of research (i.e., rhetorical) and methods. In qualitative research researchers' beliefs are represented by paradigms like post-positivism, constructivism, advocacy/participatory, and pragmatism, although each one holds different beliefs and views about knowledge. Post-positivist researchers take scientific approach to research and view inquiry as a series of logically related steps, believe in multiple perspectives from participants as opposed to a single reality, use rigorous methods of qualitative data collection and analysis, and use computer programs to assist in data analysis. Post-positivism approach elements are reductionistic, logical and tend to be cause-and-effect-oriented. The results of qualitative studies are written and presented in form of scientific reports.

As stated above, this study employed qualitative approach (post-positivist orientation) to investigate in-depth issues to do with use of ICTs to access information by researchers in research institutions, with specific reference to KIRDI and KEMRI. The main subjects of study were researchers from these two organizations selected because the institutions are well established and have integrated ICTs in research activities. The study sought to investigate how researchers utilized ICTs in accessing information. It was necessary to find out the content available and how this met the information needs of researchers.

Qualitative research comprises five different research methods, namely narrative research, phenomenology, grounded theory, ethnography and case study. This study employed multiple case study approach because it allows one or multiple phenomenon to be studied in depth and in detail, in context and holistically, and to be looked at as a whole. Yin (1984) affirms that the approach gives meaningful characteristics of real-life events like individual life cycle, organizational and managerial processes, neighbourhood change, international relations, and maturation of industries. This gives case study advantage over other approaches like surveys and experiments, which are known to separate the unit of study from its real-life context.

### 3.3.1   Case study

A case study research involves the exploration of an issue through one or more cases within a restricted system, like the selected research institutions in this study. It is a choice restricted to a selective setting and on what is to be studied across disciplines. According to Kombo (2006) a case study brings out deeper insights and understanding of the phenomena, thus allowing a great deal to be learnt from a representative samples of the phenomena under study. Leedy and Ormrod (2005) add that, in a case study, a particular individual, programme or event is studied in depth for a defined period of time through multiple sources of data collection like observations, interviews and document analysis, including reports. It is suitable for learning more about a little known or poorly understood situation and how they change over time as a result of certain circumstances or interventions. However, its major weakness is that when a single case is involved, the findings cannot be generalized to other situations.

The strength of a case study is in describing, understanding and explaining of concepts. This strength translates into interpretivism, which is a paradigm of qualitative research. During data analysis, data is described to make it understandable by assigning explanations.

The fact that multiple data collection instruments can be used for the same research to collect extensive data resulting in full understanding of a phenomenon being studied, justifies the use of qualitative case study approach in this study. Another justification is in its flexibility to clarification with offers of supplementary documentary evidence from respondents during interviews that allow concepts to be examined in depth to gain deeper understanding and explanations of the concepts under study. The approach allows the researcher to state events as they are in their natural environment, holistically and to explore and find out what goes within a complex system.

According to Burns (2000), case study approach usually generate subjective data which reveal variables, hidden concepts, processes and relationships, because it is based on the premise that it can be a typical replica of many other cases; therefore, once one case is studied, it can provide insights into a class of events from which the case has been drawn and may be applicable in another case.

## 3.4    Research Design

The study employed qualitative research approach with some aspects of quantitative techniques to analyze data that was quantitative in nature. Qualitative approach was chosen in support of Patton (2001) because it goes beyond statistical results and permits description of units in depth and detail, holistically and in context.

Furthermore, its emphasis of seeing the social world from the viewpoint of the actors (like researchers or people working in organizations doing particular jobs) who, in this study formed respondents or informants, and what they said, was an important element in this research. The choice of qualitative research lies on the choice of five philosophical assumptions like nature of reality (ontology), knowing what is known (epistemology), role of value (axiology), language (rhetorical) and methodological assumptions from which researchers make a stand.

## 3.5    Study Population

The researcher was referred to the offices of the Human Resource Managers for confirmation of the population of researchers in the two study organizations. The information given revealed that the institutions had more than 200 researchers spread in different areas of specializations, departments and stations. Thus, the number of researchers was deemed sufficient to give the researcher a reasonable sample size for the study. The researcher approached the already identified respondents by the Human Resource Manager.

The study population comprised 60 researchers from KIRDI and 55 researchers from KEMRI. The population at KIRDI consisted mainly of Engineers, Food Scientists, Chemists, Environment Scientists, Economists and Ceramics Experts and also included Laboratory Technologists and Engineering Technicians. At KEMRI the population was drawn from the areas of Epidemiology, Climate Change and Human Health Research, Centre for Virus Research, Centre for Traditional Medicines and Drug Research, Centre for Biotechnology Research and Development, Centre for Public Health Research, Entomology, Grantsmanship or Research Funding, Centre for

Vector Biology and Control Research in Kisumu, and Centre for Geographic Medicine Research in Kilifi. The key informants at KIRDI comprised the Managing Director, 2 Deputy Directors, 6 library staff at NIIC and 7 ICT personnel. At KEMRI the key informants consisted of the Director, 2 Deputy Directors, 9 librarians and 9 IT staff. Thus, the total population of researchers from the two research institutions was 115, while that of key informants was 37, which resulted in a sample size of 152.

The population studied was stratified. Although Patton (2001) states that in purposive sampling the size of the sample is determined by informational consideration (until no new information is forthwith coming), there are no rules for sample size in qualitative inquiry. It all depends on what one wants to know, the purpose of the inquiry, what is at stake, what will be useful, what will have credibility, and what can be done. In this study, the researcher attempted to interview all researchers including key informants.

## 3.6    Sampling Techniques

The 152 respondents comprising 115 researchers and 37 key informants from the two study organizations were stratified by their area of specialization, departments and stations. After stratification the researcher conveniently used the list of relevant cases from Human Resource department to purposefully select information-rich as well as information-poor cases from each stratum interviewed, observed and their experience shared with the researcher in order to find out how they used ICTs to access information for research. The sampling was designed to produce generalized results specific to KIRDI and KEMRI, although the pattern could be replicated elsewhere since the entire targeted population was large enough for generalization. Data from these samples was used to make a generalized judgement on researchers at KIRDI and KEMRI as well as elsewhere.

The study employed purposive sampling technique because it allows for the selection of information-rich cases whose study clarifies the questions under study. Due to the flexibility in qualitative research, and as stated by Patton (2001), the study employed more than one sampling strategies. The cases were sampled from KIRDI and replicated in KEMRI using convenience and maximum participant variation strategy for purposive sampling. The technique enabled the researcher to capture and describe central themes that cut across all the environmental variations that emanated from the different categories such as area of specialization, departments, duration of work among others. Maximum variation strategy turns a weakness into strength by capturing all common emerging patterns from variations and turning them into shared facts.

The use of more than one strategy is supported by Creswell (2007), when he states that researchers can use one or more of the sampling strategies in a single study. The cases to be studied were conveniently identified with assistance from Human Resource department at both KIRDI and KEMRI through provision of relevant lists for the cases under study. According to Patton (2001) the techniques allowed in-depth study and deeper understanding of a phenomenon and permitted generalization, enabling the researcher to learn a great deal about issues of central importance to the purpose of the inquiry. The researchers were stratified into categories or sub-groups by departments dealing with various subjects.

The sampling technique used to select the number of respondents from the entire population of study involved identifying and defining the population. Although there are several techniques for sampling, not all of them could be employed in this study. A

good example is the simple random sampling, which was not chosen because of its simplicity and does not give good representation of sub-groups. Non-response errors are also high. Systematic random sampling was also not chosen because of low response due to its tradition of following the order of lists of population, neither was cluster random sampling chosen because of lack of complete representation of target groups.

## 3.7    Data Collection Method

Data collection involved using face-to-face interviews, observation during interviews as well as documentary evidence. The three instruments were used because they are complementary to each other. This was done in order to collect comprehensive and reliable data.

The interview schedules were semi-structured for the collection of primary data (information gathered directly from respondents). They were administered by the researcher to the relevant respondents. Secondary data, like reports, journals and books (print and electronic) and Internet were also used.

There are several data collection instruments which can be used when carrying out qualitative research, a category under which this investigation falls. Due to the in-depth nature of this study, multiple sources of information were used because no single information source could be trusted to provide comprehensive data on the case under study.

### 3.7.1    Data Collection Procedure

Researchers collect data to further their understanding of a puzzling issue. In qualitative research, the procedure for data collection is inductive, from the ground up. In this study the research instruments employed influenced the procedure used. In the case of interviews, the researcher approached the already identified respondents in person and requested them persuasively to be interviewed. A letter requesting for informed consent was presented to them. The researcher used interview schedule to ask the interviewee questions and wrote the answers in the space provided in the interview schedule. In the case of observation, observation guides were employed.

Before embarking on the study, the researcher obtained a research permit from NCST as required by the government. Thereafter, the researcher reported in person to the Nairobi Provincial Commissioner and Provincial Director of Education where the letter accompanying the permit was stamped for authorization to carry out research in Nairobi area. The researcher presented the research permit and a letter from Moi University to the offices of the Directors of the two study organizations certifying that the researcher was a bone-fide student of the university and therefore sought authority on behalf of the researcher to carry out research in their institutions. In addition, the researcher wrote a letter of introduction and that of informed consent to the two institutions stating the purpose of the research. The researcher was referred to the office of the Human Resource Manager from where the researcher was re-directed to the various heads of departments after meeting the requirements.

A pilot study was carried out on four researchers, two from each institution, on the research instruments before they were administered to identified and accessible respondents. A letter of introduction seeking informed consent was presented to potential respondents explaining the purpose of the research, the general nature of the study, and how and what the collected data would be used for. This was done so that they could be at ease to give information freely. They were promised that their confidentiality would be protected and assured that processing and use of the information they availed conformed to the pledges made.

Time management was a priority especially for the pre-arranged appointments like with the Managing Director; hence, punctuality was essential. The researcher maintained friendliness and remained focused throughout the period of research and after in order to get in-depth information. During data collection the language employed was clear, simple and easily understood by respondents. The use of jargon or specialized terminology was avoided and only relevant information to this study was collected.

**3.7.2  Interviews**

Research interviews are among the three instruments of data collection in qualitative research. Hannabuss (1996) stated that people identify the interview as a suitable method for gathering information due to its natural basis in human conversation and allows the researcher to adjust pace and style of asking questions. There are different forms of interviews, like the unstructured interviews, which were not chosen because they are time consuming and the respondent can dwell on one item for long and take control of the interview. Likewise, structured interviews were not chosen because of

similarities in questions that the respondents were asked, and the fact that the researcher could have influenced the respondents because it is too formal. This study employed face-to-face interviews using semi-structured interview schedules because they allowed for flexibility and the researcher was able to use open and closed-ended questions.

### 3.7.3    Face-to-face Interviews

Face-to-face interviews were conducted using semi-structured interview schedule (i.e., a list of questions or topics that needed to be orally asked by the interviewee) as the main data collection instrument. It consisted of open and closed ended questions, which enabled the researcher to get a complete and detailed description of what was being studied including probing for clarification, flexibility in data gathering, and ensuring uniformity and consistency in asking questions as outlined in the interview schedule.

The schedule serves as a basic checklist of issues to be explored during interview with every respondent. In this case, it made interviewing of a number of different researchers more systematic and comprehensive because the researcher planned in advance what to ask or explore. Face-to-face interview was selected because it yields instant, high response rate, accurate response because it is flexible to clarification of questions, and it offers opportunity for the collection of supplementary data. Moreover, it has no risk of a wrong person responding as compared to mailed or distributed questionnaire, which takes a longer time, has low response rate and stands a risk of a wrong person responding or wrong answers being given due to lack of time for clarification. Likewise, focused group interview was not selected because this

research was not based on one institution; it would not be easy to assemble all the researchers at one time, given the fact that they worked in different institutions and departments with different subject backgrounds and ran different projects; they could be in the field at the time this researcher wanted to conduct a focused group interview.

### 3.7.4    Observation

Observation was used as a complimentary data collection method to confirm or disapprove points made by respondents. In this method, researchers were observed in their natural work environment, like labs and offices, to understand how they carried out their research work. The researcher participated in the work situation to get a first hand feel of the situation under the study, simply to observe and experience events, situations and behaviours. This approach best fitted the concept of how researchers used ICTs to access industrial information.

Observation was used to identify information systems, including ICT facilities and services available, and to establish how they were accessible to researchers. This method was selected to complement face-to-face interview, and verify and confirm facts availability of information sources.

### 3.7.5    Analysis of Documentary Evidence

Documentary evidence entails perusing through trails of existing documents and records of an organization in order to trace the organization's history, current status and insights into the dynamics of everyday functioning that is relevant to this study. These documents included paper products like lists of employees, brochures, annual reports (including analysis of organizational documentation) and any other published

information that was availed together with the use of the websites (e.g., www.kirdi.go.ke). Documentary evidence was only used to complement the data collection methods mentioned above. This method was chosen because it gave insights and background information on the study institutions, and described events and issues in greater details. A good example is when respondents talked of use of some electronic resources; the researcher consulted the websites, newsletters and reports to get the full picture.

### 3.7.6   Pilot Study and Pre-Testing of the Instruments

The interview schedules and observation guide were tried out on four respondents two of whom were from KIRDI and another two were from KEMRI as a pilot study before they were administered to identified and accessible respondents. One researcher pointed out ambiguity on a question on use of ICT and it was clarified to them that this referred to researchers' use of ICTs in accessing information, and they were comfortable with the question as it was without further referral. Pre-testing involved face-to-face interview with the sampled respondents. This being a pilot procedure, it was identical to the ones used during the actual data collection and was done in order to come up with uniform and meaningful observations geared towards revealing whether the chosen techniques would achieve the anticipated results. The outcome of the pilot study, which included preparation of a letter of informed consent, were used in refining weaknesses in the research design in readiness for the actual fieldwork.

## 3.8    Data Analysis

The collected data was examined for deductions and inferences so as to find meaning. It was systematically arranged to allow for the drawing of comparisons, contrasts and insights, which involved uncovering underlying structures and informants' views, and extracting important variables and categorizing them.

The data collected during this study was mainly qualitative in nature with only a few numerical data, like the number of years worked. There are several strategies often used in analyzing qualitative data. The strategies include but not limited to grouping together common or similar responses that form patterns into categories, constructing conversational themes among others. In order to identify concepts, major themes and show how these themes supported the assumptions of this study, content analysis was used to convert qualitative data into quantitative by coding according to probable cause and effect, putting emphasis on why something(s) was said. Themes were identified from the research data and used to develop common interpretations for ease of management and formation of relationships that led to theoretical assumptions. The content in text format were entered into a computer for processing using computer software called Special Program for Social Science (SPSS) to get some idea of what the final content looked like in terms of frequencies and percentages of common text contents. The assumptions were then compared against the results or direct quotes from participants to establish whether the impacts were achievable and measurable. Where necessary a table or chart was generated.

**3.9     Validity and Reliability**

Validity refers to the extent to which an instrument measures what it is intended to measure. Reliability is a measure of consistency using the same instrument, and whether it yields the same results. Denzin (1970) observed that multiple and independent methods should, if reaching the same conclusions, have greater reliability than a single methodological approach to a problem.

Using the pilot study, the validity of the research instruments were tested on a small sample of the population in order to find out if data collection instruments and field procedures worked the way they were meant to. The aim of the pilot study was to help reveal any weaknesses in the instruments and to find out whether the questions the interviewees were asked measured to the expectation (i.e., clarity of wordings as interpreted by respondents, context of data collection and topical areas being addressed). Any weaknesses revealed by the pilot study were clarified and revised to reflect the changes. This gave insight to the understanding of the truth as stated by Angen (2000), which Kelliher (2005) noted improves with a combination of specific research techniques to relevant and to the adoption of appropriate standards.

**3.10    Data Presentation**

Data was presented in the following three ways: using statistical techniques like tables, and charts to represent results. The major themes were picked and presented in a descriptive manner; and, tables were developed to find out frequency of certain responses from where conclusions were drawn. Data interpretation was done in a simple language and manner to make it easy for understanding.

**3.11    Ethical Consideration**

This study, like any other qualitative research, involved the use of human beings as subjects. The subjects were made to understand that the study was to establish whether they get access to information resources as and when they want to, and that the study was for academic purposes; hence, it would not cause them physical or psychological harm by, for example, change their behaviour. The study was also not an attempt to cause them pain or distress.

Based on that background and understanding, among the issues considered were to protect them from harm, seek informed consent, and assure them of the right to privacy and honesty. Since data gathering instruments included the use of semi-structured interview schedule, among the challenges faced was convincing the respondents to freely give their views on access and use of ICTs in sourcing for information at their respective institutions, KIRDI and KEMRI. The following are some of the issues that were taken into consideration before embarking on the study: The researcher,

1. Sought permission from the NCST, as the scientific authority in Kenya, to conduct research within the country in the academic and research institutions mentioned above. NCST issued a research permit to the researcher.

2. Sought permission from KIRDI and KEMRI (i.e. the management) to conduct research in the institutions.

3. Sought consent from the subjects to voluntarily participate in the research and assured them that their right to privacy would be guaranteed and, in cases of unwillingness to give certain information, then, this right would be treated

with respect. The subjects were informed in advance about the purpose of the study and the relevance of their participation in the study.

4. Assured confidentiality with regard to information that participants gave; that it would be guarded. The data collected would be used for the stated purpose and no other person would have access to the information whatsoever.

The researcher maintained openness and honesty during the entire period of the study without changing any arrangements agreed beforehand like the use of responses for other purposes.

### 3.12 Summary

The chapter has outlined the methods used in the study delving into the philosophical stance discussing the positivism and interpretive approaches. The interpretive approach was deemed to best fit the underlying assumptions of this study using multi-case strategy for the two study organizations. The approach was selected so as to extract similarities in the two research institutions and to try and establish areas of generalization. Semi-structured interviews formed the primary data collection methods for this qualitative and interpretive study. Respondents were interviewed from their offices or labs during the months of May to August, 2010. The written interviews were processed using SPSS. In addition, secondary sources, like observation and other documentary sources also formed part of data collection methods.

The chapter also addressed the ethical requirements, which were sorted out before commencement of the study including seeking informed consent from the respondents before the start of any interview. The main themes included seeking:

1. Permission to conduct research from the NCST, which is the scientific authority in Kenya

2. Permission to conduct research in the two study organizations

3. Informed consent from the subjects to voluntarily participate in the research and assuring them of their right to privacy

4. Confidentiality of information given, including purpose and use of the information.

**CHAPTER FOUR**

**DATA PRESENTATION, ANALYSIS AND INTERPRETATION –**

**CASE STUDY ORGANIZATION 1**

## 4.1   Introduction

Chapters Four and Five present, analyse and interpret data from the study. The data for each institution are separately presented in order to highlight issues raised by respective researchers at each institution. This particular chapter presents the data obtained through interviews and observations on the use of ICTs in accessing information by researchers at KIRDI. The presentation of data is descriptive in nature, while the analysis is based on the study objectives. A few statistical data are presented in tables, bar charts and column charts.

A description of researchers' characteristics, including work experience, academic qualification, and area of specialization are given in order to ascertain their information needs as influenced by their expertise in relation to the activities they perform to meet their research mandate. The chapter gives an account of the sources researchers consulted including level of usefulness of the sources and extent to which the available information sources met researchers' information needs. Explanation is provided on a range of ICTs used and utilization of ICTs to access information and the researchers' perception on the use of ICTs. A description of existing institutional ICT policies and how they support information access, sharing and exchange are given. An overview of challenges experienced by researchers in accessing information is given as well as suggestions on how the challenges can be addressed in order to improve utilization of ICTs in accessing information.

**4.2    Characteristics of Researchers and Workers**

Sixty respondents recognized by the institution as researchers were interviewed and the breakdown of their professional specialization is summarized in Table 4.1.

**Table 4.1: Distribution of Respondents at KIRDI (n=60)**

| Departments / Centres | Title | Number of Respondents | Percent age (%) |
|---|---|---|---|
| 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 term researcher referred to those working in the departments shown in the above table. As the table shows, respondents from KIRDI were spread across several commercial service centres and divisions. The respondents 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.

KIRDI was found to be too large in nature, making it necessary to present the findings according to established functional or service centres for clarity of events in accordance with the organizational structure. The Division of Food Science and Technology had the highest number of respondents, mostly researchers in various specific area of specialization like the food production, processing of honey and mushroom growing.

### 4.2.1   Distribution of Respondents

The sixty interviewed respondents comprised researchers, technicians, laboratory technologists and Head of Intellectual Property. Tables 4.2 summarize the distribution of respondents by category.

**Table 4.2 Distribution of respondents at KIRDI by category (n=60)**

| Category of respondents | Number of respondents | Percentage (%) |
|---|---|---|
| Researchers | 56 | 93 |
| Technologists | 3 | 5 |
| Lawyers (Intellectual Property) | 1 | 2 |
| **Total** | **60** | **100** |

As the table shows, out of the 60 respondents, 56 (93%) were researchers by profession, while 3 (5%) were technologists, and 1 (2%) was a lawyer.

Key informants, who totalled 16, were also interviewed. The first category comprised the Director and two Deputy Directors one of whom was responsible for Finance and Administration, and the second one was in charge of Research and Development; the latter was therefore responsible for researchers, IT experts and Information Science professionals. This category formed the top management with the role of decision-making, policy related issues, and facilitation for carrying out research activities.

The second category of key informants comprised 7 IT experts and 6 Information Science professionals. Their role was important as they gave technical assistance on ICTs on one hand, and enhanced access and provision of industrial information to researchers on the other. Responses from this category were important as they ascertained utilization of ICTs and information related issues raised by researchers.

### 4.2.2   Respondents' Duration of Service

The researchers were asked to indicate their duration of service at KIRDI. This was necessary to ascertain their work experience at the institution. Table 4.3 below summarizes their responses.

Table 4.3 Respondents' duration of service at KIRDI (n=60)

| Years of Service | Number of Respondents | Percentage (%) |
|---|---|---|
| 0 – 4 | 47 | 78 |
| 5 – 9 | 1 | 2 |
| 10 – 14 | 3 | 5 |
| 15 – 19 | 3 | 5 |
| 20 – 24 | 3 | 5 |
| 25 – 29 | 2 | 3 |
| 30 – 34 | 1 | 2 |
| 35 and above | 0 | 0 |
| **Total** | **60** | **100** |

The above table shows that most researchers at KIRDI had served for less than five years. Out of the 60 respondents interviewed 47 (78%) of them said they had served the institution for up to four years. This was an indication that KIRDI had young researchers. It also indicates a high turnover of employees, which would affect the retention of knowledge and skills.

One researcher said they had worked for a period of between 5 and 9 years. Some 3 (5%) of the respondents stated that they had worked for a period of 10 to 14 years, while another 3 (5%) had worked for between 15 and 19 years. In the category of long service, the study established that 3 respondents (5%) had served for a period of between 20 and 24 years and that 2 had served the institution for between 25 and 29 years. The study revealed that in the service range of between 30 and 34 years, only 1 respondent had served for 32 years. This was the longest serving respondent.

### 4.2.3   Respondents' Academic Qualification

The study sought to find out the qualifications of the respondents so as to establish whether this would have any influence on their information needs. Table 4.4 below summarizes their responses.

**Table 4.4 Respondent' academic qualifications at KIRDI (n=60)**

| Qualification | Number of Respondents | Percent (%) |
|---|---|---|
| PhD | 2 | 3 |
| Master's degree | 28 | 47 |
| Bachelor's degree | 24 | 40 |
| Diploma | 6 | 10 |
| **Total** | **60** | **100** |

It was established that the respondents had varied qualifications ranging from Doctorate degrees to as low as diploma level. The study captured 2 respondents with PhD qualifications, 28 with Master's degree, 24 with a Bachelor's degree, and 6 with Diploma qualifications. The researcher assumed that such stratification was necessary as it would assist in making recommendations on information needs of researchers.

### 4.2.4   Area of  Specialization

During data collection the respondents were asked to state their area of specialization. It was found necessary to find out their areas of specialization and to establish whether researchers' area of specialization had any influence on the respondents information needs.

Responses revealed that most of the researchers had varied areas of specialization, except for Food Sciences and Technology which had most (13) respondents. Engineering, including Mechanical Engineering, had 8 respondents, followed closely

by Environment and Energy with 4 respondents, while Textile Engineering had 3 respondents and Chemical Engineering 3 respondents. Other areas of specialization included Leather, Tannery Development and Spares, Water Quality Control and Management, Ceramics and Chemistry – Natural Products, Food Production and Processing – Mushroom, Agricultural Management – and Project Studies.

## 4.3 Information Needs of Researchers

It was found necessary to establish the information needs of researchers in view of their diversified areas of specialization as demonstrated in (4.2). The respondents were asked to state the information they needed to help them undertake their daily activities. In their response 28 said they needed relevant information in their specialized areas such as food technologies and processing, recipes, chemical engineering, energy and environment. They also needed information on the economy, such as micro-economic data, crop production in other countries for comparison, family growth and sustenance, and GDP. One respondent stated that they needed:

> *"Up-to-date information on new recipes; food processing technologies; chemicals, like banana processing and value addition; analysis equipment; fabricators and sources and information concerning a particular project."*

Given the variation in researchers' area of specialization information needs were bound to vary. The study established that out of those interviewed 11 said they needed current information in terms of primary literature (print or electronic) consisting of among others journals and reports, while 10 said they needed information on protocols, conventions, standard operating statistical procedures, manuals and, notebooks, including information from the Internet. A similar set of the interviewed respondents said they required information to do with research findings, emerging

issues and data. It was found that 3 respondents needed reference materials like existing patents including dimensions with material specifications together with current testing methods, reviews, previews and reports. Another 3 respondents said they needed information on accessibility to donors for funding proposals, management information, including project management information, or information about new projects like call for proposals and project progress. While there was only one respondent who said they needed information about website addresses, databases, training opportunities, workshops, seminars and conferences, 2 of those interviewed stated that they needed information to do with:

> *"Research funding agencies/donors and their funding field..."*
> *"Available knowledge and related research funding to avoid duplication and reference materials; methods and tools"*

It was observed that, whereas most researchers were interested in information in their areas of specialization, information needs for 17 of them was geared towards acquiring ICT skills, availability of equipment by the employer.

### 4.3.1   Influence of Researchers' Duration of Service on Information Needs

This study established that the length of service, or work experience may not necessarily affect researchers' information needs; rather, their information needs is affected by on-going research activities. It was established that the more the number of years worked, the fewer the work-force in the available positions in the institution. It was observed that most researchers had not worked at KIRDI for long possibly due to institutional employment policy vis-à-vis staff establishment, poor remuneration, which may have forced them to leave employment for greener pastures, or they took early retirement to start their own income generating activities in their specialized

areas. This pattern could be alluded to the fact that there may be few specialized research institutions to take on specialized researchers in similar job categories in Kenya.

As for the respondents who had worked for a period of up-to 4 years, there was no clear pattern in their quest for information. In their responses they spelt out the fact that they needed information on:

> *"Current testing methods and existing standards, conventions, statistical operating procedures"*
>
> *"Information on existing patents including technical information for developing what is being researched and what is available in the market"*
>
> *"Function of prototype materials properties, capacity of the equipment and rate of production"*
>
> *"Data or up-to-date information about food processing techniques, analysis, equipment, fabricators and sources"*
>
> *"Research activities and technological development in other areas of the world like ICT; family growth and sustenance"*
>
> *"Innovations, value addition technologies and publication"*
>
> *"Funding agencies, directories "*

There was only one respondent in the category of those who had served KIRDI for a period that ranged 5 to 9 years and said they needed:

> *"Literature on subject index study, protocols, best practices, latest knowledge in the field of study"*

Three respondents who had worked for between 10 and 14 years said they needed:

> *"Relevant information in chemical engineering like manuals"*
>
> *"Technical information, information from the Internet, business information, scholarships information, and donor support information"*
>
> *"Literature (both hard and soft); manuals (procedures and methods) technical information like journals "*

A second set of 3 respondents who had served for a period of between 15 and 19 years sounded more experienced and focused in their responses as they said they needed:

> *"Information on economy, macro-economic data, etc."*
>
> *"Technical information, information from Internet, business information, scholarship information and donor support information"*
>
> *"Information from clients, dimension, material specifications and constituents"*

Another set of 3 respondents who had served KIRDI for a period of between 20 and 24 years said they needed information on:

> *"Project proposals, financial statements of funds utilization, resources usage like human resources and equipment"*
>
> *"Spares acquisition, supplies and new development"*
>
> *"Scientific information mainly"*

Two respondents who had worked for a period of between 25 years and 29 years said they needed information on:

> *"Available knowledge and related research findings to avoid duplications, reference materials, methods and tools"*
>
> *"Books, journals and web-based information in food science"*

The study captured one respondent in the work experience of the range between 30 and 34 years (the respondent had served the institution for 32 years) who said they needed information on:

> *"New recipes, processing chemicals and new methods of testing"*

### 4.3.2   Influence of Specialization on Researchers' Information Needs

It was found necessary to identify the various activities carried out by researchers in their specialized areas of research and to ascertain how the activities they performed

on a daily basis influenced their information needs and the information sources that they used, including type and format. This was essential in order to establish whether their information needs is in any way influenced by their area of specialization and daily activities. The information was important in determining and recommending what information to avail for research activities; hence, the respondents were asked to state what information they needed to undertake their daily activities.

The study established that the information needs of researchers at KIRDI varied immensely, due to their diversified areas of specialization. It was observed that majority of researchers carry out a number of research activities, which include leather processing, marketing research, data collection, analysis in the laboratory, proposal writing and grants seeking, report writing and reviews, protocols, project identification, planning and implementation, materials testing methods and benchmarks from other institutions, quality analysis, project budgeting, sourcing and consolidation of information, design and documentation of developed technologies (including technology transfer), machine design and supervision during fabrication, repairs and maintenance of machines, business advisory services, assisting clients on food processing issues, policy work, economic support services and general administration, patent drafting and other related intellectual property issues, consultancy, monitoring and evaluation, training and capacity development, literature search or surveys, review and execution of research activities and dissemination of science to end users.

## 4.4    Information Sources Consulted by Industrial Researchers

The study sought to establish the various types of information sources available and consulted by the respondents. In effect, they were asked to state the sources of information they consulted whenever they needed information. The responses are shown in Figure 4.1.
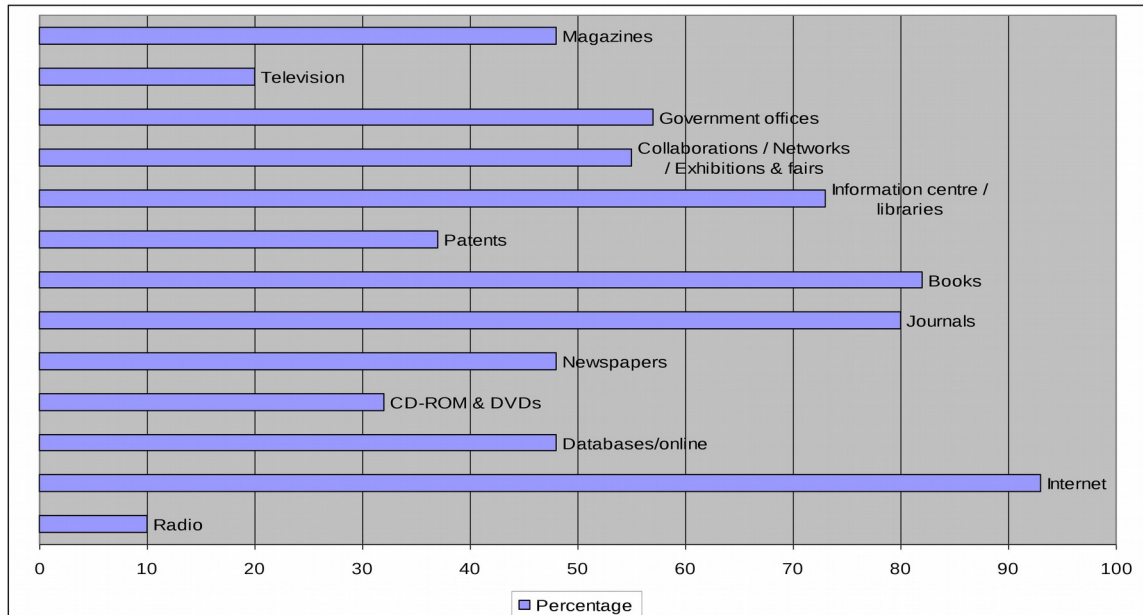


*Figure 4.1: Information sources consulted by researchers (multi-responses)*

The findings indicate that the Internet emerged as the most consulted source of information as stated by 56 (93%) of those interviewed. The respondents said that they used it for research; some of them said they used Google to start their information search. The Internet was useful in consulting e-journals databases like OARE.

Primary sources of information like journals were the most popularly consulted as reported by 48 (80%) of those interviewed who said they use journals for research. It was established that magazines and newspapers were frequently used by 29 (48%) of the respondents, while patents were consulted by 22 (37%). In the case of tertiary

sources of information, it was established that researchers still consult information sources like published books, directories and dictionaries. As reported by 49 (82%) of the respondents, the book was the most consulted source of information in this category, with 39 (65%) of the respondents stating that they consulted directories. With regard to information services, 44 (73%) of the respondents reported that they visited libraries and information centres. This number consists of more than half of the respondents. The purpose of their visit was to look for research information in order to get a variety of relevant information.

The study revealed that due to the varied nature of specialization, industrial researchers also sought information from government offices. This fact was confirmed by 34 (57%) of the respondents. They stated the nature of information for they consulted:

> *"Enquiries to Government of Kenya offices and other government departments / research bodies"*
> *"Relevant Government institutions such as KEBS, KIPI, NEMA etc."*
> *"Government agencies and other sister research institutions both local and abroad "*

The study established that researchers lean on each other's shoulder during research, a conclusion that was drawn from 33 (55%) of the respondents who said they consulted collaborators and other networks for information. This can be alluded to the fact that industrial research consists of several players, as was the case at KIRDI, for some given assignments. The study established that research institutions work on joint projects funded by one source. When responding to a question on what other sources of information they used, some respondents said they turn to:

> *"Peers and friends for consultation "*
> *"Consultation with experts in the areas of interest"*

*"Consultations with colleagues from other institutions when need be"*
*"Collaborating institutes e.g. KARI"*
*"Conferences and conducted interviews with peers"*

Online databases online were popularly used during research as reported by 19(32%) of the interviewed respondents who said they used databases from websites, CD-ROM and DVDs. The available publications included Directory of Manufacturing Industries; Sources of Industrial and Technical Information (SITI), and Directory of Sources of Industrial and Technological Information in Kenya, (which contains library holdings). They also had access to OARE. These sentiments validate the responses from the industrial researchers on the types of information sources available to them for carrying out their research activities.

One of the core functions of the Department of Technology Transfer and Extension Services, under the NIIC, is 'to provide industrial technological information' as stated in the service charter. To that effect the researcher in this study sought to establish from information professionals what information sources were available for the researchers at the NIIC. The information professionals said they had:

*"Annual reports; safety manuals; Research Catalogues; Clinical engineering books; Food Technology; e-journals"*
*"Hard and Electronic copies of Journals and Books, Directories, Patents, etc."*
*"Online publications in the library"*

It was observed that the collection consisted of brochures, Directory of Manufacturing Industries in Kenya (also available in electronic format and maintained by NIIC), annual reports, project reports, discussion papers, KIRDI newsletters, research catalogues, and Directory of Sources of Industrial and Technological Information in

Kenya (also available in electronic format). The above responses were in line with the general objectives that NIIC; it is stated that it exists to improve industrial and technological information transfer through production of directories, profiles of technology, bibliographies and research catalogues.

### 4.4.1 Level of Usefulness of available Information Sources

The study sought to know how useful the various information sources were to researchers at the NIIC in KIRDI. This was important in order to establish whether or not NIIC provided the information needed by researchers to perform their daily activities. The respondents were asked to state how useful the various information sources were. Figure 4.2 shows results from multiple responses on the level of usefulness of available information sources.
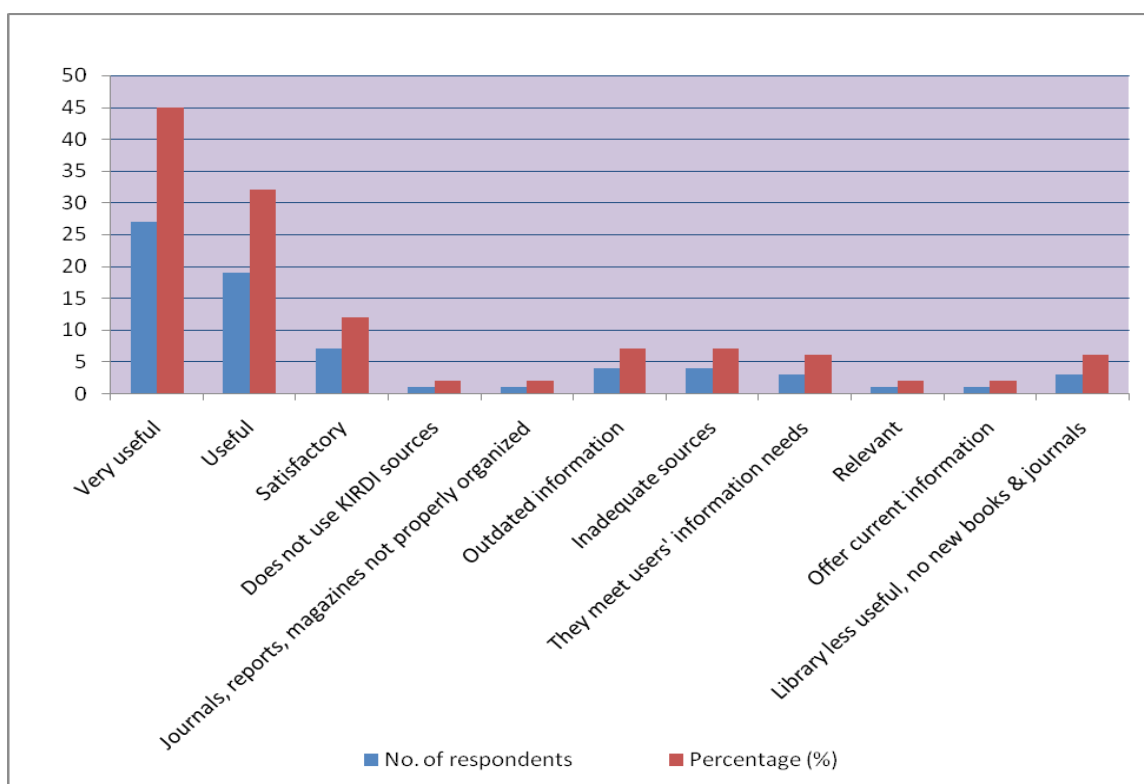


*Figure 4.2: Level of usefulness of the available sources of information*

The findings revealed that 27 (45%) of the respondents found the available information sources to be very useful. The respondents said the sources were:

*"Very useful, the sources actually give the details and specifics required"*

*"Very useful in obtaining information, aid in time saving and convenient & good output"*

*"Very useful especially library (NIIC) indispensable for research"*

*"Very important in guiding development of research concepts and review of available knowledge"*

Out of the interviewed respondents 19 (32%) said the sources were simply useful. In their own words, two respondents said the sources were:

*"Useful, they help although not very detailed"*

*"Useful, but insufficient"*

Whereas 7 (12%) of the respondents said the sources were satisfactory, one respondent specifically said the sources were:

*"Satisfactory although not sufficient for development of prototypes, it gives me a good start"*

It was also established that some respondents were not happy or were satisfied with the available sources. This was confirmed by 4 (7%) of the respondents who were of the view that the sources were outdated. While in support of their opinion, a similar number of researchers said the available sources of information were inadequate for research. In addition another 3 (5%) of the respondents said the library was less useful as it had no new books or journals. Some respondents said the sources were:

*"Less useful because books are outdated. Journals, reports and Magazines are not properly organized and one lands on them by accident"*

> *"Less useful, Not up-to date information and not always available when required*
> *Not very useful, books are too old…"*

One respondent did not hide their dissatisfaction and negative response as they said that they:

> *"Do not use KIRDI sources; they use alternative personal information sources and networks"*

The negative responses notwithstanding, the institution received some positive responses from 3 (5%) of the interviewed respondents who said the resources met researchers' information needs. One respondent said the sources were relevant, while another one said the sources offer current information.

### 4.4.2   Extent to which available Information Sources Met Information Needs

The study sought to know the extent to which the available information sources at NIIC met the information needs of researchers. It was assumed that the results would help in establishing the relevance of information sources to respondents' research activities. The respondents were asked to state the extent to which the available sources met their information needs. Figure 4.3 shows the results of the multiple responses.
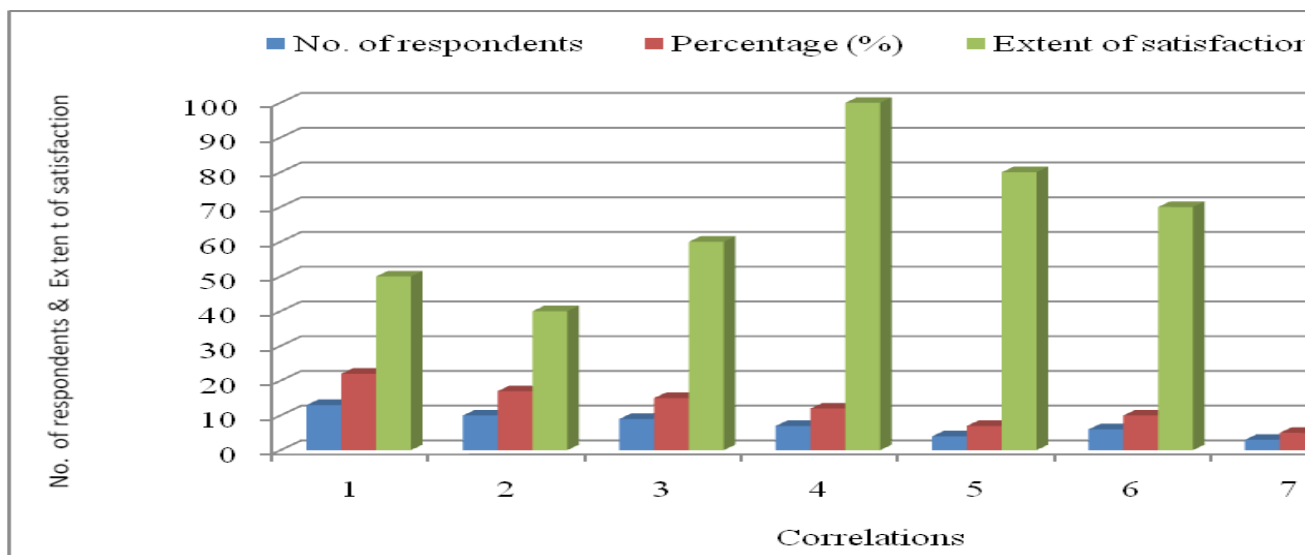
*Figure 4.3: Extent to which information sources met researchers' information needs*

The information workers at NIIC were likely to use the Internet to access industrial information from other sources for industrial research in their effort to meet researchers' information needs from foreign and local partners. The findings as shown on Figure 4.3 indicate that 13 (22%) of the respondents said that the available information sources at their institution met 50 per cent of their needs, while 10 (17%) said that the sources met 40 per cent of their needs.

Another influence of area of specialization was noted when 9 (15%) of the respondents said the information sources met 60 per cent of their information needs, yet 7 (12%) said the contents of the available information sources met 100 per cent of their information needs for research. At the same time, 4 (7%) of the respondents said the sources met 80 per cent of their information needs, and only one said the available information sources met 75 per cent of their needs for daily research activities. In addition, 6 (10%) of the respondents said the sources met 70 per cent of their information needs.

In comparison, variation in respect of area of specialization had an impact on researchers differently as indicated in a situation where some 3 (5%) of the respondents reported that they were satisfied with the information sources, as they met 85 per cent of their information needs, while another 3 (5%) said that the sources only met 25 per cent of their needs. However, on a positive note, one respondent said the sources met 95 per cent of their information needs, while other two also said the sources met 35 and 30 per cent of their needs respectively. Lastly, one respondent felt the available information sources did not meet their needs at all.

### 4.4.3    Researchers' Preferred Format of Information Materials

The study further sought to establish the format in which researchers preferred to have their information material in order to carry out their daily activities. Hence, the respondents were asked to state their preferred format of information material. It was observed that most researchers had either laptop or desktop computers for accessing the Internet's electronic or online resources from their offices or labs. The same facilities were also available for researchers' use at the NIIC and at the Department of Information Communication Technology. This served as a confirmation of the use of electronic format of information resources; researchers were allowed to access online resources from these service points.

It was also observed that KIRDI had Internet facilities at the headquarters where majority of researchers were based and also its own website. It emerged during the interviews that to encourage or motivate researchers on the use of electronic formats, the institution advanced researchers interest free loans for the purchase of laptops, which became their personal properties once they finished the repayment.

It was observed that respondents gave multi responses during the interviews. The study established that 55 (98%) of the respondents which represented the majority, preferred information in electronic format comprising the use of electronic resources like journals, CD-ROMs, DVDs, and online databases. This is an indication that the use of electronic information was favoured by most of the researchers. However, the findings established that 37 (62%) of the respondents consulted information in hard copy format, which included the use of printed books, journals, magazines, newspapers, standards, patents, reports, manuals, Directories, and indexes.

The findings revealed that one respondent preferred a one-to-one consultation format which involved consulting with:

*"Peers and friends consultation"*
*"Consultation with experts in the areas of interest"*

This format of information was mostly preferred when researchers dealt with joint projects within or between different institutions including the stage of proposal writing. Only one of the respondents reported that they used media information like listening to news and watching or following an informative science documentary of interest from a particular television or radio channel.

## 4.5    Access to and Utilization of ICTs

The main purpose of this study was to investigate the use of ICTs in accessing information by industrial researchers in the process of searching for information. The respondents were asked to state how often they used ICTs to access information. The findings are presented in Table 4.5.

**Table 4.5: Frequency of ICTs use to access information (n=58)**

| ICTs Usage to Access Information | Number of Respondents | Percentage (%) |
|---|---|---|
| Daily | 56 | 97 |
| Moderately | 2 | 3 |
| **TOTAL** | **58** | **100** |

The study established that 56 (97%) of the respondents use ICTs daily to access information for carrying out their daily research activities. Out of the interviewed respondents 2 (3%) said they moderately use ICTs (i.e., not daily).

### 4.5.1    Range of ICTs used by Researchers to meet their Information Needs

The study sought to establish the range of ICTs researchers use at KIRDI. The respondents were asked to state which ICTs they used and which of them best met their information needs.

The findings indicated that 55 (95%) of the respondents used computers. This percentage is more than half of those interviewed. It was noted that there was a close match between those who said they used computers and those who used the Internet as 54 (93%) said they used the Internet to access information. Majority of them reported that the Internet was the best in meeting their information needs. Only 3 of the respondents said they used modems for Internet.

The findings also indicated that 41 (71%) of the respondents used electronic resources from online databases, while 44 (74%) use CDs/DVDs. The latter pointed out that they used CDs/DVDs as information storage devices for their research work. It was established that, in addition, 48 (83%) of the respondents said they used flash disks, while 8 (14%) said they used PDAs. The rest of the respondents said they used cameras and scanners to capture and store data from the field.

In the area of communication the use of mobile phones as communication tools was reported by 43 (74%) of the respondents, while 38 (66%) said that they used fixed telephone lines, and 17 (29%) used fax machine for real time communication or share research findings with their colleagues.

The study findings also established that 38 (66%) of the respondents said they used television to follow-up on scientific documentaries, while the radio was reportedly used by 20 (34%) of the respondents to get news and follow-up on interesting programmes, and 17 (29%) said they used video technology for documentaries. It was also established from the study findings that while 20 (34%) of the respondents said they used scanners to exchange information with their colleagues 19 (29%) said they were still using videos.

### 4.5.2   Usefulness of the various ICTs Used by Researchers

The study sought to know the extent to which the available ICTs were useful to researchers. This was important in making recommendation for their improved utilization in accessing information. The respondents were first asked to state what they used ICTs for. In their opening multiple responses, 55 (95%) said they used ICTs

for research, while 22 (38%) said they also used the ICTs for entertainment. The respondents were then asked to state how useful the various ICTs they used were. Their responses were measured in terms of important, very useful, moderately useful, useful, less useful and not useful.

On the importance of the computers, only one of the respondents said that they were most useful, while 49 (84%) said it was very useful, and another 9 (15%) simply said it was useful. On average, all respondents considered computers to be useful in carrying out research activities like laboratory analysis, project proposal development, data collection and analysis, leather processing and quality analysis, research work and laboratory tests, carry out industrial research and marketing, data collection, analysis and laboratory experiments, sourcing for information, consolidation of information among other several administrative duties, and development of prototypes and equipment.

The use of the Internet was positively reported by those interviewed, who either reported using it at their place of work, home or at the cyber. The findings showed that only one respondent stated that it was most useful, while 48 (82%) said that it was very useful, and 7 (12%) said it was useful. It is clear that over 94 per cent of the respondents considered the Internet to be useful in sending e-mails, and searching and compiling valuable food information from various sources. However, two respondents said the Internet was less useful to them.

There has been an increase in the use of mobile phones in research especially among colleagues and peers. Out of those interviewed 41 (71%) attested that mobile phones

were very useful, especially in financial transactions while in the field for paying research assistants and also in the cases of delayed payment of per diems, as well as for finding out fish prices and type of fish catch for the day. Some 11 (19%) of the respondents said mobile phones were useful. In total 90 per cent of the respondents used mobile phones. However, it was established that mobile phones were not useful to some two respondents, with one of them saying that they did not find it useful, while another was categorical that it was not useful but could not explain why.

Flash disks were found to be an important tool in the storage of research data. The study established that 52 (89%) of the respondents said it was very useful, while 7 (12%) said it was useful for storage and was portable. In total, almost all respondents used flash disks.

It was observed that most researchers were in possession of external hard drives which they said was their personal tools for information storage. Those who had them said that they were very useful for back-ups. As for other storage mediums, 21 (36%) of the respondents said they used CD-ROMs for storage for data, information and field data. Out of the interviewed respondents 24 (41%) said the CDs were very useful, while 9 (15%) said that this type of ICT was less useful to them. The optical disks, especially the DVDs, were found to be another important tool for data and information storage as stated by 45 (76%) of the respondents. It was established that 22 (38%) of the respondents said DVDs were very useful, while 23 (39%) said it was useful. Whereas 8 (14%) of the respondents felt that the technology was less useful for their research work, it can be deduced that 77 per cent used DVDs for storing research data.

On the magnetic disk devises, 30 (52%) of the respondents said that videos still played an important role in the research world for recording events by respondents who were found to use them, while 14 (24%) said that they were very useful, and 41 per cent said they were useful. In total 65 per cent of the respondents felt that the videos were useful tools. However, some 12 (21%) felt that they were less useful. One of the respondents was categorical that videos were not useful.

During the study, it was observed that the use of modems was not very common at KIRDI as only 3 per cent of the respondents said that they were very useful. This could be attributed to the cost of information communication or cost of buying data bundles for communication during the data collection period. At the time, the mobile telecommunication sector was then monopolized by a few service providers, namely Safaricom and Airtel.

Fixed telephones were reportedly used by 38 (66%) of the respondents. This percentage is more than half of the respondents found to be using fixed telephones. Out of the interviewed respondents 18 (31%) said that fixed telephones were very useful communication tools, while 20 (34%) said that it was useful in research, and 9 (15%) said it was less useful. There were some 3 per cent of respondents who said that the fixed telephone line was not useful.

Only one respondent reported that they used cameras during research and that it was a useful tool in research, one respondent said it was moderately useful, 14 (24%) it was less useful, and one respondent felt the tool was not useful to them. The respondent

said that the camera is used in capturing or recording images both as photographs and as moving images.

In broadcasting technology, the radio was still considered important as stated by 33 (57%) of the respondents of whom 15 (26%) said that the radio was very useful, while 17 (29%) said it was useful in research, especially in reporting emerging issues. This having been a multi response, the study noted that all in all the radio was being used by 47 (81%) of the respondents, although the technology was less useful to 13 (23%) of the respondents.

The study also revealed that, although television was still important and useful in research at KIRDI, it was not popular because only 7 (12%) of the respondents reported using television. They said it was less useful to them, while one of the respondents felt it was not useful in research.

### 4.5.3   Point of Access to ICT Tools and Services

The study sought to find out the various points from which respondents accessed ICTs in the course of carrying out their daily activities. This was necessary in ascertaining whether the institution availed any ICTs to researchers. The respondents were asked to state where they access ICTs, whether from the office or from home. The study established from the multiple responses that there existed several access points to ICT tools as shown in Table 4.6.

**Table 4.6: ICTs Access Points for Researchers**

| Access Point | Number of Respondents | Percentage |
|---|---|---|
| Library / Information Resource Centre | 26 | 45 |
| Office | 58 | 100 |
| ICT Department | 3 | 5 |
| Cyber | 18 | 31 |
| Home | 43 | 74 |
| Lab | 12 | 21 |
| Any Where for Mobile & Laptop | 2 | 4 |
| Office of Workmate or Colleague | 1 | 2 |
| Institutions of Collaboration | 1 | 2 |

It was established that all researchers accessed ICTs from their offices. As shown in the above table 58 (100%) of the respondents said they used ICTs to access information from their respective offices, while 43 (74%) said they access ICTs from their homes, and another 18 (31%) said they access ICTs from cyber cafés. Two of the respondents said that they often got access through their mobile phones or laptops, and that they could access information from anywhere since there was no fixed or specific point of access given that the gadgets are portable. Only one respondent claimed to access ICTs from the ICT Department, while another one said they access ICTs from their labs. Only one respondent said that they accessed ICTs from the office of a workmate or colleague and sometimes from institutions of collaboration.

In the case of the Library / Information Resource Centre 46 (45%) of the respondents confirmed they had access to ICTs through the library or information resource centre. It was apparent that none of the researchers from KIRDI said they got access to information through satellite while in the field.

### 4.5.4 Services Available

The study relied on the responses of the key informants to establish the range of services available to respondents. Information professionals were asked to state what role their department played in helping researchers carry out their research activities. The following are some of the responses:

> *"Assist in information search like use of Internet as well as assisting them to access other information materials easily whenever called upon"*
> *"The department has computer databases for information retrieval and other information materials"*
> *"Provision of personal modems especially when Internet is down"*
> *"Through exchanging ideas on what they need as well as their output"*
> *"Provision of relevant information materials through purchase of new books and other information materials like journals"*
> *"Providing information through interlibrary loans, lending or loaning services of research materials from NIIC"*

The IT personnel interviewed stated that their role in meeting researchers' information needs was more technological in nature as follows:

> *"Through provision of standard services, authentication of right equipment and use of licensed software including developing software"*
> *"We have provided Internet facilities for online research to ensure their information needs are met"*
> *"Ensuring all researchers have a computer to facilitate their research"*
> *"Provision of technical support, modern analysis tools and installation of software like SPSS for data analysis"*
> *"Training researchers on the use of software and raising of IT literacy level"*
> *"ICT staff ensure that the research media like Internet and computer components are properly maintained to work, uninterrupted or that there is consistency in Internet connectivity and local network"*

**4.5.5   Researchers' Perception of use of ICTs**

The study sought to find out the researchers' perception of the use of ICTs during their search for information. They were asked to give their perception of value and use of ICTs to access information, and say how useful ICTs were in terms of their research information needs. Figure 4.4 shows the results of the multiple responses with regard to how researchers regard ICTs in the course of carrying out their research activities.
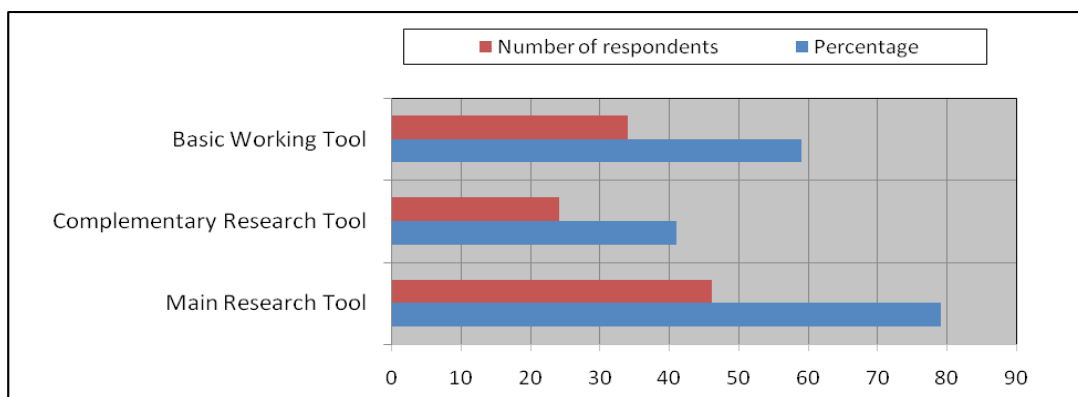


*Figure 4.4: Researchers Perception on use of ICTs*

As shown in the figure 4.4, 46 (79%) of the respondents regarded ICTs as their main research tool. Another 34 (59%) stated that ICTs were their basic working tool, while 24 (41%) said that ICTs were complementary research tools. The study revealed that most researchers regard the use of ICTs highly 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"*

However, there were some respondents who felt that ICTs were not very effective in accessing industrial information. A few of them said ICTs were:

*"Not that much reliable, most information is on product profile while underlying principles are withheld"*

*"Difficult to obtain full information from industries as most fear competition, and that some competitors could use them to their disadvantage. Most of industrial data is scanty unless for marketing purposes"*

*"Difficult to obtain detailed results"*

*"Effective for basic information, but not high-end and critical information"*

Although the above views from confirm that ICTs are highly regarded by researchers, some of them felt that there was still room for improvement on what ICTs were capable of offering as far as research information is concerned.

### 4.5.6    Use of ICTs in Information Searching and Retrieval

The study further sought to establish whether respondents conduct their own literature searches. Researchers were asked to state who conducted information searches for them. It was established that the respondents at KIRDI used ICTs in the course of carrying out their daily research activities including information searches. It was found that 48 (83%) of the respondents normally conducted their own information searches, while 6 (10%) said their information searches were only done for them by their peers and fellow colleagues when they were too busy. Only 3 (5%) respondents said that their information searches were done for them by library staff and sometimes the ICT personnel when they could not succeed by themselves. However, it was also

established that information searches for 2 (3%) of the respondents were done by the office secretary because the concerned researchers did not know how to use ICTs.

## 4.6    Institutional ICT Policy

The study sought to find out what institutional ICT policies exist to govern the use of ICTs and how these policies support information access, sharing and exchange. The respondents were asked to state what institutional ICT policies or regulations existed and how they enhanced information access and use of ICTs at KIRDI.

It was established that 38 (66%) of the respondents knew of the existence of some institutional ICT policy where researchers were expected to employ committal signature on fair use of ICT or use of passwords, and that only staff had access to ICTs. They added that at all times they were expected to protect their Internet accounts from outsiders for security reasons and to adhere to ethical practices and norms. Some of them indicated that they knew of the existence of a clearance procedure to use equipment and one said that:

> *"One needed clearance by the institute to bring in and use their personal computers"*

In addition, 9 (16%) of the respondents reported they had knowledge of ICT policy on the use of ICTs for official use only, and that only authorized sites could be visited; there was no visiting social sites like Facebook during working hours. It was clear from 7 (12%) respondents that a draft policy on ICT was being prepared covering such areas as Internet access, e-mail, program installation and network security, including a policy on continuous training of staff on ICT skills and on the use of diskettes. One respondent reported of only having knowledge of the incubation policy,

while other respondents said they knew there were policies on Intellectual Property Rights and regulation, as well as a National ICT Policy in that was in place. Nevertheless, 31 (53%) of the respondents stated that there was none; they were not aware or did not know of the existence of any institutional ICT policy. The rest of the respondents asked the researcher to confirm with ICT department, while some felt that the ICT policy issue was not applicable to them.

On the same issue of ICT policy, 22 (38%) of the respondents felt that the institution ought to establish, implement and enforce the policy in consultation with researchers, and also subject it to constant review. Among the restriction to be maintained include no Facebooking, no visiting restricted areas, and only research related sites.

In responding to the question on the existence of ICT policies at KIRDI, the key informants in the category of Director and Deputy Directors said:

> *"There are certain sites that are restricted e.g. Facebook"*
> *"ICT has to be extended overly beyond research and development. It's a basic research tool and can be used to fight corruption"*
> *"Rights of downloads, ICT policy on research related sites"*

IT specialists and information professionals were asked to state how KIRDI was planning to address the issue of ICT policy or regulations at institutional level with regard to access to information. IT specialists said researchers would have Internet connectivity in all areas including rural areas and that the institution will use fibre optic cable to improve connectivity (unlimited connectivity) or increase ICT capacity and bandwidth supported by wireless connection or any new or latest technology to reduce cost and arrange to pay Internet service providers. They also emphasized the

fact that the antivirus programs would also be routinely checked and updated, and that KIRDI would enforce the ICT policy once developed, which include increase in Internet bandwidth and restriction on access to irrelevant sites or illegal websites. The policy would be placed in a frame and displayed.

The administrators gave varying views as follows:

> *"KIRDI plans to develop and enforce an ICT policy"*
> *"No porn sites, charts and no music, only for research use"*
> *"To be able to communicate with planners and partners"*

### 4.6.1 Institutional ICT support

Although the issue of the existence of institutional ICT support was not posed to the researchers, a few respondents raised a number of negative issues related to the execution of research activities and the ICT support they received from the:

> *"ICTs not adequate; poorly planned"*
> *"Occasional interference when ICT personnel change; those in charge are not very keen to always maintain Internet connection"*

The IT personnel reported that they monitored the implementation of policies, procedures and standards in addition to the provision of ICT support to researchers. They provided technical support to computer users as reported and stated by 10 IT personnel on areas such as ICT infrastructure, maintenance and services including computer upgrading and data entry for some researchers. Some of the administrators said:

> *"Most offices have Internet connectivity and equipment like desktop"*
> *"Being facilitated with the right ICT tools"*

It was necessary to seek opinion of the key informants who comprised the Director and the Deputy Directors on the ICT tools the institution gave researchers, to ensure they got the needed information on time. They stated that the institution provided desktop computers with accessories like flash disks, Internet connectivity, and modems. On request, researchers were advanced finances to purchase laptops. In addition arrangements were made for expertise from India.

It was evident from the administrators, who are the decision-makers, that the institution gave ICT support to researchers in terms of availing a reasonable budget for computers and accessories. The Director of Administration and Finance confirmed that researchers were given support in terms of interest free advance loans for the purchase of laptops for research. The other items of support from the institution as demonstrated by the Director and his Deputies included internet connection, use of available modems, flash disks and availing external expertise. The support, according to the Director and the Deputies, was very useful to researchers in their research work. One of the Directors said the researchers were given support:

> *"By providing the necessary ICT resources and any required facilitation. I am facilitated with air time"*
> *"Facilitation as much as KIRDI can so long as within mandate"*

The administrators were then asked about plans that the institution had on the use of ICTs. Below are the responses from each of them:

> *"Ensure there is connectivity for all the researchers and there are plans to tap onto the fibre optic cables"*
> *"ICTs to be basic working tool, invest in fibre optic cabling including KENET with an aim of increasing bandwidth and reducing cost"*

*"Proposed to have a link to universities' data for non-duplication of research and work as a team and that ICTs to be basic working tool"*

The above sentiments gave an indication that, in future, more ICT support needs to be given by the management to the researchers.

## 4.7 Challenges Encountered by Researchers Using ICTs to Access Information

The study sought to establish the challenges that researchers experienced in accessing and using information. The respondents were asked to state the challenges they experienced in accessing information. This was important in knowing about their experience and suggesting ways for improving access to and in the use of ICTs for information in this institution, as well as in making recommendations to the management. It was also important in helping to assess whether the challenges were a contributing factor to the diffusion of ICTs in accessing information for research.

The study established that all 58 (100%) of the respondents encountered problems to do with infrastructure, including such elements as electricity/power surge, bandwidth, and that the institution had not tapped into technological advancement like cable or fibre optic technology. It was found that 48 (83%) of the respondents experienced slow Internet connectivity; after securing a connection, this was followed by the slow speed of Internet, slow log-in access and low bandwidth sometimes due to huge traffic. In addition, the respondents lamented that there were problems to do with the Internet connection or server being down resulting in lack of access or down time due to power surge or outage as reported by 17 (29%) of the respondents. They reported that these resulted in unpredictable resumption of service after interruption, leading to

loss of data. The challenges hampered their ease of use as well as coping with the high speed of technological advancement.

The key informants (who were also the decision-makers) were asked to state some of the challenges ICTs posed to researchers at KIRDI. In their responses they reported that the challenges included:

> *"Constant blackout or power outage, slow connectivity on some days, in addition to some computers being much older"*
> *"Computer phobia since some researchers were not very comfortable with Internet calling for training opportunities"*
> *"Slow speed, training, ICT skills upgrading, viruses, loss of data and security"*

There were also challenges related to software updating and data compatibility. This was reported by 33 (57%) of the respondents, consisting of more than half of those interviewed. They said that they encountered problems of software compatibility; for example, problems with Adobe Acrobat when down loading PDF files, a problem they attributed to inconsistency with existing values, just like the word documents in the case of Microsoft Office 2003 and Microsoft Office 2010.

Another challenge or problem was that of equipment being too old, obsolete and outdated. This was expressed by 14 (24%) of the respondents. They said that some equipment could not be updated due to insufficient funds. Another challenge was to do with maintenance of equipment and frequent breakdowns of computers/server/switch in respect to slow response to emergencies by the IT department; the department had inadequate personnel to handle ICT issues.

The ratio of researchers to the number of computers available was also an issue as reported by 4 (7%) of the respondents who complained that the facilities were not adequate. They requested that the management should add more computers. One respondent singled out the hindrance to access and use of ICTs as having to do with:

> *"Inadequate or in-accessibility to equipment due to poorly planned or lack of facilities and unavailability of resources"*

Information overload was also cited as a challenge. This was stated by 10 (17%) of the respondents who felt that the use of ICTs exposed them to too much information, with 5 (9%) complaining of information overload, and not being sure of relevancy and reliability of information and authenticity of the sources. They said they encountered too much irrelevant or junk information that it was difficult to select what to read, while some other respondents had issues with currency of information, especially content having established that the hard copies available at NIIC were outdated.

When the respondents were asked to state whether they got access directly and easily to a title in the collection at the time they wanted the information. This was meant to ascertain their competence and extent of using ICTs in searching for information. It was established that 35 (43%) of the respondents had no problems as they got access directly and easily to a title in the collection at the time they wanted it using Internet search engines. Whereas a few respondents got access, they said it was not easy, as there were times when one would not get what they wanted; hence, they spent more time. However, some of the respondents stated that there were challenges related to competencies in search and retrieval of information, as they were being re-directed from one site to another through other gateways like Science Direct.

Technological advancement was reported as an obstacle to access and use of ICTs by 45 (78%) of the respondents. It was also established that 30 (52%) of the respondents found their main challenge as keeping up-to-date with technological changes, and they said that ICT was such a dynamic area.

The study established the issue of training as a hindrance to access to information. The findings indicated that 44 (73%) of the respondents pegged their hindrance to access and use of ICTs to limited training. It was observed that this number was more than half of the respondents, while 19 (33%) attributed their problems to lack of proper ICT skills and lack of computer training and the understanding of ICT's role in research.

Another challenge encountered by respondents was related to access and retrieval. The findings showed that 14 (24%) of the respondents experienced restriction and access to certain sites caused by use of passwords, Internet connectivity or too many links through which one had to pass. Reliability and lack of network made it impossible for researchers to access information, while 2 respondents said they encountered restriction on some social sites during working hours and that of mal-function sites.

Hindrance due to costs was reported by 35 (60%) of the respondents. They said that their major obstacles to access and use of ICTs for research information were related to affordability, subscription requirements and the high cost of accessing electronic information resources like e-books and e-journals. The study established that another 35 (43%) complained that the pay per use was too expensive because the payment

was pegged on the USD. They also cited the payment of annual subscription fee before one could access restricted information, which required constant subscription to e-journals coupled with constant denial of full access to use e-books and journals.

When information and IT professionals were asked to state how information at NIIC was useful to the researchers, they indirectly responded to access challenges. They said:

*"Lack of finance hinders updating of information"*
*"NIIC is equipped with a library that houses journals, books and other information materials, but some of the constraints faced come in the form of unavailability of sufficient funds to update the library"*

The decision-makers in charge of administration and finance were asked to state how often they visited their institutional library and how they found the available information sources. This question was asked to help in establishing whether or not they were aware of the challenges researchers faced in the library. In their response, one of them said they visited once in a while, while the other 2 only visited when required. One of them indicated that they did not frequent the library because:

*"The information sources were not up-to-date, they required improvement especially journals; and that the institution needed to make arrangements with the publishers to get e-resources"*

The Director gave light on the budget and said that, in the year 2009/2010, KIRDI had a budget of Kshs. 35 million for ICTs (this interview was conducted on 16th February, 2010). However, the ICT manager said the budget was about 27 million and suggested that 50 million would be sufficient for the support of ICTs since what was in place was not adequate to support ICT usage.

Responding to what they could do in their position to increase the budget, the Director and ICT Manager each said:

> *"Initiate more investment and building capacity to assemble computers on the ground"*
>
> *"Will increase depending on need"*
>
> *"Review the current one and encourage the centre (ICT) to have income generating activities"*

The study also established that, to some extent, institutional ICT policy was a hindrance to access and use of ICTs at KIRDI. This was reported by 19 (33%) of the respondents who said that in some cases the existence of such a policy was not made conspicuous; hence, many researchers were not aware of its existence. The respondents who were aware of the existence of the policy and were also aware that it was in place, felt that it was poor since researchers and some ICT personnel were not involved during its drafting. They had issues with the number of restrictions placed on them, such as no Facebooking, no visiting restricted sites, and that only research related sited were allowed.

## 4.8    Suggested Ways of Improving Access to and Use of Information

The study sought to engage participants in establishing solutions to the challenges they experienced and how the challenges can be addressed for the smooth running of research and the institution they work for. The respondents were asked to state how the challenges/problems could be solved.

Several responses were received from interviewed respondents, some of which were found to be relevant to this study. Respondents specifically pointed out that management should:

> *"Make ICTs i.e. computers and accessories accessible to researchers and all other levels of personnel within the institution including those in rural stations. All researchers to have Internet connectivity in all areas"*
>
> *Develop an efficient ICT policy in liaison with the ICT users"*
>
> *"Management to spearhead use of ICTs & facilitate interconnection beyond the office through modems for Internet disconnection and install wireless Internet and provide computers to the staff"*
>
> *"Improvement on facilities and especially continuous training"*
>
> *"Lobby for free access to e-resources or increase subscription to e-resources and data banks professionals to enhance access to relevant research information"*
>
> *"Tax exempt on ICTs to reduce cost and make them affordable"*
>
> *"Improve ICT budget"*
>
> *"ICTs to be used as institutional repositories for information storage, sharing & refereeing or collaborative projects"*
>
> *"Provide application software to staff"*
>
> *"Use fibre optic cable to improve connectivity (unlimited connectivity) or increase ICT capacity & bandwidth; supported by wireless connection or any new or latest technology to reduce cost; agree and pay internet service providers promptly"*

The administrators echoed the sentiments/suggestions as they all felt that the institution should:

> *"Invest in user training and support as a priority; followed by researchers' continuous training to upgrade their ICT Skills either at incubation centre or through seminars, workshops, conferences"*
>
> *"Have a standby generator to ease power outage"*
>
> *"Improve the budget depending on exchequer allocation"*

*"Policy on disposal of old equipment that depends on need not fixed number of years, or after ten years or between three to five years"*
*"Subscription to e-journals"*
*"Expansion of bandwidth"*

The service providers to researchers, who consisted of information and IT professionals, on their part came up with some solutions to the challenges. Most of them expressed dissatisfaction with the budgetary allocation for service provision, and availability and access of information to researchers. Some of them suggested and said they would:

*"Convince the management to set/accept the budget for NIIC. The information sources are obsolete and outdated due to lack of section budget"*
*"Carry out end user survey to determine if they are satisfied and their suggestions on improvement"*

On ways of improving the services, one thing that came out clear was that the information professionals would:

*"Convince the management to also set up a digital library for researchers or NIIC"*

## 4.9    Summary

The findings have demonstrated that researchers look at various specific research areas and need a wide range of information. If the specific research areas are not well studied and understood, the researchers may not be well served in their respective service centres. Their information needs include current and relevant information related to their research areas like new recipes, food processing technologies (e.g. banana processing and value addition), chemicals and analysis equipment including protocols, conventions and standard operating procedures. Researchers also needed

information on research findings and emerging issues, data collection and analysis, lab management, patent drafting and intellectual property issues, proposal writing, accessibility to donors, project management, consultancies, and monitoring and evaluation. In addition, they needed information on networking and partnerships, administration, accounts and budgeting.

There were various sources of information used among which the Internet emerged as the most consulted source of information especially for communicating with peers, collaborators including fellow colleagues through e-mails and consulting in the various areas of specialization as well as accessing product information. Primary literature like journals (print and electronic), reports, reviews, manuscripts, manuals and notebooks, patents, magazines and newspapers were among the information materials needed. In addition, the use of tertiary literature, which includes books, directories and online databases, was evident.

The findings confirmed that researchers utilized a wide range of ICTs for research on a daily basis, with the Internet being the most heavily consulted or used. The range of ICTs used include computers (both desktop and laptop), PDAs, flash disks, CDs/DVDs, cameras, scanners, fixed telephone lines, fax machines, mobile phones, Internet, online databases, websites, radio, television and video technology, for documentaries. ICTs are mainly used to carry out research work, although occasionally they are used for entertainment while at work.

Researchers access the ICTs from their offices, homes, labs, ICT Department, institutional library/information centre, sometimes cyber cafés and anywhere in the

case of mobile phones. They regard ICTs as their main working tool for research, as well as basic and/or complementary working tool.

Majority of the researchers conduct their own literature searches with only a smaller portion of them having their literature searches conducted by their peers and friends when they are too busy, and library staff because they were unable to succeed in information searches on their own. Office secretaries also assisted their bosses to search for information because the latter lacked ICT skills.

Access to needed information was not always an easy task for researchers. Some did not get access with ease since the results revealed that some researchers needed assistance to access information using ICTs. The main problems they encountered were to do with infrastructure, inadequate or poorly planned facilities, Internet connectivity, slow Internet speed or low bandwidth, limited ICT skills, power outage and software compatibility.

ICT skills and website addresses emerged as a requisite for researchers to use the Internet, especially for communication, since there are those who needed assistance to access information using ICTs.

**CHAPTER FIVE**

**DATA PRESENTATION, ANALYSIS AND INTERPRETATION:**

**CASE STUDY ORGANIZATION 2**

**5.1     Introduction**

This chapter presents analysis and interpretations of data obtained through interviews

and observations on the use of ICTs in accessing information by researchers at

KEMRI. The presentation of data is descriptive, while the analysis is based on the

study objectives. As mentioned in Chapter Four, the data for each institution are

separately presented in order to highlight issues raised by researchers in each

institution. Some statistical data are presented in tables and figures.

A description of researchers' characteristics, including work experience, academic

qualification and area of specialization are given in order to ascertain their

information needs as influenced by their expertise in relation to the activities they

perform to meet their research mandate. An account of the sources they consulted is

also presented, including the level of usefulness of the sources and the extent to which

the available information sources meet researchers' information needs. The

description of existing institutional ICT policies is presented and how the policies

support information access, sharing and exchange. In addition, the range of ICTs used,

access to and use of ICTs, including the point of utilization of ICTs to access

information and researchers' perception on the use of ICTs are identified. An

overview of challenges experienced by researchers in accessing information is given

as well as suggestions on how the challenges can be addressed in order to improve the

utilization of ICTs.

**5.2    Characteristics of Researchers and Work Environment**

A total of 55 respondents from KEMRI, and who comprised researchers, technologists and medical officers, were interviewed. Table 5.1 provides a summary of categories and distribution of respondents.

**Table 5.1: 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** |

At KEMRI, respondents were spread across several centres in the country as shown in Table 5.1. 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.

### 5.2.1  Distribution of Respondents

The fifty five interviewed respondents comprised researchers, technologists and coordinators. Table 5.2 provides a summary of the distribution of respondents by category.

**Table 5.2: Distribution of respondents at KEMRI by category (n=55)**

| Category of respondents | Number of respondents | Percentage (%) |
|---|---|---|
| Researchers | 40 | 73 |
| Technologists | 12 | 22 |
| Coordinator | 3 | 5 |
| **Total** | **55** | **100** |

As the table shows, out of the 55 respondents, 40 (73%) were researchers by profession, while 12 (22%) were technologists, and 3 (5%) were coordinators.

The study captured and interviewed 18 key informants who were grouped into two categories for ease of data presentation. The first category comprised 2 Deputy Directors. one of whom was responsible for Research and Development and also responsible for researchers, IT experts and information science professionals. The second Deputy Director was responsible for Administration and Finance. These Deputy Directors formed the top management whose role was that of decision-making, dealing with policy related issues and facilitating the carrying out of research activities.

The second category of key informants comprised 9 IT experts and 7 information Science professionals. Their role in the organization was important as they gave technical assistance on ICTs, as well as enhanced access and provision of medical information to researchers. Their responses served to ascertain the utilization of ICTs and information related issues raised by researchers.

### 5.2.2   Researchers' Duration of Service at the Institution

The researchers were asked to state their duration of service at KEMRI. This was necessary to ascertain their work experience at the institution. Table 5.3 summarizes their responses.

**Table 5.3: Researchers' duration of service (n=55)**

| Years of service | Number of respondents | Percentage (%) |
|---|---|---|
| 0 – 4 | 28 | 51 |
| 5 – 9 | 14 | 26 |
| 10 – 14 | 3 | 5 |
| 15 – 19 | 2 | 4 |
| 20 – 24 | 3 | 5 |
| 25 – 29 | 5 | 9 |
| 30 and above | 0 | 0 |
| **Total** | **55** | **100** |

The study established that most researchers had served for less than five years. As the Table shows, 28 (51%) of those interviewed had served the institution for a period of up-to 4 years and had not therefore worked for long at the institution. This was also an indication that KEMRI had more young researchers. Of those interviewed, 14 (26%)

of them had work experience of between 5 and 9 years, and 3 (5%) of the respondents had worked for a period of between 10 and 14 years, while 2 (4%) had served the institution for a period of between 15 and 19 years. Only 3 (5%) had served the institution for a period of between 20 and 24 years.

As for the case of long service category, only 5 (9%) of the respondents had worked for a period of between 25 and 29 years with 4 out of the 5 having served KEMRI for a period of 25 years. That meant that the longest serving respondent had worked for 28 years.

The study established that the more the years of work experience, the fewer the work force in position, except for 4 respondents in the last category. It was observed that most researchers had not worked at KEMRI for long. The longest serving respondent had worked for 28 years. The researcher alluded this pattern to the fact that most respondents, being medical practitioners, may have gone into private practice, since there are few similar specialized medical research institutions to take on researchers in similar job categories in Kenya.

### 5.2.3   Respondents' Academic Qualification

It was found necessary to find out whether a respondents' qualification had any influence on their information needs. The researchers were asked to state their academic qualification. This was necessary to match the qualification with the research activities they carry out at the institution. Table 5.4 summarizes their responses.

**Table 5.4: Respondents' Academic Qualifications (n=55)**

| Qualification | Number of Respondents | Percentage (%) |
|---|---|---|
| PhD degree | 15 | 27 |
| Master's degree | 23 | 42 |
| Postgraduate diploma | 1 | 2 |
| Bachelor's degree | 14 | 25 |
| Higher National Diploma | 2 | 4 |
| **Total** | **55** | **100** |

The study established that the respondents had varied qualifications ranging from Doctorate degrees to as low as Diploma qualifications. The study captured 15 respondents with PhD qualifications, 23 with Master's degrees, 14 with Bachelor's degree, 1 with Post graduate Diploma and 2 Higher National Diploma holders. The researcher found such stratification necessary as it assisted in making recommendations on information needs of researchers at the institution.

### 5.2.4   Area of Specialization

It was found necessary to find out areas of specialization of the respondents and whether this had any influence on their information needs. Hence, during data collection the respondents were asked to state their area of specialization.

Responses revealed varied areas of specialization among the researchers. Out of the interviewed respondents 8 (14%) were from the Centre for Microbiology Research and had specialized in such areas as Bacteriology, Medical Microbiology, Epidemiology and Immunology. The areas of specialization for 9 (16%) of the respondents from Climate and Human Health Research ranged from Epidemiology of Malaria to Highland Malaria, while 8 (15%) respondents from the Centre for Clinical

Research had specialized in Radiology, Genetics, Clinical Trials and Clinical Human Biology among others. Another 6 (11%) of the respondents from the Centre for Traditional Medicine and Drug Research had specialized in such areas as Traditional Medicine, Medicinal Plants, Malaria Drug Research, Chemistry and Safety and Efficacy of Medicinal Plants. This approach was taken in order to establish whether medical researchers' information needs was influenced by their area of specialization.

### 5.3    Information Needs of Researchers

It was observed that the diversified nature of specialization of the researchers as demonstrated in section 5.2.4 above made provision of information to meet their needs an uphill task. It was therefore found necessary to establish their information needs in order to suggest and recommend relevant information that would meet their needs.

When the respondents were asked to state the information they needed to undertake their daily activities, 17 (31%) said they required relevant information in their specialized areas. The range of needed information consisted of latest techniques of carrying out activities like phytochemical anti-malarial procedures, clinical malarial cases and diseases, lab and clinical trial practices and skills, new and diagnosis kits or data, innovation and research findings in Schistosomiasis and other parasitic diseases, topography, climate, population movement, use of medicinal plants and the scientific information on medicinal plants, and product information for supplies.

The study established that 13 (20%) of the respondents needed primary literature (print and electronic) consisting of journals, reports, notes, manuals, data and

documents, reviews, previews among others, while 8 (15%) simply said they needed current information with no specific preference. It was also established that some 6 (11%) of the respondents needed secondary literature consisting of books, patents and other reference works, while another 6 (11%) required information on research findings and Internet information. It was interesting to find that only 5 (9%) of the respondents said they required electronic resources.

It was also found that 10 (18%) of those interviewed stated that they needed information on protocols that are used by other researchers, conventions, standard operating statistical procedures, manuals and patents among others. However, some 3 (5%) researchers said they needed information on partnerships and collaborations with fellow scientists, while 2 (4%) said they needed information on emerging issues. In contrast only 1 (2%) respondent said they needed information about website addresses, databases, e-mails, telephone contacts, training, workshops, seminars and conferences among others.

The study established that out of interviewed only 5 (9%) said they needed information on proposal and report writing, donors and funding agencies for funding proposals, project management, new projects like call for proposals and project progress reports. However, it was observed that 4 (6%) of those interviewed needed information on the acquisition of ICT skills and clinical trials skills, while 3 (5%) needed information on the provision of medical care and follow-ups, ICT availability and equipment. The following are some of the information needs the researchers expressed:

"*Relevant information on area of specialization*"

*"Research methodologies and updates on current research area"*

*"Information on donors and Funding agencies"*

*"Proposal writing and report writing information"*

*"Project management information"*

*"Current innovations and research in Schistosomiasis and other parasitic diseases"*

*"Molecular analysis research notes and molecular microbiology"*

*"Information about vector habitats and vectors of interest"*

*"Provision of medical care"*

*"Information on current research findings"*

*"Product information for supplies"*

## 5.3.1   Influence of Researchers' Duration of Service on Information Needs

The respondents who had worked for a period of up-to 4 years did not form a pattern in their quest for information. In their responses they indicated that they needed:

*"Literature on previously published work in my area of interest, scientific protocols and journals"*

*"General standards for General Clinical Practice (GCLP) and other local applicable standards, knowledge on lab & clinical trial practices"*

*"Information on clinical malaria cases, topography, climate, population movement etc."*

*"Technical reports, Schedules from the various field clinical trials and transport needs"*

*"Assay protocols, record keeping types and the type of sample storage methods"*

*"Molecular analysis research notes and scientific publications on Malaria diseases"*

*"Information on the latest techniques of carrying out the daily activities like phytochemical anti-malarial and toxicity and on use of medicinal plants & the scientific information on medicinal plants"*

> *"Research findings, raw data, emerging issues, technical reports & e-journals"*
>
> *"Staining techniques"*
>
> *"New and effective diagnostic kits provision of diagnostic data"*
>
> *"Project management information and research methodologies and updates on current research area"*

It was established that the respondents who had served the institution for a period of 5-9 years with an equivalent duration of work experience were still young professionals who still needed guidance. Most respondents in this category said they were serving at the level of Assistant Research Officers and they needed:

> *"Current information from the Internet and statistical analysis programs"*
>
> *"Standard operating procedures"*
>
> *"We need partners in various research fields"*
>
> *"Reference books, journal access"*
>
> *"Recruitment, provision of medical care and follow-ups"*

Likewise, the respondents who had worked for 10-14 years said they needed:

> *"Information related to their activities"*
>
> *"Internet, up-to-date information, manuals, standard operations procedures, primary and secondary literature"*
>
> *"Relevant literature material, softwares"*
>
> *"Product information for supplies and relevant articles for proposal/ manuscripts"*

The two respondents who had worked for 15-19 years stated that they needed:

> *"Primary and secondary literature"*
>
> *"Up-to-date information, manuals, standard operations procedures"*
>
> *"Internet, e-mail, phone"*

Respondents with 20-24 years of work experience at KEMRI were more specific in their information needs. In their response, they said they needed:

> *"Accessibility to donors who can fund the approved proposal, references to proposals and writing of reports, etc."*
> *"Internet, library, consult with colleagues"*
> *"Database of staff research activities, references and availability of ICT"*

Respondents who had served the institution for 25 years, who were 4 in number and worked as chief laboratory technologist or research scientist, senior laboratory technologist and principal research officer whose daily activities involved fieldwork, reviews and project management, said they needed:

> *"Journals and textbooks"*
> *"Preview reports, literature in science, publications, consultation with fellow scientists"*
> *"Techniques new and old, current innovations and research in Schistosomiasis and other parasitic diseases"*
> *"Electronic information on new publications on molecular microbiology"*

A respondent serving at the level of Chief Research Officer who had served for 28 years carrying out manuscript reviews and doing proposals development, accounts, data analysis and communication in the area of Climate and Human Health stated that they needed information on:

> *"Data and documents"*

The results point out that the more experienced researchers consulted a lot of primary literature for their daily work, which included reviews or preview reports, journals, reports and field notes, and also carried out a lot of consultations with fellow

scientists in their specialized areas of expertise. It was therefore noted that experience had a considerable influence on the information needs of researchers.

### 5.3.2   Influence of Area of Specialization on Researchers' Information Needs

It was found necessary to identify the respondents' areas of specialization and the various activities they carry out, and establish whether the activities they performed in their various areas of specialization had any influence on their information needs. This was important in determining and recommending what information to avail for research activities.

The respondents were asked to state what information they needed in order to undertake their daily activities. It was observed that majority of the researchers carried out various research activities like conducting health service research and culturing malaria parasite, data collection, analysis in the laboratory, literature search, information retrieval via Internet, consulting e-journals and uploading and downloading files and electronic communications (e-mails). The respondents reported that they carried out scientific writing like writing, proposals/publications, report writing and reviewing for others, grants seeking, soliciting for grants and funding, project budgeting, monitoring utilization of donor funding, maintenance of donors databases, and maintenance of calendar of events for donor funding. They also reported that they dealt with networks and partnerships, protocol development, project identification, planning and implementation, field-based active case surveillance and hospital-based case surveillance including basic biological research of human tissues, field logistics, field supplies & field infrastructure.

Respondents said that they were also involved in laboratory assays and management, policy work, learning practical skills and general administration, medical research, monitoring and evaluation, rearing sand flies (vectors), Phytochemical, anti-malarial and toxicity studies of medicinal plants, Providing medical care to general & research patients, disease management, bio proper diagnosis and treatment, data analysis, cleaning and modelling, research and diagnosing in microbiology, teaching graduate students, conferences and learning, RNA extraction, CDNA synthesis, PCR and Gel electrophoresis, routine laboratory work, X-ray reporting, drug extract bioassays, cell culture and cyto-toxicity analysis, diagnosis of samples from patients (e.g., staining of slides), phlebotomy, and running samples like stool, separation of PBMSCs, separation of plasma, record keeping and laboratory safety procedures, evaluation on gram stained smears, aerobic and amaerobic cultures, trial coordination, and preparation of trial documents.

## 5.4    Information Sources Consulted by Medical Researchers

The researcher sought to find out the various sources of information available for consultation by researchers in this study organization. The respondents were asked to state the sources they consulted whenever they needed information. Figure 5.1 shows multi-responses on the variety of sources consulted by researchers.
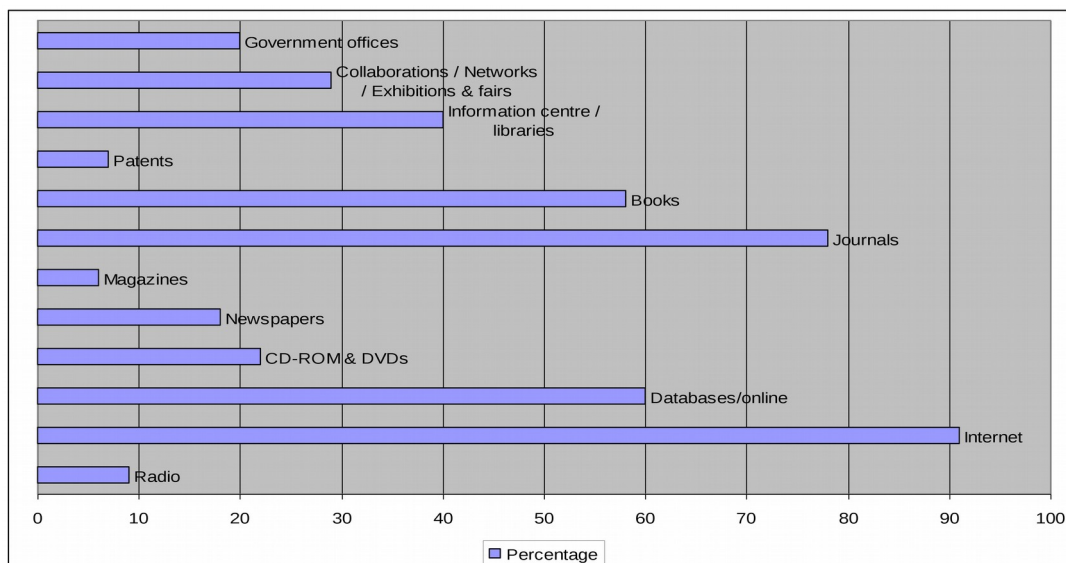
*Figure 5.1: Information Sources Consulted by Researchers (multi responses)*

It was established that Internet emerged as the most popular information source as it was consulted by 50 (91%) of the interviewed respondents. They said they used the Internet for research especially to access electronic medical and health journals in order to know what had been published, and to keep in touch with peers and friends through e-mails and social networks like Facebook and LinkedIn.

Among primary sources of information, journals were the most consulted as reported by 43 (78%) of the respondents who said that they used journals such as African Index Medicus (AIM), the international index to African health literature for research. Out of the interviewed respondents 10 (18%) said they consulted newspapers for news update, while 4 (6%) said they used magazines to explore topical issue. In the same findings, 5 (8%) of the respondents said they utilized the radio for current affairs and news items. Only 4 (6%) respondents said they consulted patents during research.

The study established that respondents used tertiary information sources. The most popularly used tertiary was the book as reported by 32 (58%) of the respondents. The use of journals and books by researchers was evidence that researchers still consult information published in hard copies. Directories were reportedly consulted by 16 (29%) of the respondents, while only three respondents stated that they used conferences and conducted interviews with peers. One of the respondents reported that they consult:

> *"Text books at National Museums of Kenya"*

The study also found that library and information centres were consulted for reference during research as stated by 22 (40%) of the respondents. The responses came from researchers based at the KEMRI headquarters, Welcome Trust and Kisian-Kisumu Centres, which were visited by the researcher during data collection, and where libraries were found to exist.

Databases online were popular and were used by researchers as reported by 33 (60%) of the respondents. The available databases included WHO's HINARI which, enables access to biomedical and health literature with interface to Pubmed for primarily accessing MEDLINE, the online version of MEDLARS. It was established that this was the most commonly used database by medical researchers at KEMRI.

The other commonly used database was Access to Global Online Research in Agriculture (AGORA) available at http://www.Aginternetwork.org). It was established that researchers also had access to EBSCO (a multidisciplinary database

available and accessed at http://web.ebscohost.com); Wiley Interscience, available at http://www.interscience.wiley.com); Mary Ann Liebert, Oxford University Press, PROTA and other databases in Biomedical Sciences, Public Health, ICT, Business Administration, Accounting and Engineering, among others through PERI.

Among the offline databases are those stored on CD ROMs and DVDs and were consulted by 12 (22%) of the respondents. The researchers specialized in such areas as diarrhoeal diseases, sexually transmitted diseases, HIV/AIDS, nutrition, Schistosomiasis, and acute respiratory infection.

The study revealed due to the varied medical specialization, some medical researchers sought information from government offices as stated by 11 (20%) of the respondents. This is because most medical facilities belong to the government and it is the government that holds most of the required information, including current decisions on health issues nationally.

The study established that, during research, a lot of consultation and networking was necessary as reported by 16 (29%) of the respondents. They said that they worked with collaborators and created a lot of networks for exhibitions and fairs in order to get information. A respondent said they sought:

*"Collaboration with institutions abroad"*

It was observed from the above sentiments involving the medical researchers that KEMRI has several types of information sources available to them for carrying out their activities. The sources ranged from directories, books, journals, collaborations, networks, exhibitions, fairs, conferences, databases online and on CDs and DVDs,

electronic resources, library and information centres and government offices. This was in line with KEMRI's mandate of conducting research in human health. The library's role is to strive to provide comprehensive library and information services for research in human health.

### 5.4.1  Level of Usefulness of Available Information Sources

The study sought to find out how useful the various sources of information available at KEMRI library were to researchers. This was important in establishing whether or not the library provided the information needed for the researchers to perform their daily activities. Hence, the respondents were asked to state how useful the various information sources were. Figure 5.2: gives the results of the multiple responses.
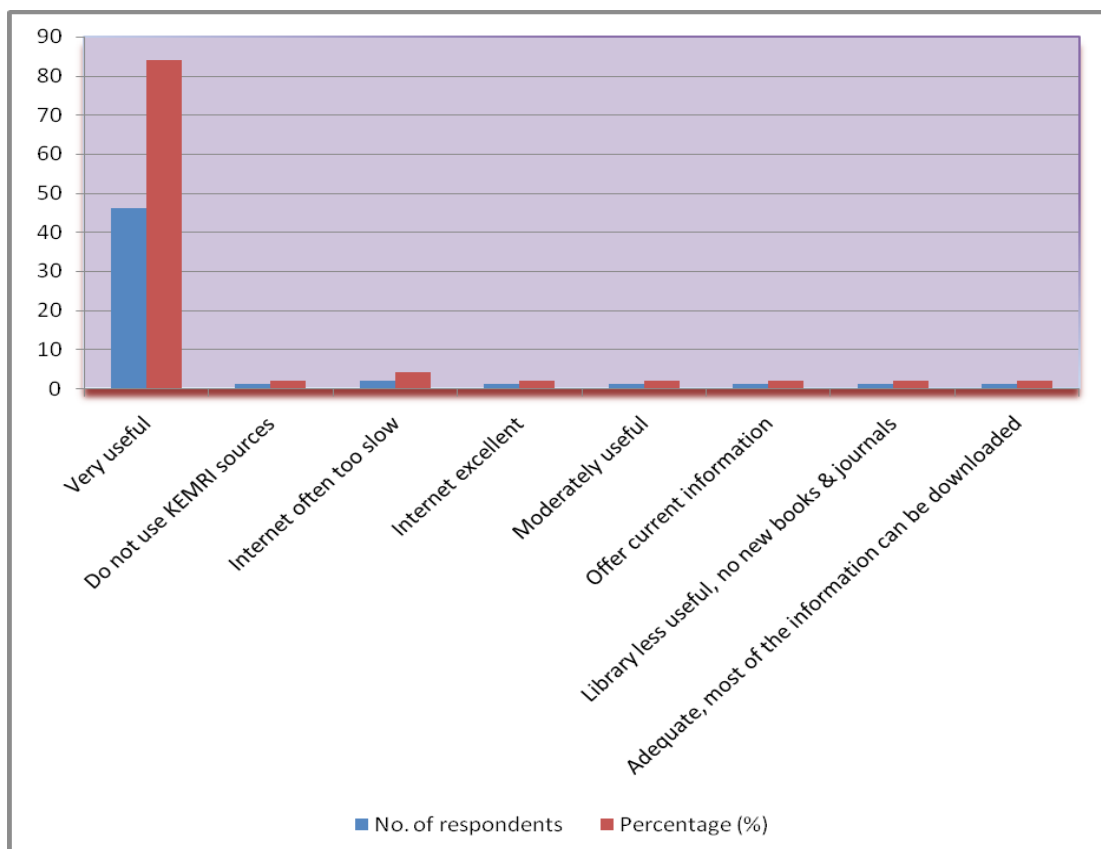


*Figure 5.2: Level of Usefulness of the available Sources of Information (Multiple Responses)*

The study revealed that 46 (84%) of the respondents were of the opinion that the available information sources were very useful. They indicated in their own words that the sources were:

> *"Very useful, library very useful and conducive; databases – Pubmed; HINARI very useful and glad for access to HINARI"*
>  *"I think HINARI is the most helpful for accessing journals though it doesn't have comprehensive access"*
> *"Adequate – most of the information can be downloaded"*
> *"Intranet very useful as well as the email"*
> *"Very useful – ICT in form of internet access – Journals library system good"*
> *"Very useful, relevant and up-to date"*
> *"Offer current information"*

One of the respondents said:

> *"Internet – excellent, library is less useful, no new books / journals"*

There were 2 respondents who, when reacting to the issue of the Internet as a source of information, said:

> *"Internet often too slow*

It was also observed that out of the interviewed respondents one said that their reason for not using KEMRI resources was that they:

> *"Do not work for KEMRI"*

One of the respondents believed that the sources at KEMRI were:

> *"Moderately useful"*

**5.4.2   Extent to which available Information Sources met Information Needs**

The study sought to find out the extent to which the available information sources at KEMRI's chain of libraries met the information needs of researchers. Hence, the respondents were asked to state the extent to which these sources met their information needs. It was assumed that the results would help in establishing the relevance of information sources to research activities. The results of the responses are shown in Figure 5.3.
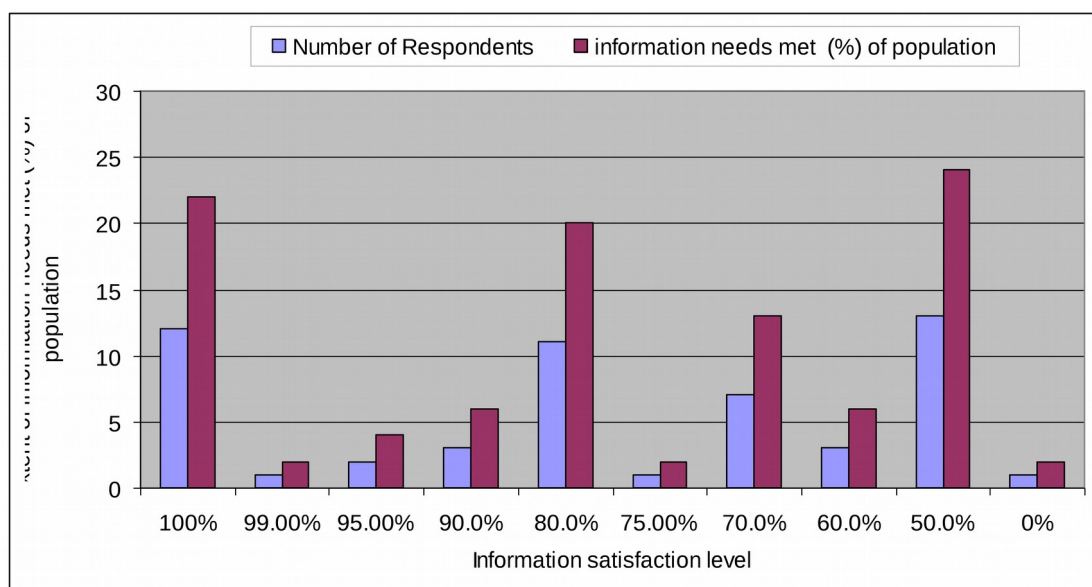


*Figure 5.3: Extent to which Information Sources met Researchers' Information Needs (Multiple Responses)*

Information is key to any successful research. When researchers at KEMRI were asked to state the extent to which the available sources met their information needs, 12 (22%) of the respondents said information sources met 100 per cent of their information needs, while 13 (24%) said the available information sources met 50 per cent of their information needs.

Confirming the influence of area specialization on information needs, 11 (20%) of the respondents said the information sources met 80 per cent of their information needs, while 7 (13%) said the available sources met 70 per cent of their information needs for research. Two sets of 3 (6%) of the respondents each said the sources met 90 per cent and 60 per cent of their information needs respectively. Out of those interviewed 2 (4%) respondents said that the available information sources met 95 per cent of their information needs for their daily research activities. On the positive side it was noted that two sets of one respondent each said the sources met 99 per cent and 75 per cent of their information needs.  In their own statements some respondents said the sources met their information needs:

> *"To my satisfaction"*
> *"100% it meets my needs fully"*
> *"60% HINARI meets my needs for e-journals to a reasonable extent though I would do with a resource having a much wider access"*
> *"Not to my satisfaction <100%"*
> *"70% quite comfy although ones search strategy needs consideration to get what you search for"*

One respondent was categorical that the available information sources did not meet their information needs at all and gave a score of 0 per cent on unmet information needs.

### 5.4.3   Researchers' Preferred Format of Information Materials

The study further sought to establish the format in which researchers preferred to have their information material in order to carry out their daily activities at KEMRI. The respondents were asked to state their preferred format of information material.

It was observed that most of the researchers had access to either laptop or desktop computers for accessing the Internet or online resources from their offices or labs. The same facilities were also available for the researchers' use in the library and in the ICT labs, Department of Information Communication Technology; researchers were allowed to access online resources from these service points. It was also observed that the institution had its own website and Internet facilities in all the stations.

On the question of formats, the respondents gave multiple responses of which some preferred both soft and hard, and were not restricted to one format. The study findings established that 45 (82%) of the respondents preferred information in soft copy, which included the use of electronic resources in PDF formats and online information materials like e-journals, CD-ROMs, DVD, online databases, protocols in database, websites and born digital format like the MS Word documents, MS Excel files, e-mails and mobile phone. One researcher said:

> *"I prefer using online sources, websites, e-journals etc".*

It was noted that researchers made use of HINARI for medical information. It was found that 22 (40%) of the respondents said that they preferred hard copy or print format, which included the use of reference books, scientific data in journals, conference files, newspapers, standards, patents, technical reports, manuals, directories and indexes.

The study also established that 3 (6%) of the respondents preferred one-to-one consultation with fellow researchers. They said they preferred:

> *"Face-to-face consultation followed by online communication"*

*"Conversation"*

This information format was mostly preferred when researchers dealt with joint projects or at the stage of proposal writing, mostly with Principal Investigators (PIs) and other collaborators

It was reported by 20 (36%) of the respondents that they preferred information in both soft and hard copy formats. In their own words they stated that they preferred:

*"Written and soft copy literature materials (i.e. soft & hard copies)"*

*"Soft copy for ease of dissemination also require hard copies, Face-to-face consultation"*

*"Soft and hard copies by surfing the Internet from specific medical websites and journals"*

There was no report on the use of information from mass (electronic) media by KEMRI researchers. Some researchers said they have:

*"Little time for television"*

## 5.5    Access to and Utilization of ICTs

The main purpose of this study was to investigate the use of ICTs in accessing information by medical researchers. The respondents were asked to state how often they used ICTs for this purpose and the results are shown in Table 5.5 shows frequency of ICTs use by researchers to access information for medical research.

**Table 5.5: Frequency of ICTs use to Access Information (n=49)**

| ICTs Usage to Access Information | Number of respondents | Percentage (%) |
|---|---|---|

| Daily | 48 | 98 |
|---|---|---|
| Moderately | 1 | 2 |
| **Total** | **49** | **100** |

The study established that all respondents (i.e., 49 - 100%) used ICTs to access information for carrying out their daily research activities. The interpretation of the above table is that 48 (98%) of the respondents used ICTs daily, while 2 per cent said they moderately (not daily) used ICTs. The two scenarios mean almost all respondents.

### 5.5.1   Range of ICTs used by Researchers

The study sought to establish the range of ICTs that the researchers used at KEMRI. The respondents were asked to state which ICTs they used and which of them best met their information needs.

Out of the interviewed respondents, 29( 59%) stated that they used computers, which included desktops and laptops. One respondent said they use them for:

> *"Data entry, analysis and patient records"*

The responses from those interviewed revealed that Internet was used by 34 (69%) of the respondents to access information. Majority of them reported that the Internet was the best in meeting their information needs at different levels like e-mail, web search and networking. One respondent said that:

> *"Internet is what mostly we use and meet my needs most"*

The use of modems was reported by 8 (16%) of the respondents who said they used them for Internet connection. However, only one respondent stated that they used online databases, especially the e-resources, while another one reported that they used websites.

In the case of storage devices, 9 (18%) of the respondents said they used flash disks, while 6 (12%) said they used CDs/DVDs for information storage and retrieval of their research work.

On the use of communication tools, 16 (33%) of the respondents said they used mobile phones, while 8 (16%) reportedly used fixed telephone lines. As for the case of real time communication, one of the interviewed respondent said they used fax machines to communicate or share research findings with their colleagues. The use of radio was reportedly used by 4 (8%) of the respondents, while 3 (6%) said they used television to follow up on scientific documentaries and not just any television program, as earlier reported. It was observed that one respondent said they used scanners and another one said they used photocopying machine for reproduction, sharing and exchange of information sources.

### 5.5.2   Usefulness of the various ICTs used by Researchers

The study sought to find out the extent to which the various ICTs were useful to researchers. This was important in making recommendation for improved utilization of ICTs in accessing information.

The respondents were first asked what they used ICTs for. It was established from the multiple responses that 43 (89%) of the respondents used ICTs for research, while 15 (30%) used ICTs for entertainment. The respondents were then asked to state how useful the various ICTs they used were. Their responses were measured in terms of important, very useful, moderately useful, useful, less useful and not useful.

The computer was considered important. Out of the interviewed respondents 47 (96%) said it was very useful, while 2 (4%) simply said it was important. Only one respondent stated that it was less useful and 5 (10%) declined to answer the question. The computer was reportedly used in research related activities for the different specialization of researchers like writing proposals, project management and review, writing reports, monitoring utilization of donor funding, maintaining database of donors, maintaining calendar of events for donor funding, research and diagnosis in microbiology, data analysis, conferences, writing and reviewing manuscripts and protocols, X-ray reporting, routine laboratory work, diagnosis of samples from patients (e.g., staining of slides, phlebotomy, running samples like stool, etc), drug extract bioassays, cell culture and cyto-toxicity analysis, culturing malaria parasite, RNA extraction, CDNA synthesis, and PCR and Gel electrophoresis.

Internet use was positively reported by those interviewed who either used it at their place of work, in their homes or at the cyber café for distance education like online courses, exchange programmes and for general knowledge. It was also reportedly used for information retrieval via Internet for accessing e-journals, uploading and downloading files including literature, and electronic communications (e-mails) among others. Out of the interviewed respondents, 48 (98%) said that Internet was

very useful, while 2 (4%) simply said it was important. There were five respondents who chose not to respond.

Mobile phones were reportedly used by the interviewed respondents for patient monitoring and monetary transactions with their research assistants (e.g., payment of field allowance or per diem through Mpesa or AirtelMoney). Out of the respondents interviewed, 35 (71%) said mobile phones were very useful, while 8 (16%) said it was important. However, 4 (8%) said it was less useful and another 8 (16%) chose not to respond. Some respondents said they used mobile phone for:

> *"Getting trade information / partner interaction like pharmaceuticals*
> *from Safaricom"*

It was established that flash disks were an important gadget in the storage of research data. The study findings show that 41 (84%) of the respondents said it was very useful, while 3 (6%) said it was important. Only 2 (4%) said it was less useful. However, one respondent attested that it was not useful, while 8 (16%) did not respond.

It was also found that CD-ROMs were fairly used for data and information storage and field data storage as articulated by 25 (51%) of the respondents who said that they were very useful. At the same time two sets of 9 (18%) each said they were important and less useful respectively. One respondent stated that CD-ROMs were not useful, while 10 (20%) chose not to respond to the question.

In the case of DVDs, they were found to be another important tool for data and information storage as affirmed by 21 (43%) of the respondents who said it was very useful, with 9 (18%) saying it was important and 11 (22%) saying they were less useful. However, 14 (29%) of them chose not to respond.

The study established that videos still played a role in the research world for recording events as stated by 15 (31%) of the respondents who said they were very useful, while 11 (22%) said they were important. The response may have been due to the different areas of specialization because it was established that 16 (33%) of the respondents felt that videos were less useful, while 13 (26%) chose not to respond.

It was observed that the use of modems was common at KEMRI as expressed by 20 (41%) of the respondents who said that they were very useful, with another 11 (22%) simply saying they were important, except for some two respondents who said they were less useful. Only one respondent said that they have never used a modem, while those who chose not to respond were 21 (42%).

The findings indicated that fixed telephone lines were still in use as stated by 21 (42%) of the respondents who said that they were very useful communication tools. Another 13 (26%) said this type of ICT was important in research, while only 5 (10%) said it was less useful. However, one of the respondents felt that the fixed telephone line was not useful, while another one said it was extinct. There was a fall back of 14 (29%) in terms of respondents who chose not to respond.

With regard to radio, the study revealed that it was still important in getting news alerts and communicating with rural communities as stated by 18 (37%) of the respondents who said it was very useful, while 10 (20%) reported that it was important. This gives a positive use of 28 (57%). However, 15 (31%) of those interviewed said it was less useful in research, and 12 (24%) chose not to respond.

The study also revealed that television (TV) was equally important and useful in research as reported by 26 (53%) of the respondents who said it was very useful to them for watching medical documentaries, while another 5 (10%) simply said it was important. However, 14 (29%) of the respondents said it was less useful. Only one respondent said that TV was not useful, while 9 (16%) did not respond to the question.

### 5.5.3   Point of Access to ICT Tools and Services

The study sought to find out the various points from which respondents accessed ICTs in the course of carrying out their daily duties. This was necessary in ascertaining whether the institution availed any ICTs to researchers. Hence, the respondents were asked to state where they accessed ICTs from. There were multiple responses the results of which are shown in the following Table 5.6.

**Table 5.6: ICTs access Points for Researchers (n=49)**

| Access Point | Number of Respondents | Percentage (%) |
|---|---|---|
| Library/Information Resource Centre | 7 | 14 |
| Office | 49 | 100 |
| Cyber | 6 | 12 |
| Home | 20 | 41 |
| No Response | 5 | 10 |

| | | |
|---|---|---|
| Lab | 5 | 10 |
| Any Where for Mobile & Laptop | 1 | 2 |
| Field via Satellite Sites | 1 | 2 |

*Note: These are multiple responses*

The study established that, at KEMRI, almost all researchers had access to ICTs from their offices. As shown in Table 5.4, 49 (100%) of the respondents used ICTs to access information from their respective offices, while 20 (41%) said they accessed them from their homes. Only 7 (14%) of the respondents said they accessed ICTs from the library or information resource centre, while 6 (12%) said they accessed ICTs from Cyber Cafés. It was established that only one respondent stated that they accessed information through their mobile phones or laptop; they accessed information from anywhere due to the portability of the tools. It was interesting to note that one respondent said that, while in the field, they accessed ICTs via satellite sites. However, 6 (10%) of the respondents chose not to respond to the question.

### 5.5.4   Services Available

The study relied on the responses of the key informants in order to establish the range of services available to respondents. The information professionals were asked to state what role their department played in helping researchers carry out their research activities. In their responses they said they supported researchers through:

> *"Provision of relevant information as per their area of specialization"*
> *"Availability of study space"*
> *"Carrying out literature searches for them"*
> *"Provision of access to information"*
> *"Through identification of research related materials to equip the library"*

*"Providing information through interlibrary loans"*

Some of the IT personnel interviewed said their role in meeting researchers' information needs was more technological in nature as follows:

> *"Facilitating research through ICT like ensure researchers have equipment and ensure internet connectivity"*
> *"Provision of Internet, e-mail, installing of repositories, information storage and printing services"*
> *"Data management and database"*
> *"Provision of technical support to computer users"*
> *"Smooth running of all ICT activities which include computer maintenance and upgrading"*
> *"By liaising with them to ensure the provision of exactly what they want"*
> *"Provision of ICT infrastructure, services, policy development"*
> *"Maintaining ICT network infrastructure to ensure its availability"*
> *"Avail and secure LAN services track machines on network"*
> *"Standards and notifying researchers on any new development"*

### 5.5.5   Researchers' Perception of Use of ICTs

The study sought to find out the researchers' perception of the use of ICTs during their search for information.  They were asked to give their perception of value and use of ICTs to access information, and say how useful ICTs were in terms of their research information needs, and to state how helpful the various ICTs were in terms of their information needs. The results of the response are shown on Figure 5.4, especially how researchers regard ICTs in the course of carrying out their research activities.
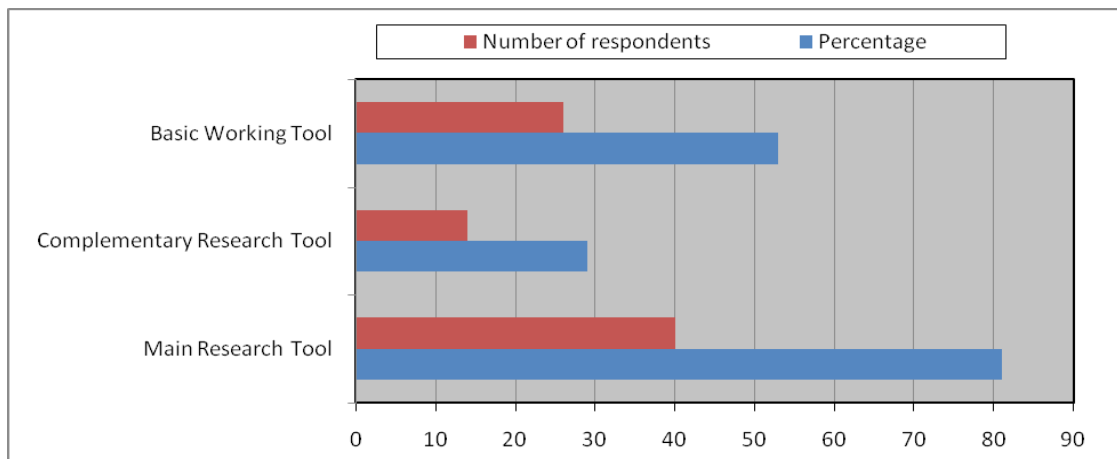
*Figure 5.4: Researchers perception on use of ICTs  (multiple responses)*

Majority of those interviewed, consisting of 40 (81%), said that they regarded ICTs as their main research tools for research. Another 26 (53%) stated that ICTs were their basic working tool, while 14 (29%) felt that ICTs were complementary research tools. Therefore, the study established that respondents regarded the use of ICTs highly in research activities.

The findings show that 37 (76%) of the respondents said ICTs were very effective in accessing information. Most of those interviewed said ICTs were reliable and very effective channel for accessing and obtaining information which was not locally available, especially journals articles; such information could be sought from experts elsewhere in the world. ICTs made the search quicker and faster since the information took various formats like DVD/CDs, or videos, etc. In addition the respondents said ICTs were excellent in accessing current information in form of online health databases, which were accessed in real time; they gave an example of the United States' National Library of Medicine. However, some 3 respondents said that ICTs:

> *"Not very effective"*

> *"In current location (KEMRI headquarter), very effective. Outside stations like here, very ineffective especially computer, Internet etc."*

### 5.5.6   Use of ICTs in Information Searching and Retrieval

The study further sought to establish whether respondents conducted their own literature searches. They were asked to state who conducted information searches for them. It was established that respondents used ICTs in the course of carrying out their research activities. The study revealed that 49 (100%) of the respondents said that they conducted their own (self) information searches. Only one respondent stated that their information searches were done for them by their peers and fellow colleagues when they were too busy, while 16 (32%) said their information searches were done for them by either library staff or ICT personnel when they failed in searching by themselves. Some respondents said the searches were done for them on:

> *"Very few occasions, engaged librarian and got good results"*
>  *"Self unless I can't get what I need myself then I ask library or my peers in the same field or profession"*

The study also established that 8 (16%) of those interviewed had their information searches done for them when they were too busy, whereas searches were done for 21 (47%) when they failed in information searches by themselves, and also when the information was not accessible due to restrictions like subscription account number. It was established that only one respondent lacked access to equipment, while some 9 (18%) felt this question was not applicable to them.

**5.6    Institutional ICT Policy**

The study sought to find out whether the institution had any ICT policy governing the use of ICTs and how the policy supported information access, sharing and exchange. Respondents were asked to state what institutional ICT policies or regulations existed and how they enhanced information access and use of ICTs at KEMRI.

It was established that 20 (41%) of the respondents knew of the existence of some institutional policy where respondents were expected to employ committal signature on fair use of ICT or use of passwords and that only staff had access to ICTs. They added that, at all times, they are expected to protect their Internet accounts from outsiders for security reasons and to adhere to ethical practices and norms for safety, control and security from incidents like virus. Another 18 (37%) said they knew there was a policy stating that ICTs were for official use and that only authorized sites were to be visited, and that the researchers were not allowed to visit  social sites like Facebook during working hours. The respondents, therefore, knew of the institutional policy on blocking of some sites.

Concerning the issue of bringing and personal ICT equipment to the workplace, 17 (35%) of the respondents indicated that they knew of the existence of a clearance procedure. One respondent said:

> *"One needed clearance by the institute to bring in and use their personal computers"*

There were only 6 (12%) of the respondents who stated that they knew of a draft policy on ICT; that it was in preparation covering Internet access, e-mail, program

installation and network security, including a policy on use of diskettes. Another 4 (8%) said they knew there were policies on accessing the internet to retrieve information to satisfy user/self-information needs.

The study found that 7 (14%) of the respondents said that there was no policy, since they were not aware or did not know of its existence or any institutional ICT policy. This is contrary to those respondents who indicated that they knew of the existence of clearance procedure to use equipment.

Some 3 (5%) respondents pointed criticised the institutional ICT policy with comments ranging from its establishment and implementation to its enforcement, saying that it should be subjected to constant revision and that it should have been strengthened through consultation with researchers with regard to the use of ICTs. Two of the respondents reported that they had challenges with the number of restrictions levied on them such as, "No Facebooking, and No visiting restricted sites"; only research related sites were allowed.

In responding to the question on existence of ICT policies at KEMRI, the key informants said they knew of:

> *"No sharing of passwords with another person"*
> *"No porno sites, no e-chats & games, run virus scan before use"*
> *"Some sites are blocked, use of passwords"*
> *"ICT Policy Document (2009), ICT Strategic Master Plan"*
> *"No accessing pornographic sites, downloading music, no use of un-scanned flashdisks, no listening to live radio and restriction on access to information and equipment"*

The key informants were asked to state how KEMRI was planning to address the issue of ICT policy or regulations at institutional level with regard to access to information. It was established that an ICT policy existed although it was not known to many except a few IT specialists. It was felt by 8 (16%) of the key informants said that the institution ought to establish, implement and enforce ICT policy in consultation with researchers and subject it to constant review and strengthen ICT policy on use of ICTs.

The administrators were asked to state how KEMRI was planning to address the issue of ICT policy or regulations at institutional level in regard to access to information. They indicated that certain restrictions would be maintained including "No Facebooking", only research related sites were to be visited, and no visiting restricted areas. Some of them said they would:

> *"Ensure there is no misuse of bandwidth by idle staff"*
> *"The institution is in the process of developing ICT policy"*

### 5.6.1 Institutional ICT Support

In as much as the respondents were not asked about the existence of institutional ICT support at the institution, they raised some very pertinent negative issues while responding to the question on challenges and ICT support they received from the institution as enumerated below:

> *"Lack of large storage capacity; some useful sites are blocked"*
> *"The personnel are very few and can therefore not handle all researchers; researchers do not embrace the latest technology in ICT"*
> *"Limited knowledge and skills in utilizing available ICT resources; no formalized training support"*

On their part the IT personnel from the institution observed, during the interviews, that they provided ICT support to researchers like in cases of maintenance and servicing computers. They also provided technical support to computer users as reported and observed by 5 of the IT personnel. The respondents also said that they provided ICT infrastructure, maintenance and services which included computer upgrading and data entry for some researchers. In verbatim reporting the following is what they said:

> *"Carry out maintenance and servicing computers"*
> *"Provision of supportive ICT infrastructure, services and policy development"*
> *"Avail and secure LAN/WAN"*
> *"Facilitating research through ICT, by the provision of email, internet support etc."*

It was found necessary to ask the key informants, who comprised the Director and their Deputies, on the tools the institution gave researchers to ensure that they got the needed information on time. It was established that the institution provided researchers with desktop and laptop computers with accessories like flash disks, Internet connection and printers-cum-fax. They also provided mobile phones for information access and fixed telephone lines in addition to an equipped library.

It was also stated that the institution availed a budget for computers and their accessories; the budget ranged from Kshs. 6, 000,000 (six million) to Kshs. 11,000,000 (eleven million). They mentioned that there was need to improve the budget through the government and donor support. The Director reiterated that they would prepare a convincing position paper for submission to the concerned

government ministry. According to the administrators interviewed, the tools were very useful:

> *"For information access"*
> *"For obtaining information, service and communication"*
> *"They improve access to and availability of information"*

As concerns plans that the institution had on the use of ICTs by researchers, the administrators said:

> *"That obvious it is effective and efficient. Should be a basic working tool for research"*
> *"It is very effective, particularly the use of Internet"*
> *"Buy more powerful computers"*

The above sentiments gave an indication of more ICT support to be given to the researchers in future by the management.

## 5.7 Challenges Encountered by Researchers Using ICTs to Access Information

The study sought to establish the challenges that researchers experienced in accessing and using information. The respondents were asked to state the challenges they experienced in accessing information. This was important in knowing about their experience and suggesting ways for improving access to and use of ICTs at the institution. Thereafter, recommendations would be made to the management and also an assessment would be done on whether this was a contributing factor to the diffusion of ICTs in accessing information for research.

Every success comes with its own challenges. This study established that 39 (78%) of the respondents encountered infrastructural problems, which included

electricity/power surge, bandwidth and cable. Infrastructure was to a large extent a major obstacle to the use of ICTs for information access. Another 32 (65%) said they experienced slow Internet connectivity or slow Internet speeds, slow log-in access or low bandwidth or sometimes huge traffic. There were 10 (20%) of the respondents who reported that their biggest challenge was slow Internet speed, hampering ease of communication and Internet reliability vis-à-vis downtime, since services could not be resumed in good time after interruption following frequent reports of server down and unpredictable Internet connectivity, poor infrastructure, ICT capacity and low bandwidth. There were also three sets of 3 (6%) respondents each who said their access problems were to do with power surge or power outage, which resulted in loss of data and dependency on electricity to access and use information for carrying out their research activities. Only one respondent reported lack of large storage capacity for data.

The list of challenges also extended to those related to software compatibility or consistency with existing values. Of the respondents, 23 (47%) said they encountered software compatibility problems, for example, WordPerfect to MS Word and Adobe Acrobat, especially when downloading PDF files, which was attributed to inconsistency with existing values. Another 3 (6%) respondents stated that their challenge was to do with software updating and data compatibility when using software like the Adobe Acrobat or the Microsoft Office series.

As for hardware related problems 16 (33%) of the respondents cited the equipment being too old, while 3 (6%) felt that their challenges were to do with maintenance and frequent breakdowns of computer/server/switch in respect of slow response to

emergencies by the IT Department. As for the number of IT staff to handle maintenance issues, 3 (4%) of the respondents said that the institution had inadequate personnel to handle ICT issues, which included old equipment and software. This sentiment was further echoed by 8 (16%) of the respondents who stated that their challenges were facility-based and ranged from access to facilities (e.g., inadequate or poorly planned or lack of facilities) and unavailability of resources, which led to unmet deadlines.

When the respondents were asked to state whether they got access directly and easily to a title in the collection at the time they wanted the information in order to ascertain their competence and extent of using ICTs in searching for information, most of them 25 (51%) reported that they got access directly and easily through the Internet search engines. Of the respondents, 3 (5%) said that most of the time they got information whenever they wanted although not always. However, 23 (47%) said they did not get access directly and easily; it was problematic and they rarely got the information. They only succeeded a few times due to subscription issues (resulting in site blockage), power surge or outage.

On the issue of Internet reliability 11 (22%) of the key informants in the category of IT and information professionals reported that the other challenges facing researchers were to do with power outages and dependency on electricity and Internet reliability in relation to downtime since service resumption after interruption was unpredictable leading to loss of data.

The findings also show that costs of various ICTs and products caused challenges as alleged by 39 (80%) of the respondents who reported that their major obstacles to access and use of ICTs for research information were caused by affordability, subscription requirements or high cost of accessing electronic information resources like e-books, e-journals and equipment. In support of that fact 5 (11%) of the respondent said their challenges in terms of affordability were in the area of cost of ICTs to access information, while 13 (27%) of the respondents complained of pay per use on electronic resources, which they saw as expensive and required constant subscription to e-journals coupled with constant denial of full access to use e-books. They also complained of being re-directed from one site to another through gateways like Science Direct. The sites were too expensive because the payment was pegged on the USD and that it required the payment of annual subscription before one could access the restricted information. Going back to the policy framework 3 (6%) of the respondents said their access problems were to do with restriction on some social sites during working hours, and restriction by use of passwords.

The key informants, who were also the decision-makers, were asked to state some of the challenges ICTs posed to researchers at KEMRI. In their responses during the interviews, one of the information professional stated that the ICT challenge was that of:

*"Bandwidth and lack of adequate technical equipment"*

*"Low Internet connection"*

The policy makers in charge of administration and finance were asked how often they visited their institutional library and how they found the available information sources. This question was asked in order to establish whether or not they were aware of some of the challenges researchers faced in the library. In their response, one said they visited at least once a week, while the other said twice a year.

On the issue of usefulness of the information sources they were non-committal to the existence of any access challenges. However, one respondent said although there was:

*"Ease of information retrieval, it was inadequate, with old equipment"*

It was established that viruses can also pose a challenge as reported by 3 (5%) of the respondents who complained of scattered cases of computer viruses in circulation and which posed danger to data, and hence data insecurity. Two respondents said that the effect of this challenge could be the loss of valuable research data.

The study established that lack of ICT skills or lack of computer training was a challenge to 37 (76%) of the respondents. Another 22 (45%) reported that the challenge facing them was lack of proper ICT skills. They called for continuous training in ICT and the understanding of its role in research.

Similarly, a sum of 25 (50%) key informants in the category of IT and information professionals felt that some of the challenges ICTs posed to researchers were lack of proper ICT skills or training and the understanding of ICT role in research, calling for

continuous training and ICT skills upgrading given the frequent pace of technological advancement. One respondent said that:

> *"ICTs change fast thus makes researchers grapple with change"*
> *"Lack of education on use of ICTs by some researchers"*

However, 11 IT and information professionals thought researchers had inadequate, or experienced lack of, services like IP provider, since the server was either down or they had unpredictable Internet connectivity due to poor infrastructure in terms of ICT capacity or low bandwidth, while 22 (45%) reported that researchers' main challenge posed by ICTs was that of coping with technological advancement, since ICT was such a dynamic area.

The findings indicated that 17 (35%) of the respondents said they encountered access problems caused by lack of keeping up-to-date with technological changes. Another 2 respondents said they encountered malfunctioning sites. It was surprising to find that 3 respondents had not encountered any access problems.

Information overload was also cited as a challenge and stated by 2 (4%) of the respondents. They said that the use of ICTs exposed them to too much information to make a selection from, with some of it being junk. They said this was a frustrating experience. The two Deputy Directors were asked to state some of the challenges ICTs posed to researchers at KEMRI. In their response during the interviews they confirmed that the challenges included:

> *"Frequent breakdowns, too many viruses in circulation"*
> *"Inadequate facilities / services like IP provider and low speed of Internet"*

On the issue of institutional ICT budget, the Acting Deputy Director, Administration and Finance, together with the ICT manager gave light on the budget and said in the year 2009/2010 KEMRI had a budget of Kshs. 11 million for ICTs (this interview was conducted on 3rd November 2009). However, the ICT manager indicated that Kshs 300 million would be sufficient for the support of ICT usage since the current allocation was not adequate.

The two Deputy Directors, while responding to what they could do in their position to increase the budget, they each said:

> *"Prepare a convincing position paper for submission to the ministry"*
> *"Need to improve on the budget depending on exchequer allocation and donor support"*

The study also established that to some extent, institutional ICT policy was a hindrance to access and use of ICTs at KEMRI whereby 19 (35%) of the respondents indicated that, where one exists, it was not made conspicuous; hence, many researchers were not aware of its existence. Those who were aware of its existence thought it was poor and that researchers and ICT personnel should be involved in the drafting.

## 5.8    Suggested Ways of Improving Access to and Use of Information

The study sought to engage participants in establishing solutions to the challenges they experienced and how the challenges could be addressed for the smooth running of research and the institution they work for. The respondents were asked to state how the challenges/problems could be solved.

The respondents gave several responses, and the following were found to be relevant to this study. They specifically suggested that management should:

*"Introduce alternative access i.e. mobile phones, etc; High bandwidth"*

*"Connectivity facilitation; purchase of airtime for modems"*

*"Availing Internet at all times"*

*"Avail resources required when required"*

*"Subscription to e-Journals including free ones for easier access to quality information"*

*"Buy more computers; Increase the Internet accessibility"*

*"Expansion of bandwidth"*

*"By employing more ICT personnel who are well remunerated; setting aside more funds for upgrading the technology and infrastructure"*

*"By provision of capacity building or continuous training on the skills required"*

*"Continuous training, skilled personnel for backup support, KEMRI to tap on Fibre optics, backup generator to support power surge, continuous training"*

*"Provision of anti-virus softwares and other application softwares to the staff"*

*"Developing an effective ICT policy in liaison with the ICT users"*

*"Enhancing training sessions to capture needs of the end users"*

*"Establish institutional repositories on the Web"*

*"Fulfill the hindrances especially improvement on facilities and training"*

*"ICT Dept. should involve all personnel to estimate their needs particularly in software and technical"*

*"Upgrading to Fibre optic for reliable connectivity"*

*"Institution policy on ICT should take care of the scientists"*

*"More financial allocation to ICT in institutes"*

*"Policy on disposal of old equipment"*

*"There is a policy like most ICT policies covering responsibility; conformity; privacy"*

> *"The need for the government to sensitize industry and training activities on the benefits of the use of ICTs"*
> *"Support infrastructure development"*

The administrators echoed the same suggestion; they all said that the institution should:

> *"Improve budget allocation"*
> *"Training (user and library staff)"*
> *"Subscription to e-journals"*
> *"Policy on disposal of old equipment to be 4-5 years"*
> *"E-waste disposal policy should be addressed very seriously"*
> *"Expansion of bandwidth\'*

On their part, the service providers to researchers, who consisted of information and IT professionals, came up with some solutions to the challenges in as far as access to information was concerned. Most of them expressed dissatisfaction with the budget allocation for provision, availability and access to information by researchers. Some of them suggested the following and said they would:

> *"Increase ICT capacity by making machine or equipment available"*
> *"Implement ICT policy effectively"*
> *"Invest a lot in ICT by increasing the budget"*

On suggestion on how to improve the services, five issues came out clearly from the information professionals. They stated that they would:

> *"Train users and library staff"*
> *"Subscribe to e-\journals"*
> *"Expand bandwidth"*

*"Improve budget allocation"*

*"Implement policy on disposal of old equipment and e-waste management of old equipment"*

As concerns how KEMRI plans to address ICT policies / regulations at institutional levels, majority of the key informants consisting of the directors, and IT and Information professionals said that there was need to establish, implement and enforce them subject to constant revision and strengthen of ICT policy in consultation with researchers on use of ICTs.

## 5.9    Summary

The findings have demonstrated that researchers look at various specific research areas and need a wide range of information. If the specific research areas are not well studied and understood, the researchers may not be well served in their respective service centres. Researchers' information needs include, among others, current and relevant information related to their research area, research findings and emerging issues, protocols used by other researchers, conventions, standards, and statistical operating procedures. They need information on data collection and analysis, lab management, diagnosis, culture, clinical trials skills, disease management, patent drafting and intellectual property issues, project management, monitoring and evaluation, consultancies, reviews, literature or information searches, accessibility to donors, and proposal writing. In addition, they needed information on networking and partnerships, administration, accounts and budgeting.

There were various sources of information used; however, the Internet emerged as the most popularly consulted source, especially for communicating with peers, including

fellow colleagues, through e-mails. It was also popular in consulting in the various areas of specialization as well as accessing medical and health information. Primary literature like journals (print and electronic), reports, manuscripts and field notes were among the information materials needed. In addition, the use of tertiary literature, which includes books, directories and online databases, was evident.

The findings confirmed that researchers utilize a wide range of ICTs for research on daily basis, with the Internet being the most heavily consulted or used. The ICTs used include computers, both desktop and laptop, flash disks, CDs/DVDs, mobile phones, Internet, online databases and websites. The ICTs are used mainly to carry out research work, without ruling out their use for entertainment while at work. Researchers access the ICTs mostly from their offices, homes, labs and their institution's library/information centre as well as from cyber cafés. They regard ICTs as their main working tool for research, as well as basic and or complementary working tool.

The results confirmed that majority of researchers conduct their own literature searches, with only a smaller portion of having their literature searches conducted by library staff because they were unable to search on their own. However, there was another lot that felt that it was the responsibility of the library staff to conduct the searches for them.

Access to the needed information was not always an easy task for researchers since some did not get access with ease; the results revealed that some researchers needed assistance to access information using ICTs. The main challenges they encountered

were to do with Internet connectivity, slow Internet speed or low bandwidth and software compatibility like the Adobe Acrobat, especially when downloading files and also consistency with values as experienced when using Microsoft Office 2003 and 2007.

ICT skills and policy emerged as a requisite for researchers to use the Internet. Another concern was the availability of ICT and equipment followed by training, workshops, seminars and conferences among others.

**CHAPTER SIX**

**DISCUSSION OF FINDINGS FROM THE TWO CASE STUDY**

**ORGANIZATIONS**

**6.1     Introduction**

This chapter collates the common findings from Chapters Four and Five, relating them to the aim of the study and research questions, which the study sought to answer, as well as other works of research discussed in Chapter Two. It draws from lessons learned in Case Study 1 and Case Study 2, and explores basic issues underlying the perception on use of ICTs to access information by researchers in the two research institutions (KIRDI and KEMRI). It also explores on how these perceptions help to answer the research questions.

The chapter discusses the findings on the common results on the information needs, sources and the extent to which these sources meet researchers' information needs. It contains discussions on common findings on the range of ICTs available in Case Studies 1 and 2 and the extent to which they are utilized by researchers to access information, including point of access to ICT tools, services and perception of researchers on the use of ICTs in addition to using them in information searching and retrieval. Also discussed are findings on identified institutional ICT policies and support, as well as challenges encountered by researchers in the use of ICTs to access information and the suggestions on ways of improving access to and use of information.

**6.2     Information Needs of Researchers**

The various research activities performed by researchers are a definite signal of their varying information needs to accomplish those activities as established by this study. This was confirmed by Leckie et al. (1996) who noted that the numerous work roles assumed by engineers could lead to different information needs, and that they are likely to look for information to solve technical problems rather than create new knowledge. They also observed that they need more internally generated information sources such as reports, drafts and benchmark tests results than they generate, while physicians and surgeons have interest in specific patient care information and consult a lot with colleagues due to insufficient information sources.

**6.2.1   Information Needs**

The first research question wanted to establish the information needs of researchers. Results on the information needs were presented in Chapters Four and Five as Case Study 1 and 2 respectively. They are based on interviews and observation data from Sections 4.2.4 and 5.2.4.

The findings demonstrated that researchers from the two organizations are involved in various specific research areas with medical or industrial environment and hence need a wide range of specialized information to undertake their daily research activities. Their information needs were mainly relevant information on their areas of specialization including on research findings and on donor and funding agencies. They may not be well served in their respective service centres if their specialized research areas are not well understood. Therefore, as the results indicate, the various activities generate varied information needs, which are influenced or determined by

the researchers' specialized areas and daily activities. This study confirms the findings of a study by Haine et al. (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".*

The results also 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".* In the case of this study, this can be alluded to the diversity of areas of specialization in the respective service centres of the two institutions.

The length of service did not have much influence on the information needs of researchers, since each one of them had a specific area of specialization. Their main concern had to do with current and relevant information, including new developments in their respective areas of specialization. The information needs of researchers who had served the two institutions for over 20 years were varied and more specific, and had a lot to do with donor funding.

Results from the two institutions also indicate that there is a high staff turnover since researchers do not work in one institution for long. Only 8 researchers from both institutions had worked for a period of 25-34 years, while 75 of them had worked for a period of 0-4 years. Staff turnover may be attributed to conditions such as when staff secures a greener pasture, remuneration and good working environment.

The responses under 4.3.1 and 5.3.1 indicate that the more experienced researchers consulted a lot of primary literature as part of their research activities. The literature included reviews or preview reports, journals, reports and field notes. They also carried out a lot of consultations with fellow scientists in their specialized area of expertise as confirmed by the responses. This finding concurs with findings of a study on information needs and seeking behaviour of medical research scientists, where it was established that scientists "worked in teams while conducting research especially in collaboration with donors" (Kimbwarata, 2002).

These findings are further consistent with what Leckie et al. (1996) said when they looked at characteristics of information needs. They noted that information need is not constant and can be influenced by a number of intervening factors which include age, nature of profession, specialization, career stage and context. The study findings also revealed that information needs are influenced by the working environment and type of task that an individual performs.

In a similar study carried out by Otike (1999), he noted that experience had a considerable influence on the information needs of lawyers. In both institutions that were studies, the respondents who had worked for a period of up-to 4 years did not form a pattern in their quest for information.

### 6.2.2 Sources of Information Consulted

The findings indicate that majority of the researchers from the two institutions use the Internet for research and to access information; they used the Internet to access electronic journals, to know what has been published, and to keep in touch with peers

and friends through e-mails and social networks like Facebook and LinkedIn. Thus, the Internet is 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 et al. (2005) who observed that the Internet constitutes a new and attractive channel for accessing the latest in scientific information. They also observed that the Internet offers researchers and students immediate access to a wide variety of research publications.

The major sources of information that were consulted by researchers from the two institutions included primary, secondary and tertiary sources. The primary sources of information consisted of journals, reports, notes, information on protocols, conventions, and standard operating statistical procedures. The respondents did not point which secondary literature they consulted. On the use of tertiary sources of information (i.e., information on a specific subject condensed from primary and secondary sources), the findings indicate that researchers needed and used reference materials like textbooks, almanacs, directories, encyclopaedias, patents, reviews, manual, reports and the Internet. Among the primary sources, the journals were the most popular. Results clearly demonstrated that libraries and information centres, including government offices, were used by the researchers from the two institutions for reference during their research activity.

The findings are consistent with a study by Majid et al. (2000) on information needs and seeking behaviour of agricultural scientists in which they established that a library is considered as the nucleus for any research activity and an essential ingredient for a

viable research system, providing an account of previous intellectual undertaking. The findings are also consistent with those of Zawawi and Majid (2001) in their study on information needs and seeking behaviour of the IMR Biomedical Scientists in Malaysia in which they established that biomedical scientists use a variety of information sources to satisfy their information needs and that they consider journal articles as the most preferred information source.

In a study on information use patterns by scientists, 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. Another study on the availability and utilization of information and communication technology for accessing health information by 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. A similar research carried out in Iran on information needs of Nanotechnology Researchers by Hasoomi et al. (2011) revealed that 69.7 per cent of researchers mainly use articles for conducting research projects and updating their field-related information of which 58.8 per cent are e-journals. They asserted that differences in information needs are caused by difference in job and field of activity.

It was prudent to establish the extent to which the available sources met researchers' information needs. The findings indicate that the available sources of information were useful and met between 50 – 95 per cent of most of the researchers' information needs. Among the sources cited included availability of the library, Internet, external

databases (like OARE, HINARI, and Pubmed), journals, books, notebooks and patents. The sources were important in guiding development of research concepts and the review of available knowledge.

## 6.3     Range of ICTs Available ICTs and Extent of Their Use by Researchers

Among the specific objectives of this study was to ascertain the information needs of researchers and to investigate the use of ICTs to access and use information. These objectives could only be met by researchers responding to the question on the range of ICTs available and the extent of their utilization to access information by researchers in the two institutions.

The findings of this study revealed that the two institutions have a wide range of ICTs, although they are still inadequate. These ICTs are used daily by researchers to carry out their research activities from their offices and other designated access points within the organizations. The available ICTs include computers (both desktop and laptops) and Internet to access electronic information such as online databases and websites. This finding is consistent with a similar study by Papzan and Yaghoubi (2008) on identifying electronic information needs of agricultural faculty, in which he established that faculty members used electronic information sources, especially those skilled in computer use and Internet surfing; they made frequent use of them than those without such skills. In a study on crossing the digital divide Royall et al. (2005) established that the Internet constitutes a new and attractive channel for accessing the latest in scientific information. Thus, it offers immediate access to a wide variety of research publications.

These findings also established that modems were used to access the Internet in some instances. In a study on access to research information in cyber cafés by Okafor (2011) citing Oyewusi and Oyeboade (2009), found that researchers prefer the Internet because it provides up-to-date information.

Devices used for data storage and capture during research included PDAs, flash disks and CDs/DVDs. They were used for back-up storage to avoid loss of research data, which could be caused by virus attack and power outage. Cameras were also found to be useful in capturing research events and pictures for illustration, while scanners were used for information sharing.

The results revealed that use of mobile phones for scientific and social communication was on the increase and that phones were popular for communication among colleagues and peers. The findings established that researchers use them for monetary transactions through such services as Mpesa from Safaricom and AirtelMoney from Airtel while in the field for payment of field allowance to research assistants, for patient monitoring, as well as for receiving trade information and partner interaction like pharmaceuticals. For the latter information was received from Safaricom and other forms of news alerts.

Since the introduction of mobile phones in the Kenyan market, the country has experienced efficiency in communication and an increase in their usage for information communication. The Presidential directive issued in June, 2011, to review the rates downward in order to encourage competition, increase mobile penetration and reduce mobile charges (Consumer Federation of Kenya, 2011) saw an increase in

subscriber numbers. According to the Communication Commission of Kenya (2010) report there were 4.7 million data subscribers of which 98 per cent were from mobile service providers like Safaricom, Airtel (formerly Zain) and Yu. These service providers drastically reduced communication and connectivity cost. The most positive was the introduction of data bundles into both MB and GB, with the purchase of unlimited monthly connectivity ranging from Kshs. 250 to 3,990.

The findings are consistent with a similar study by Tewari (2008) on use of multimedia message service (MMS) technology in which he found that mobile phones were used to capture a dysrhythmia occurring intra-operatively in a patient to the consultant in charge. He argues that mobile phones have become an inseparable companion for doctors worldwide, although there is no standard rule for their use in hospitals. In the case of Organization 1 (KIRDI) mobile phones were used to monitor fish catches and market prices, while in the case of Organization 2 (KEMRI) mobile phones were reportedly used to monitor malaria cases with patients and for monetary transactions with research assistants (e.g. payment of field allowances or per diems through Mpesa and Airtel). The respondents explained how the phones have become handy in getting trade information as well as in the interaction with partners like pharmaceuticals both from Safaricom (service provider).

The findings further indicated that radios and television, together with video technology, were used for recording and watching documentaries. These sources mostly give current information on topical issues.

Researchers used ICTs mainly to carry out research work and regard them as their main working tool for research. This was a major finding, common to researcher from the two institutions. There was a deliberate attempt by the decision-makers of the two case study organizations to provide researchers with some computer facilities or incentives such as interest free loans to purchase them. The fact that both organizations had a department of IT and an ICT lab was an indication the decision-makers were concerned with the subject of ICT utilization.

On the issue of extent to which the available sources met researchers' information needs, the findings indicate that although some of the sources were out-dated, they were still useful, and they met between 50 to 95 per cent information needs. Among the sources cited included availability of the library, Internet, external databases (like OARE, HINARI, and Pubmed), journals, books, note books and patents. The sources were important in guiding development of research concepts and in the review of available knowledge.

### 6.3.1   Institutional ICT policies, information Access and Use of ICTs

The fourth research question sought to establish if the two institutions had their own ICT policies and how the policies enhanced information access and use of ICTs. The findings indicate that although the two institutions were at the point of drafting respective policies, it was not clear whether or not the drafts were being domesticating from the National ICT Masterplan or the constitution, and if the researchers or IT personnel from the two institutions were involved at national level drafting. This is important since the Masterplan clearly calls for the alignment of the policy to the reality devolution, and also tackle key challenges that may hinder the ICT sector from

playing their role in national development. The existence of institutional ICT policy in the two institutions was not known by majority of the researchers yet it is a requisite facility in the information access and use of ICTs. However, most researchers in the two institutions were aware of some restrictions on use of ICTs in accessing information, including the aspect of bringing and using personal computers to the workplace and within the network. The restrictions included the use of committal signature on fair use of ICT or the use of passwords to be specific, and that they were expected to protect their Internet accounts from outsiders for security reasons.

It was proposed that the institutions should involve researchers at the point of drafting ICT policy, as the policy directly affected their information access. The ICT Authority (2011) also advocated for participatory approach that entails taking care of soft issues such as attitude, creating enthusiasm and motivating all stakeholders through consultations as required by the Constitution. It was, however, evident that the two institutions had plans to develop and enforce an ICT policy with restriction on the sites to visit, particularly exclusion of porn and music sites. These policies would be made publicly available. In terms of ICT support, the institutions are to ensure that researchers have Internet connectivity and ought to tap on the fibre optic cables, while considering cloud computing for information storage.

It was necessary to establish how the existing ICT policy enhances information access and use of ICTs. The findings indicate that researchers were required to employ committal signatures on fair use of ICT or use of passwords and that only staff had access to them for official use. The researchers were equally expected to protect their Internet as well as e-mail accounts when accessing and exchanging information with

peers, and were expected to visit only authorized sites on the Internet. In terms of data security, 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 fear of being insecure with regard to account hacking and data loss, while on the other restriction on unauthorized sites such as Facebook limited them from social interaction with their peers and colleagues.

## 6.4    Challenges Experienced by Researchers in Accessing Information

The fifth research question sought to establish whether researchers experienced any challenges in accessing information. The findings helped to confirm that access to needed information was not always an easy task for all researchers. Whereas most researchers had no problems with accessing the required information, some did not find it easy; the results revealed that some researchers needed assistance to access information using ICTs.

The challenge facing researchers was lack of proper ICT skills and training; hence, they called for continuous training in ICTs and the understanding of their role in research. When this was not much of a challenge, there was the issue of cost whereby they experienced the challenge of pay per use on electronic resources which turned out to be too expensive, especially in cases that required constant subscription to e-journals coupled with constant denial of full access to use e-books.

The other challenges that were encountered included inadequate or lack of services like Internet connectivity via Internet Protocol (IP) provider, frequent reports of server down and unpredictable Internet connectivity, poor infrastructure, ICT capacity and low bandwidth. Slow Internet speed hampered the ease of communication and non-reliability downtime, since services could not be resumed in good time after interruption. The Researchers also complained of experiencing constant blackouts or power outage resulting in loss of data.

Facility-based challenges ranged from access to facilities, which were either inadequate or poor, planned or lack of facilities and unavailability of resources, to that of coping with technological advancement. The same finding was established in a study conducted by Ayoo (2001) that among industrial researchers in Kenya the internet use was hampered by lack of computer and literacy skills. In a study carried out on managing health records by Mwangi (2005) recommended enhancement of technological infrastructure involving provision of adequate computing and networking facilities, as well as improvement on physical access to computing facilities and other ICTs and services.

Challenges experienced on institutional policy on use of ICTs ranged from its establishment and implementation to enforcement and the fact that it should be subjected to constant revision while involving the researchers so that they can also own the document. This fact was confirmed by researchers when they raised complaints that had to do with the number of restrictions levied on them such as no Face-booking and visit to restricted areas were allowed; only research related sites were allowed.

**6.5     Improvement to Information Access and Use**

In a bid to establish solutions to improving information access and use based on challenges under section 4.7 and 5.7, the findings indicate that majority of participants from the two institutions suggested ICTs like computers and accessories to be made accessible to researchers and other staff including those in rural stations. This is supported by their responses in section 4.4.4 where they expressed their views on the use of ICTs being their main, basic and complementary research tool. Internet connectivity and accessibility should be increased and available at all times (24 hours a day) in all areas by preferably taping on fibre optic cable technology to improve connectivity and bandwidth, supported by wireless connection.

Findings also suggest the introduction of alternative access, such as Internet connection through mobile phones, which would improve access to and use of information and that the management should be tasked to spearhead the use of ICTs and facilitate interconnection beyond the office through modems and purchase of airtime. Marcus et al. (2007) found that researchers depend 100 per cent on online resources and rely upon libraries' online presence both at work and at home. The Internet has undoubtedly changed our information and communication behaviour (Fuhrmann, 2007). She notes that research takes place in virtual global organizations which utilize resources located all over the world.

To improve use of information, the findings established that the research institutions should avail resources when they are required, and that they should subscribe to electronic resources like journals and books, including those that give free access like OARE, for easier access to quality information. There is also need for ICTs to be used

as institutional repositories for information storage or data banks that allow enhanced access by researchers to relevant research information, as well as sharing, refereeing or when undertaking collaborative projects. Introduction of a digital library at the institutions for researchers may also improve access to and use of information.

Skills came out as one of the impediments to access and use of information using ICTs. The findings suggested that there is need for investing in continuous training for researchers and other users to upgrade or update their ICT skills; this can be done within the institutions through seminars, workshops or conferences. The respondents also spelt out the need for skilled personnel who would provide back-up support.

On the issue of ICT policy, it was felt that researchers should be involved in the development of institutional policy to take care of scientific issues like responsibility, conformity and privacy. Disposal of old equipment and e-waste treatment should preferably be pegged on need and not based on fixed period (e.g., number of years).
The budget was also found to impede information access and use. To that effect it was suggested that current budgets need improvement upwards. This would ensure the provision of sufficient ICT and up-to-date facilities including subscription to e-resources and updating the already outdated information resources through purchase of books and journals.

On the issue of data security, which was brought up by researchers, they suggested that antivirus and other application software should be made a mandatory provision for researchers, as a solution that automates data protection to reduce risks and operation costs. The protection of information can be done anywhere, be it in storage,

on the network, on the applications or at the endpoint. According to Marcus (2007) researchers are frustrated by lack of a standard to guide their desire to make data more accessible.

## 6.6 Use of ICTs in Organizations

Section 1.2.2 explained how researchers especially in the agricultural sector, use ICTs such as radios and television to access relevant information at the right time and format through human innovations. Under information sources consulted by researchers in section 4.3 and 5.3 the Internet was found to be the most consulted ICT for research both at KIRDI and KEMRI, mostly by using Google search engine to extract information from electronic journals. The results in both organizations indicate that over 90 per cent of the respondents used Internet for research. The results indicate that researchers in both institutions normally conduct their own searches using ICTs to retrieve relevant information for research.

Databases online were extensively used in the two study organizations. The most popular databases used at KIRDI, representing the industrial sector, were Directory of Manufacturing Industries, Sources of Industrial and Technical Information (SITI) among others. On the other hand, at KEMRI the researchers consulted Internet Access to Research Initiative (HINARI), PUBMED and Medline for Biomedical and health literature. They also referred to other databases like EBSCO, Wiley Interscience, Mary Ann Liebert and Oxford University Press to get current research literature. CD-ROM and DVD were mainly used as storage devices as well as sources for information retrieval.

The use of mobile phones in the two institutions was on the increase for scientific and social communication and that they were popular for communication among colleagues and peers. The SMS was very popular in passing information and general communication whether personal or official, like talking to a doctor, alerts or patient monitoring

It was established that mobile phones were used to monitor fish catches and market prices in the first case study organization, while they were used to monitor malaria cases with patients in the second. The findings also established that researchers used mobile phones for monetary transactions. They specifically used Mpesa from Safaricom, yuCash from yuMobile and AirtelMoney from Airtel while in the field for payment of field allowance to research assistants and also for patient monitoring, as well as receiving trade information and partner interaction like pharmaceuticals from Safaricom and other news alerts.

Although going by institutional policy the use of social sites like Facebook during working was prohibited, most respondents used LinkedIn and e-mails to communicate with their peers and friends; LinkedIn connected people in the same profession and research area.

Although the findings show that researchers in the two study organizations were provided with inadequate computers and other ICTs, the approach employed at KIRDI is a big contribution towards the diffusion and use of computers among researchers in the two different research institutions; at KIRDI, researchers were provided with interest-free loans to buy laptops which they ended up owning after full re-payment.

The KIRDI initiative made most researchers use and own laptop computers in addition to the ones they were officially provided with in their offices. The incubation initiative in the computer lab was also extensively used by researchers working on software development in addition to the computers available at the NIIC. Researchers at KEMRI were provided with computers though not in sufficient numbers. They also had access to an elaborate ICT lab.

Under 4.4 and 5.4 the results indicate that almost 100 per cent of the respondents used ICTs. This shows that the adoption rate of ICTs is good and can still be improved on, especially in the areas where the facilities are inadequate more so the outside stations of the two study organizations.

**CHAPTER SEVEN**

**SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

**7.1     Introduction**

This study investigated the use of ICTs in accessing information by researchers in selected public research institutions in Kenya. This chapter presents a summary of the major findings, conclusions reached and recommendations for the two research institutions.

Based on the study findings, and the General Systems Theory and the Diffusion of Innovation Theory, it was found that for industrial and health researchers to continuously have the capacity to access required relevant, current and quality information that meets their needs for research, they need to adopt and use ICTs. ICTs would not only give them a framework for enhanced access to industrial and health information, but it would also provide them with access to relevant research information irrespective of their area of specialization and their physical location. They would also allow them to select and re-use the information for their research activities which is important for the development and growth of the nation, as well as the achievement of Kenya Vision 2030.

The study was guided by the following questions:

1.  What are the information requirements of researchers at KIRDI and KEMRI?

2.  To what extent do the existing resources, systems and services at both KIRDI and KEMRI meet researchers' information needs?

3. What is the range of available ICTs at KIRDI and KEMRI and to what extent are they utilized by researchers to access information?

4. What institutional ICT policies exist at KIRDI and KEMRI and how do they enhance information access and use of ICTs?

5. What are the challenges that researchers experience in accessing information?

6. How can the use of ICTs to access and use information be improved in the two case study institutions?

## 7.2 Summary of Findings

Among the key findings that were common in the two institutions was the fact that researchers had various areas of specialization that required a wide range of specialized information to help them undertake their daily research activities. Based on the variation of specialized areas, the researchers have come to regard ICTs as their basic and main research tools.

Given the paradigm shift in the way information is published and availed, there is need to tap onto the potential of ICT devices as a means of enhancing access to the needed information. These devices should be friendly to enable the production of accurate and well versed research papers. The use of cloud computing can be explored, due to their ability to provide archiving services that allows one to access their field notes and other raw data from researchers; this would make reference to them easier and faster. Digital devices would also save on time and space in terms of storage and access for reference.

It was established that researchers consulted different information sources for their daily research. Among the primary sources of information they consulted were journals, reports, notes, manuals, information on protocols, conventions and standard operating statistical procedures. Tertiary sources comprised directories, books, patents, reviews, previews, reports, and the Internet among others. The findings established that the use of Internet and digital media was on the rise as compared to print media. This rise, coupled with social networking sites, cloud computing and storage facilities raised the need to tap into the Internet for immediate access to a wide variety of research information resources.

The Internet was also found to ease access since one can access information stored online from a wide variety of Internet enabled devices from areas of their own convenience at any time. The use of audio visual media provided current information on topical issues which was also widely used by the researchers.

The findings revealed that the information resources met researchers' information needs, indicating the level of reliability and accuracy of the available sources. This attribute calls for continuous improvement, since the use of current sources of information has a positive impact on the results of any new research and circumvents duplication of research.

This study found that the two institutions had various types of ICTs comprising computers (both desktop and laptops) and Internet to access electronic information like online databases and websites. In some instances, modems were used to access the Internet. It was also established that there exists a number of devices like PDAs,

flash disks and CDs/DVDs which were used for data storage and capturing during research as well as back-up storage to avoid loss of research data. Cameras were also found to be useful in capturing research events and pictures for illustration. Scanners were used for information sharing.

The findings revealed that mobile phones were heavily used in the course of carrying out research activities including monetary transactions through such platforms as Mpesa and AirtelMoney. The fixed telephone lines were also still in use for communication and so were the fax lines. The radios, television and videos were also in use for recording and watching documentaries. For purposes of information sharing photocopiers and printers were found to be in use.

One of the key findings in respect of access and utilization of ICTs was the fact that researchers view ICTs as their basic and complementary working tools for carrying out research activities. If research institutions have to help in the diffusion of ICTs among researchers, then they should ensure that every researcher has access to a computer, in addition to availing other ICT facilities. The ICTs should be adequate to cater for newly employed researchers as well as being more user friendly to enable the production of accurate and well versed research results that can be published in scientific journals.

Although the institutions were in the process of drafting the regulatory framework for access to information using ICTs, the findings established that researchers needed ICT policies put in place regarding information access and use. It was noted that this was an important aspect to safeguard against risks related to improper use of ICTs. The

researchers also requested to be involved in the development of ICT policies that guide information use and access as the policies also impact on their access to various documents, user rights and privileges.

Whereas access to information was no challenge, there were other factors that posed challenges in accessing information by researchers. The findings revealed that the two institutions did not have adequate computers for researchers and that there was need to keep the researchers abreast with new developments in the technology used. This included continuous training in computer and ICT skills so as to equip them with proper skills that can enable them to better understand the role of ICTs in research. There was need to improve on the Internet infrastructure, including connectivity and the bandwidth, to reduce downtimes on the Internet service and thus increase speeds of access. There is need for the libraries of the research institutions to join or renew membership to existing information consortiums in order to reduce or review costs for access to the various pay per use information resources such as e-journals. This would go a long way in improving access to information resources, encouraging the use of ICTs and at the same time speeding up the diffusion of ICTs.

### 7.2.1   Information Needs of Researchers

The study findings indicated that researchers from the two organizations looked at various specific research areas and needed a wide range of relevant information to undertake their daily research activities. The findings established that in the two institutions researchers were inadequately served with information in their respective specialized research areas and nature of work in different service centres. This called

for current and relevant information including new developments in their area of specialization.

Among the key findings was the fact that researchers regarded ICTs as their main research tools. Given the paradigm shift in the way information is published and availed, there is need to tap into the potential of these devices as a means of enhancing access to the needed information for research activities. The devices should be use friendly to enable the production of accurate and well versed research papers. There is need to explore the use of smart phones like iPhones, iPads and Tablett to access information, PDA and cloud computing for their ability to provide archiving services that allows one to access their field notes and other raw data. In terms of storage and access for reference, digital storage would save on time and space. Mell and Grance (2011) observed that it is a model that enables convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services).

**7.2.2 Extent to which Resources and Services met Researchers' Information Needs**

The findings established that the existing information resources and services were useful to researchers and that they met 50 to 95 per cent of their information needs. They helped in guiding development of research concepts and review of knowledge. The resources included availability of the library, Internet and external databases like OARE, HINARI, Pubmed, journals, books, notebooks and patents. This shows the level of reliability and accuracy of the available information sources and calls for continuous improvement since the use of current sources has a positive impact on the

results of any new research and in the avoidance on duplication of research. This is in line with the observation by Tuhumwire and Okello-Obura (2010) on legal information needs where they established that law is a highly knowledge-intensive domain and that obtaining accurate and up-to-date legal information can mean the difference between winning and losing cases.

### 7.2.3    Range of available ICTs and their Extent of Utilization

This study established that, whereas the two institutions had a wide range of ICTs, these were still inadequate for use by all researchers to carry out their daily research activities. The available ICTs ranged from computers (both desktop and laptops) and Internet infrastructure to accessing electronic information such as online databases and institutional websites that have links to relevant partners. It was also established that researchers had acquired modems which they used to access the Internet in some instances as prefer internet because it provided up-to-date information. Among the available devices researchers used for data storage and capture during research were PDAs, flash disks and CDs/DVDs. Researchers had also acquired cameras which they used in capturing research events and pictures for illustration. Scanners were found to be used for information sharing.

The use of mobile phone was on the increase for scientific and social communication. The phones were popular for communication among colleagues and peers. The SMS facility was popular in passing information and for general communication, whether personal or official like in the talk to a doctor alerts or patient monitoring. It was established that the phones were also used to monitor fish catch and market prices in one case study organization, while in the second case study organization they were

used to monitor malaria cases with patients. The findings also established that researchers used mobile phones for monetary transactions, specifically using Mpesa from Safaricom, yuCash from yuMobile and AirtelMoney from Airtel while in the field for payment of field allowance to research assistants. They were also used for receiving trade information and partner interaction like pharmaceuticals from Safaricom and other news alerts.

The findings further indicated that radios and television, together with video technology were used for recording and watching documentaries. These sources mostly gave current information on topical issues.

### 7.2.4 Institutional ICT Policies, Information Access and Use Of ICTs

This study established that, although the institutions were in the process of drafting the regulatory framework regarding the use of ICTs at workplace, most researchers only knew of the existence of some restrictions on use of ICTs. They were neither aware of the exercise nor were they included in the drafting of the policy. They however raised concerns on the need for their institutions to enforce ICT policies regarding information access and use of ICTs since this was important for safeguarding against risks related to their improper use. This was necessary as it would guide ICT personnel in the maintenance of the safety and integrity of data stored in various databases with regard to threat from hackers and malicious users who may deface or delete databases, and introduce viruses and malware that may cause data loss. The researchers, who are the end users, also argued that there was need to involve them in the development of ICT policies guiding information use and access as the policies also impacted on their access to information and various

documents, user rights and privileges. The Kenya National ICT Masterplan has addressed these issues and emphasizes the need to understand that ICT matters fall under several pieces of legislation which encompasses Kenya Communication Act of 1998; Science and Technology Act (Cap. 250) of 1977; and Kenya Broadcasting Corporation Act of 1988.

It was established that the existing institutional ICT policy did not fully enhance information access and use of ICTs since researchers were required to employ committal signatures on fair use of ICTs or use of passwords, and that only staff had access to use ICTs for official use. They were expected to protect their Internet passwords as well as e-mail accounts when accessing and exchanging information with peers and were only allowed to visit authorized 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. The restriction on unauthorized sites such as Facebook limited researchers from social interaction with their peers and colleagues.

### 7.2.5   Challenges Experienced by Researchers in Accessing Information

One of the key findings was that of ease of access to information. The findings revealed that there was need for researchers to keep abreast with technological developments which can be a barrier in accessing information. The researchers were found to have inadequate skills to handle ICTs and this hampered their random access to the required information ease. They alluded that there was need for continuous training in order to equip them with proper up-to-date skills that could enable them to better understand the role of ICT in research.

Internet connectivity was either inadequate, poor or was lacking in some stations. It was established that Internet connectivity was unpredictable due to poor infrastructure, low bandwidth and ICT capacity. Most of the times the researchers were notified of the server being down or they experienced low Internet speed coupled with frequent power outages.

The findings also revealed that the facilities were inadequate and were not well planned for since not all researchers and other support staff had access to the facilities, especially those from satellite stations. Although one organization encouraged researchers to apply for interest free loans to purchase laptops in order to encourage diffusion of ICTs, not all researchers took the loans, possibly due to payment terms which included a shorter repayment period.

### 7.2.6   How oo Improve the use of ICTs to Access Information

The findings established that the two institutions did not have adequate computers and accessories for use by all researchers and support staff in both urban and rural areas, despite them having identified ICTs as their basic, main and complementary working tools. On the issue of the Internet connectivity and bandwidth it was established that this was inadequate and needed improvement in all areas including suggestions for use of wireless connectivity or mobile phones. It was envisaged that improvement on the Internet infrastructure would play a big role in reducing downtimes on the service and thus increase speeds of access to the Internet. The findings established that institutional repositories were not conspicuous in both institutions and needed improvement for access and use of information as well as sharing, refereeing and collaborative works.

ICT skills for researchers were not at par with the advancement in technology and the environment under which peer reviewed articles were being published. This was found to be hampering information access by the researchers. Although majority of them did not experience difficulties with access to information using ICTs, some of them required assistance on retrieval of the needed information whereby they made use of their peers and secretaries. They therefore requested that the institutions should consider investing in continuous training in order to upgrade and impart the necessary ICT skills.

It was established that lack of ICT policy and non-involvement of researchers in the developing of the policy impeded on their positive contribution to the use of ICTs for the benefit of the institutions. This was in such aspects as conformity, privacy, data security, disposal of equipment and freedom to use ICTs with ease especially social media like Facebook during working hours when they had valid reasons to use the facility.

## 7.3    Conclusion

Information has been found to be the most critical element in both industrial and health related research activities Researchers regard ICTs as their main research tool; while emphasizing the need to tap into the potential of these devices as a means of enhancing access to the needed information for research activities. Thus, to researchers ICTs are their basic and complementary working tools for carrying out research activities.

Research institutions can help with the diffusion of ICTs among researchers by ensuring that every researcher has access to a computer, in addition to availing other ICT facilities like the use of Internet and other digital media which the study found to be on the rise compared to print media. The Internet, which was the most used ICT by researchers, was found to ease access to information since one can access information stored online from a wide variety of Internet-enabled devices any time from points of their own convenience. There is need for concerted efforts towards the improvement on the Internet infrastructure including the bandwidth spectrum, which would play a big role in reducing downtimes on the Internet service and thus increase access speed. The use of the various types of ICTs provides researchers with unlimited opportunities for improving access to specialized information sources for enhanced efficiency and effectiveness resulting from the timely application of relevant information for decision-making. ICTs offer enhanced access to specialized data whether from local or international quarters, electronic resources available from online databases, government libraries or peer reviewed articles or from the use of mobile phones, in particular the SMS facilities.

The diffusion and adaptation of ICTs depend on researchers' area of specialization, the information needs that go with that area of specialization, the learning and sharing of research knowledge, and innovation that arise from the area of specialization. There is therefore need for researchers to keep abreast with new developments in the technology used in terms of continuous training in order to equip them with proper skills and enable them better understand the role of ICT in research.

Policy regulation is a necessity in any enterprise and research institutions are no exemptions. The researchers argue that there is need to have ICT policies put in place regarding information access and use as this is important for safeguarding data against risks related to improper use of ICTs. The researchers therefore requested to be involved in the development of ICT policies since the policies have a lot of impact on their access to various documents, user rights and privilege.

Memberships to information consortiums have added advantage to information workers and researchers. This is because the limited monetary resources are pooled together so as to have more bargaining power for accessing information sources. There is need for the libraries of research institutions to join or renew membership to existing information consortiums in order to reduce or review costs for access to the various pay per use information resources such as e-journals. This would go a long way in increasing access to information resources, encouraging the use of ICTs and at the same time speeding up the diffusion of ICTs.

## 7.4    Recommendations

Based on the challenges faced by the researchers, which included lack of adequate computers, coupled with unreliable Internet connectivity and lack of access to adequate research resources, which eventually impacted on time spent conducting research, there was need to improve information access and use. It is recommended that research institution should consider:

- Tapping into the growing smart phone and tablet market in order to ease problems of information access. Recent technological developments for the

various smart phones and tablets allow for access to key resource documents anywhere any time.

- Exploring cloud computing so as to benefit from and allow for cloud storage. This would ease information sharing amongst researchers, and access as well as back-up storage and archiving of documents.

- Carrying out continuous training so as to equip researchers with relevant skills that would ease their access to various ICTs.

- Employing adequate skilled ICT personnel to be support staff whose role would be to give technical assistance to researchers in their work.

The aim of this study was to investigate the use of ICTs in accessing information by researchers in the two research institutions. The findings revealed that the researchers have inadequate computers as well as Internet skills for keeping up-to-date with developments in technology. The findings also indicated that researchers lacked awareness of the available e-resources and information literacy awareness in general. The recommendations of this study are listed in the following sections as indicated in the categories below.

### 7.4.1    Policy Makers

This study strongly recommends that policy makers should carry out an ICTs training needs assessment in order to map out the necessary skills required by researchers in the two study organizations 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 most research institutions as they help in the adoption and diffusion of ICT; more and more researchers would want to own and be associated with computer literacy.

The study also recommends allocation of adequate budget to cater for ICT needs of researchers at the two institutions to enable ICT personnel acquire enough ICTs, which comprise equipment and maintenance, for use by all researchers including those working in satellite stations. The researchers raised issues to do with availability of LANs or WANs which needs to be captured in the budget, since researchers need to network even from within the institution. The issue of storage of data, which was raised by researchers, should be looked into by securing large servers from the allocated budget while considering cloud computing. The budget should be adequate enough to cater for training of the ICT personnel and continuous training in ICT skills for researchers and support staff. Based on the findings of the study, the budget allocation should allow for improved ICT infrastructure in line with the modern trends, software updates and renewal of various licences.

Arising from the findings of this study there is need for a participatory approach in the development of ICT policy by involving researchers at the point of drafting ICT policy 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 administrators' perception that social sites are a pass time channel should be erased from their minds and instead they need to be convinced that researchers use social sites responsively as they are an invaluable source for research information; they are a reliable channel for

communicating and sharing research findings with peers. It is therefore strongly recommended that administrators in research institutions should ensure the establishment, implementation and enforcement of ICT policy in consultation with researchers. They should also subject the policy to constant review and strengthen it on the use of ICTs.

### 7.4.2   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. It is therefore important that information workers and ICT personnel explore opportunities of developing online communication tools to meet these needs. In as much as the information workers have strived to hold face-to-face training with the researchers mostly on the use of e-resources, the ICT personnel can 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.

There is need for **information workers** to provide the required information by making subscriptions to relevant information sources including electronic databases like OARE, HINARI and PubMed. The libraries of the research institutions should join or renew membership to existing information consortiums in order to reduce or review costs for access to the various pay per use electronic information resources such as e-journals. This would go a long way to increase access to information

resource, encourage the use of ICTs and at the same time speed up the diffusion of ICTs.

Although the information workers are doing a commendable job on training researchers on how to retrieve print and electronic resources, the trainings should be continuous so as to ease access to required research information. The training can be done quarterly so that researchers make the training part of their daily work to improve their skills in the retrieval of specialized information for research while enhancing diffusion of ICT utilization 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 increase Internet access speeds. The institutional ICT support is to ensure that researchers have unlimited Internet connectivity for 24 hours a day 7 days a week by tapping into 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

### 7.4.3   Researchers

Having made strong consideration that ICTs have become basic and main working research tools, especially the use of mobile phones for monitoring fish catch and market prices, monitoring health, data collection and monetary transactions during research, researchers should explore more innovative ways of using ICTs to get credible results in research. They should publicize the use of ICTs to researchers and the general public in order to enhance diffusion of their 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 hamper 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 specialized information in the case study organizations. They should be made aware of the human ICT requirements. Frequent skills development should be imbedded as part of their working condition or solution to their information needs, access and use.

Considering the need for institutional repositories, there is need for researchers to 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 in the development of the institutional information data-banks or archives.

Researchers working in public 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. Among the strong points is that researchers should use social media sites responsively in order to convince the administrators that such sites are an invaluable source for research information, as well as being a reliable channel for communicating and sharing research findings with peers.

## 7.4.4 Proposed Framework for Improving ICT Utilization to Access Information

Respondents gave several suggestions on improving ICT utilization in the two research institutions. The proposed framework identifies four main factors found to be pertinent from this study. It recognizes the following factors that influence utilization of ICTs in accessing information, namely researchers' information needs, technological issues, communication channels, exchange and sharing (including skills and institutional factors). As the main actors, researchers' suggestions for improvement formed the basis of the framework.

(a)   **Researchers information needs factors** - The findings of this study established that information needs is a determining factor in the utilization of ICTs by researchers in accessing information. The need or thirst for information determines how the information is to be accessed. It is therefore the driving force (see section 6.1). Within this factor it was found that researcher's area of specialization played a major role in determining what information resources to avail for the various research activities. The nature of work within the research activities was also varied.

Another component that was found to influence need was the storage medium and data security and integrity among others. The study proposes a framework

as illustrated in Figure 6.1, which provides a pictorial representation for improving utilization of ICTs by researchers in accessing information in research institutions. The study findings showed that training plays an important role in the exchange and sharing of information as it equips researchers with the necessary skills for the utilization of ICTs in accessing information.

(b)  **Technological factors** - This study also established that technological factors had influence on the utilization of ICTs. It was established that the emerging ICTs provide added advantage and play an invaluable role in availing numerous opportunities for accessing information, bringing efficiency and service delivery. The study established that researchers preferred web-based services or electronic resources as their source of information. Depending on the characteristics of the researchers, which include their ICT skills, in line with the current technological trends such as mobile phone technology. This will influence the use of the range of available ICTs and determine which ones are to be purchased only if the cost is affordable. The technology has to be reliable and sustainable because researchers' information needs is threatened by relevance, data storage, security and integrity.

There is need to enlighten decision-makers, ICT personnel and information providers to ensure relevance of content on the various ICT platforms that can be accessed by researchers to quench their information thirst, as well as provide opportunities for training to acquire necessary skills that can enable ease of information access and retrieval and also provide incentives like interest free loans to researchers for purchase of personal computers to enhance use and adoption of ICTs in accessing information.

(c)  **Exchange and sharing factors –** Another crucial factor is the exchange and sharing of knowledge (like is the case with KDN) an experience which can only be attained through learning. The study identified training, whether long or short-term, as a major issue in the utilization of ICTs in accessing information. Training give researchers an opportunity to gain necessary skills to access relevant information processed and stored in various ICTs, as well as helps them cope with technological developments. The training is also for the ICT personnel for provision of the required support, and for information workers and researchers. The respondents suggested that the training can comprise seminars, conferences and workshops, including the area of continuous training to upgrade ICT skills.
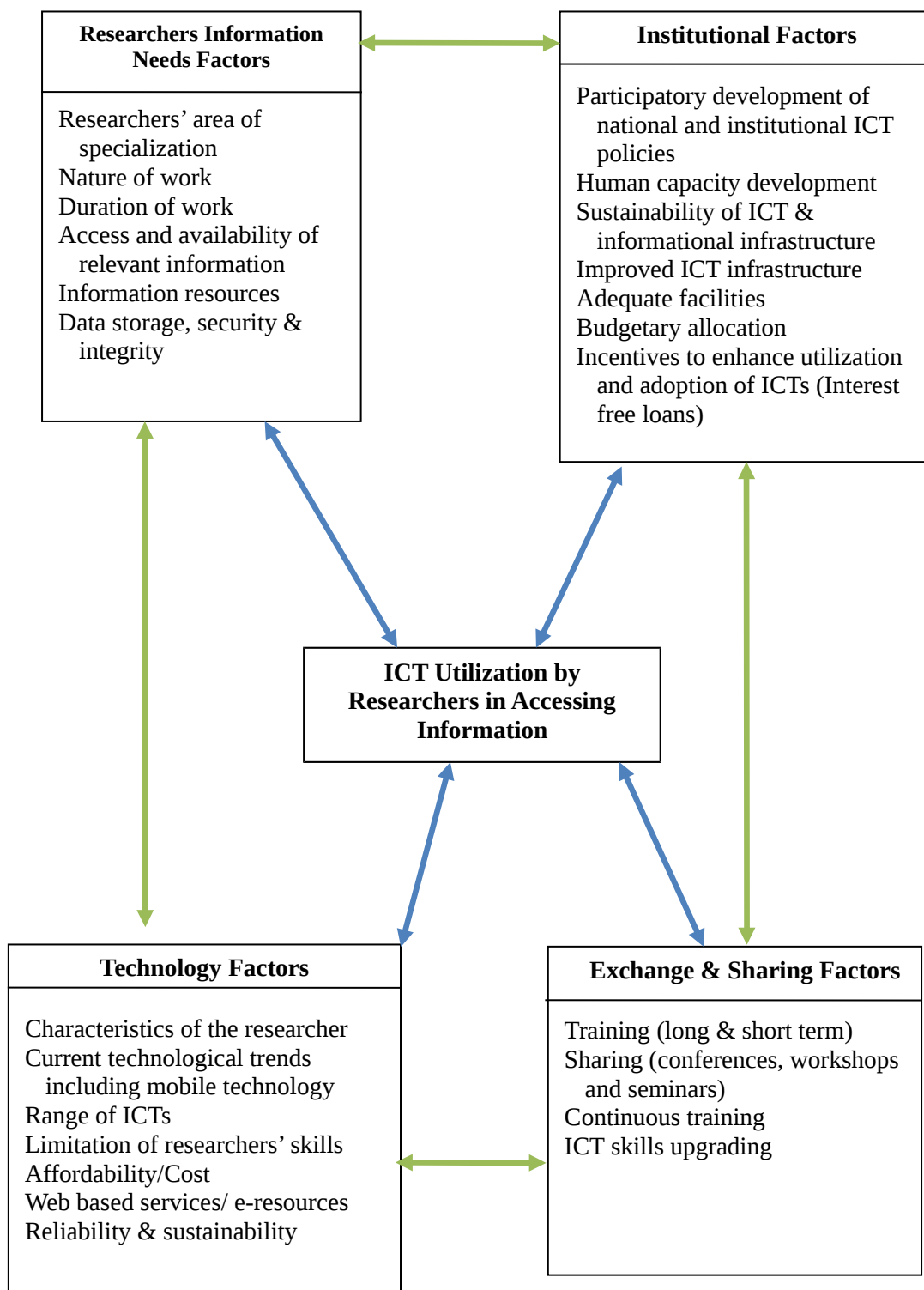
*Figure 6.1: Proposed framework for ICT utilization by researchers in accessing information*

(d)   **Institutional factors** such as organization management– Lastly, the study established that institutional factors also played a hefty role in the utilization of ICTs in accessing relevant information for research activities. There is need for the two research institutions to improve ICT infrastructure since researchers identified ICTs as their main, basic and complementary working tools, with web-based services being the most useful and used source of information. The decision-makers need to carry out a training needs assessment to establish the requirements for human capacity development across the institution, as well as carry out a needs assessment on facilities to establish the number and different types of ICTs needed by researchers since the study established that the existing ones were inadequate yet they were necessary for research activities. This calls for improvement on the budgetary allocation to provide for one that can comfortably sustain ICT and information infrastructure, while maintaining the issuance of incentives like interest free loans to researchers in order to enhance ownership and use of ICTs by researchers.

Another major component of the institutional factor suggested by researchers for improvement on ICT utilization was that there is need for participatory approach in the development of ICT policies both at institutional and national level, especially with regard to use and access since the issue had a lot of impact on their freedom to access information, various documents, user rights and privileges. Involving researchers in developing such policies would allow them to give their scientific guidance and contribution on the use of social media during research for the benefit of research institutions in the areas of

conformity, privacy data security and disposal of equipment (e-waste management).

## 7.5    Suggestions for Further Research

The study focused on the use of ICTs in accessing information by researchers in selected public research institutions in Kenya. Several issues were raised from the study that would require further research, especially the factors that deter diffusion and utilization of ICTs by researchers in industrial and health industries.

- ICT policies seem to be a barrier in the adoption and diffusion of ICTs among researchers. Further research should be carried out to come up with strategies for implementation of policies that guide the diffusion and utilization of ICTs in research institutions now that the government has offered free laptops to primary schools.

- Skills came out strongly in the study. It is recommended that further research be undertaken in the area of continuous ICT training skills for researchers in order to improve their access to specialized information and to establish whether the skills should be imbedded as part of working conditions or solution to researchers' information needs, access and use.

  The Internet came out as the most preferred ICT facility for carrying out research. Further research should be carried out to focus on status of Internet connectivity and infrastructure for it to be the preferred channel for retrieving relevant research information.

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## APPENDIX A:

## INTERVIEW SCHEDULE FOR RESEARCHERS AT KIRDI

*All information collected will be treated with confidentiality*

**Section One – Personal Data**

Name:………………………………………………………………………………….

Date of Interview:………………………………………………………………………..

Research Area:…………………………………………………………………………..

Qualification:…………………………………………………………………………….

Position:………………………………………………………………………………….

Department:……………………………………………………………………………

How long have you worked at KIRDI?…………………………...…………………...

**Section Two – Information Needs**

1. What activities do you carry out on a daily basis?

……………………………………………………………………………………………

……………………………………………………………………………………………

2. What information do you need to undertake the above activities?

……………………………………………………………………………………………

……………………………………………………………………………………………

3. What format do you prefer to get the information, in order to undertake the above activities? …………………………………………………………………………………….

………………………………………………………………………………………..

4. What sources do you consult whenever you need information? (e.g. Radio, Television, Internet, Databases/online, CD-ROM databases, Newspapers, Magazines, Journals, Books, Patents, Information centres/libraries, Collaborations/Exhibitions and fairs, Government offices)

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………

5. How useful are the various information sources you use at KIRDI?

…………………………………………………………………………………………..

……………………………………………………………………………………………

6. To what extent do the contents of these sources meet your information needs?

…………………………………………………………………………………………………………

…………………………………………………………………………………………………........…

**Section Three – Access and use of ICTs**

*(Define what is meant by ICTs to the interviewees beforehand)*

1. How often do you use ICTs to access information?

…………………………………………………………………….....................………….

2. Which ICTs do you use and which ones best meet your information needs?

………………………………………………………………………………….…..…………

…………………………………………………………………………………………....……

3. Where do you access these ICTs from (e.g. Office or home etc)?

……………………………………. …………………………………………………...……..

4. How often do you get/or miss the information you need?

.............…………………………………………………………………………..……..

5. Who conducts information searches for you?

…………………………………………………....…………………………….............…….

6. Do you get access directly and easily to a title in the collection at the time you want?

………………………………………………………………………………………...

7. What access problems do you encounter when using ICTs for information search?

…………………………………………....…………………………………………….............…….

8. What ICT policies or regulations exist regarding the use of ICTs at KIRDI?

……………………………………………………………………………….............…..

…………………………………………………………………………………...............…….

9. How useful are the following ICTs:

      Radio   ………………………………………………………………...………….

      Television.……………………………………………………….......……

      Videos  ……………………………………………………….…………

      Mobile phones  …………………………………………………….....……..

      Telephone (i.e. fixed lines and wireless)……………………………...………

      Internet……………………………………………………………….………

      Computer……………………………………………………………….……..

      CD-ROMs………………………………………………………………..

      DVDs………………………………………………………………......………

      Flash disks………………………………………………………......…………

10. What other sources of information do you consult if your information needs are not met at KIRDI?

…………………………………………..................................................................

…………………………………………………………………………………………...……………

11. What advantages do ICTs have over the other sources of information?

…………………………………………........................................................

…………………………………………………………………………………………..…………………

12.   What   are   the   disadvantages   of   using   ICTs   for   industrial   researchers?

…………………………………………........................................................

…………………………………………………………………………………………...……………

13. How effective is the use of ICTs in accessing industrial information?

…………………………………………...............................................................

…………………………………………………………………………………………..……………

14. How does ICTs assist you for:

      Research purposes…………………………………………………………….

      Data processing……………………………………………….…………………

      Modelling innovations…………………………………………...…………………

      Reference searches……………………………………………...………………

      Distance education…………………………………………...…………………

      To keep in touch with peers/friends……………………………...……………

      Internet/related services……………………………………………………

      To contact SMEs………………………………………………...…………..

      Business agencies…………………………………………………......………

      Communication e.g. Email…………………………………………….....……

      News alert……………………………………………………………...…………

      Getting trade information………………………………………………...…

      Web sites……………………………………………………………….......……

      OPAC  …………………………………………………………………......…..

15. What are the major hindrances in the use of ICTs to access information? Explain

      Lack of computer training……………………………………………….............

      Lack of ICT skills…………………………………………………….........……

      Cultural taboos………………………………………………….…...........……

      Affordability…………………………………………………………………

      Infrastructure e.g. connectivity……………………………………………

      Technological advancement…………………………………………………

      ICTs policy at KIRDI…………………………………………………………

16. What challenges do ICTs pose to you in the course of doing research?

…………………………………………...............................................................

…………………………………………………………………………………………..……………

17. How can some of the above challenges/problems be solved?

…………………………………………….........................................................

……………………………………………………………………………...…………

18. What recommendation can you give in regard to access and use of ICTs to access information?

…………………………………………….........................................................

……………………………………………………………………………...…………


Thanks for your cooperation

# APPENDIX B

## INTERVIEW SCHEDULE FOR RESEARCHERS AT KEMRI

*All information collected will be treated with confidentiality*

**Section One – Personal Data**

Name:…………………………………………………………………………………….

Date of Interview:………………………………………………………………………..

Research Area:…………………………………………………………………………..

Qualification:…………………………………………………………………………….

Position:………………………………………………………………………………….

Department:………………………………………………………………………………

How long have you worked at KEMRI?………………………………..…………………...

**Section Two – Information Needs**

1. What activities do you carry out on a daily basis?

………………………………………………........................................................................

………………………………………………………………………………………..…………

2. What information do you need to undertake the above activities?

………………………………………………........................................................................

………………………………………………………………………………………..…………

3. What format do you prefer to get the information, in order to undertake the above activities? …………………………………………………………………...………………….

………………………………………………........................................................................

4. What sources do you consult whenever you need information? (e.g. Radio, Television, Internet, Databases/online, CD-ROM databases, Newspapers, Magazines, Journals, Books, Patents, Information centres/libraries, Collaborations/Exhibitions and fairs, Government offices)

………………………………………………........................................................................

………………………………………………………………………………………..…………

5. How useful are the various information sources you use at KEMRI?

………………………………………………........................................................................

………………………………………………………………………………………..…………

6. To what extent do the contents of these sources meet your information needs?

………………………………………………........................................................................

………………………………………………………………………………………..…………

**Section Three – Access and use of ICTs**

*(Define what is meant by ICTs to the interviewees beforehand)*

1. How often do you use ICTs to access information?

…………………………………………………………………………...............……..

2. Which ICTs do you use and which ones best meet your information needs?

………………………………………….....................................................................

………………………………………………………………………..……………

3. Where do you access these ICTs from? e.g. Office or home etc

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………………………………………………………………………..……………

4. How often do you get/or miss the information you need?

………………………………………….....................................................................

………………………………………………………………………..……………

5. Who conducts information searches for you?

………………………………………….....................................................................

………………………………………………………………………..……………

6. Do you get access directly and easily to a title in the collection at the time you want?

………………………………………….....................................................................

………………………………………………………………………..……………

7. What access problems do you encounter when using ICTs for information search?

………………………………………….....................................................................

………………………………………………………………………..……………

8. What ICT policies or regulations exist regarding the use of ICTs at KEMRI?

………………………………………….....................................................................

………………………………………………………………………..……………

9. How usefulness are the following ICTs: (Useful, Very useful, Important, moderately useful, Less useful, not useful)

        Radio   ………………………………………………………………….

        Television…………………………………………………………………

        Videos  …………………………………………………………………

        Mobile phones  ………………………………………………………..

        Telephone (i.e. fixed lines and wireless)…………………………………

        Internet…………………………………………………………………

        Computer……………………………………………………………….

        CD-ROMs……………………………………………………………..

DVDs……………………………………………………………………………

Flash disks…………………………………………………………………………

10. What other sources of information do you consult if your information needs are not met at KEMRI?

……………………………………………….......................................................................

………………………………………………………………………………..……………

11. What advantages do ICTs have over the other sources of information?

……………………………………………….......................................................................

………………………………………………………………………………..……………

12. What are the disadvantages of using ICTs for health researchers?...........................

……………………………………………….......................................................................

………………………………………………………………………………..……………

13. How effective is the use of ICTs in accessing health information?

……………………………………………….......................................................................

………………………………………………………………………………..……………

14. How does ICTs assist you:

      Research purposes………………………………………………………………….

      Data processing……………………………………………………………………

      Modelling innovations………………………………………………………………

      Reference searches…………………………………………………………………

      Distance education…………………………………………………………………

      To keep in touch with peers/friends…………………………………………………

      Internet/related services……………………………………………………………

      To contact rural clinics……………………………………………………………..

      Business agencies……………………………………………………………………

      Communication e.g. Email…………………………………………………………

      News alert……………………………………………………………………………

      Getting Trade information……………………………………………………………

      Web sites……………………………………………………………………………

      OPAC  ……………………………………………………………………………..

15. What are the major hindrances in the use of ICTs to access information? Explain

      Lack of computer training……………………………………………………

      Lack of ICT skills……………………………………………………………

      Cultural taboos……………………………………………………………..………

      Affordability…………………………………………………………………………

      Infrastructure e.g. connectivity………………………………………………………

      Technological advancement…………………………………………………………

ICTs policy at KEMRI…………………………………………………………………

16. What challenges do ICTs pose to you in the course of doing research?

…………………..………………………………………………………………….......

17. How can some of the above challenges/problems be solved?

……………………………………………........................................................................

……………………………………………………………………………..…………

18. What recommendation can you give in regard to access and use of ICTs to access information?

……………………………………………........................................................................

……………………………………………………………………………..…………


Thanks for your cooperation

**APPENDIX C**

**INTERVIEW SCHEDULE FOR THE DIRECTOR OF KIRDI**

*All information collected will be treated with confidentiality*

**Section One – Personal Data**

Name:……………………………………………………………………………….

Date of Interview:………………………………………………………………………..

Research Area:……………………………………………………………………..

Qualification:……………………………………………………………………….

Position:…………………………………………………………………………….

Department:………………………………………………………………………..

**Section Two – Information Needs**

1. What is the mandate of KIRDI?

………………………………………….........................……………………………..

2. What activities are KIRDI researchers expected to carry out on a daily basis?

………………………………………….........................……………………………..

3. What arrangements has KIRDI put in place to meet their information needs in order to undertake the above activities? ………………………………………………………

………………………………………….........................……………………………..

4. What ICT gadgets does KIRDI provide researchers with to ensure they get the needed information on time?

………………………………………….........................……………………………..

5. How useful are these ICTs to researchers as information sources?

………………………………………….........................……………………………..

6. To what extent do these sources meet their information needs?

………………………………………….........................……………………………..

7. How does KIRDI ensure researcher's information needs are met?

………………………………………….........................……………………………..

**Section Three – Access and use of ICTs**

*(The researcher defines what is meant by ICTs to the Director beforehand)*

1. What are the different ICTs in your office? (Computer, Camera, Scanner, Printer, Mobile phone, Internet, DVD, CD-ROM, Database)

………………………………………….........................……………………………..

2. What are they used for?

…………………………………………….....................……………………………………..

3. Where else do you access the ICTs from?

…………………………………………….....................……………………………………..

4. What plans does KIRDI have on the use of ICTs as an option for meeting researchers' information needs?

…………………………………………….....................……………………………………..

5a. How does KIRDI ensure that intellectual property rights including Copy rights of researchers are not infringed?

…………………………………………….....................……………………………………..

5b. How does KIRDI secure Patents of innovations, Trade Marks?

…………………………………………….....................……………………………………..

5c. How does KIRDI disseminate information about innovations to other researchers and the general public?

…………………………………………….....................……………………………………..

6. What focal points does KIRDI have for access and distribution or use of these documents/manuals?

…………………………………………….....................……………………………………..

7. How does KIRDI ensure that researchers produce quality products?

…………………………………………….....................……………………………………..

8. In what format are KIRDI information products documented?

…………………………………………….....................……………………………………..

9a. How often do you visit NIIC and how do you find the information sources there?

…………………………………………….....................……………………………………..

9b. What strikes you when you use any of the ICTs available at NIIC?

…………………………………………….....................……………………………………..

10. What problems did you encounter in accessing information using ICTs at NIIC?

…………………………………………….....................……………………………………..

12. What would your office do to improve the situation?

…………………………………………….....................……………………………………..

13. How would the use of ICTs boost researchers' information base for the success of research work at KIRDI?

…………………………………………….....................……………………………………..

14. What is the impact of ICTs on research output at KIRDI?

…………………………………………….....................……………………………………..

15. What comments do you have on the effectiveness of using ICTs to access industrial information?

…………………………………………….................……………………………………..

16. How are researchers and information professionals motivated to use ICTs?

…………………………………………….................……………………………………..

17. What are the advantages of using ICTs for industrial researchers?

…………………………………………….................……………………………………..

18. What information policies or regulation does KIRDI have on ICTs?

…………………………………………….................……………………………………..

19. How is KIRDI planning to address ICT policies/regulations at institutional level in regard to access to information?

…………………………………………….................……………………………………..

20. What are the likely areas where ICTs can serve KIRDI better?

…………………………………………….................……………………………………..

21. What are some of the challenges that ICTs pose to researchers at KIRDI?

…………………………………………….................……………………………………..

22a. What is KIRDI's budget on ICTs?

…………………………………………….................……………………………………..

22b. What would you do to increase it?

…………………………………………….................……………………………………..


Thanks for your cooperation

**APPENDIX D**

**INTERVIEW SCHEDULE FOR THE DIRECTOR OF KEMRI**

*All information collected will be treated with confidentiality*

**Section One – Personal Data**

Name:……………………………………………………………………………………..

Date of Interview:………………………………………………………………………..

Research Area:…………………………………………………………………………..

Qualification:……………………………………………………………………………

Position:………………………………………………………………………………….

Department:……………………………………………………………………………..

**Section Two – Information Needs**

1. What is the mandate of KEMRI?

……………………………………………...............…………………………………..

2. What activities are KEMRI researchers expected to carry out on a daily basis?

……………………………………………...............…………………………………..

3. What arrangements has KEMRI put in place to meet their information needs in order to undertake the above activities? ……………………………………………………………

……………………………………………...............…………………………………..

4. What ICT gadgets does KEMRI provide researchers with to ensure they get the needed information on time?

……………………………………………...............…………………………………..

5. How useful are these ICTs to researchers as information sources?

……………………………………………...............…………………………………..

6. To what extent do these sources meet their information needs?

……………………………………………...............…………………………………..

7. How does KEMRI ensure researcher's information needs are met?

……………………………………………...............…………………………………..

**Section Three – Access and use of ICTs**

*(The researcher defines what is meant by ICTs to the Director beforehand)*

1. What are the different ICTs in your office?

……………………………………………...............…………………………………..

2. What are they used for?

……………………………………………...............…………………………………..

3. Where else do you access the ICTs from?

……………………………………........……………………………………..

4. What plans does KEMRI have on the use of ICTs as an option for meeting researchers' information needs?

……………………………………........……………………………………..

5a. How does KEMRI ensure that intellectual property rights including Copy rights of researchers are not infringed?

……………………………………........……………………………………..

5b. How does KEMRI secure Patents of innovations, Trade Marks?

……………………………………........……………………………………..

5c. How does KEMRI disseminate information about innovations to other researchers and the general public?

……………………………………........……………………………………..

6. What focal points does KEMRI have for access and distribution or use of these documents/manuals?

……………………………………........……………………………………..

7. How does KEMRI ensure that researchers produce quality products?

……………………………………........……………………………………..

8. In what format are KEMRI information products documented?

……………………………………........……………………………………..

9a. How often do you visit KEMRI's main library or other information centres and how do you find the information sources there?

……………………………………........……………………………………..

9b. What strikes you when you use any of the ICTs available at the main library/or information centres?

……………………………………........……………………………………..

10. What problems did you encounter in accessing information using ICTs at the library/information centres?

……………………………………........……………………………………..

12. What would your office do to improve the situation?

……………………………………........……………………………………..

13. How would the use of ICTs boost researchers' information base for the success of research work at KEMRI?

……………………………………........……………………………………..

14. What is the impact of ICTs on research output at KEMRI?

……………………………………........……………………………………..

15. How effective is it to use ICTs to access health information?

………………………………………….................…………………………………..

16. How are researchers and information professionals motivated to use ICTs?

………………………………………….................…………………………………..

17. What are the advantages of using ICTs for health researchers?

………………………………………….................…………………………………..

18. What information policies or regulation does KEMRI have on ICTs?

………………………………………….................…………………………………..

19. How is KEMRI planning to address ICT policies/regulations at institutional level in regard to access to information?

………………………………………….................…………………………………..

20. What are the likely areas where ICTs can serve KEMRI better?

………………………………………….................…………………………………..

21. What are some of the challenges that ICTs pose to researchers at KEMRI?

………………………………………….................…………………………………..

22a. What is KEMRI budget on ICTs?

………………………………………….................…………………………………..

22b. What would you do to increase it?

………………………………………….................…………………………………..


Thanks for your cooperation

**APPENDIX E**

**INTERVIEW SCHEDULE FOR INFORMATION AND
IT PROFESSIONALS AT KIRDI**

*All information collected will be treated with confidentiality*

**Section One – Personal Data**

Name:……………………………………………………………………………….

Date of Interview:………………………………………………………………..

Area of specialization……………………………………………………………..

Qualification:……………………………………………………………………….

Position:…………………………………………………………………………….

Department:………………………………………………………………………..

Duration at KIRDI: ………………………………………………………………..

**Section Two – Information Needs**

1. How does your department help KIRDI in meeting her objectives?

…………………………………………..............………………………………..

2. What role does your department play in helping researchers' carry out their research activities at KIRDI?

…………………………………………..............………………………………..

3. How does your department ensure that researcher's information needs are met in order to undertake their research activities? ……………………………….…..........……………

…………………………………………..............………………………………..

4. What information sources are available to researchers to ensure they get the needed information on time?

…………………………………………..............………………………………..

5. How useful are these sources to researchers as information sources?

…………………………………………..............………………………………..

6. To what extent do these sources meet their information needs?

…………………………………………..............………………………………..

7. How does your department ensure researcher's information needs are met?

…………………………………………..............………………………………..

**Section Three – Access and use of ICTs**

*(The researcher defines what is meant by ICTs to Information/IT staff beforehand)*

1a. What range of ICTs are available at your department for use by researchers?

………………………………….…………………………………………………………..

1b. What are they used for?

…………………………………….……………………………………………………………..

1c. Where else do staff in your department access the ICTs from?

………………………………………..………………………………………………………..

1d. What plans does KIRDI have on the use of ICTs as an option for meeting researchers' information needs?

………………………………………………………………………………………………..

2a. How does KIRDI ensure that intellectual property rights of researchers are not infringed?

…………………………………….…………………………………………………………..

2b. How are Patents of innovations, Trade Marks, Copy rights secured?

……………………………………….…………………………………………………………..

3a. How does KIRDI ensure that researchers produce quality products?

……………………………………….…………………………………………………………..

3b. How does KIRDI relate to Kenya Bureau of Standards?

……………………………………….…………………………………………………………..

5a. In what format are KIRDI information products documented?

……………………………………….…………………………………………………………..

5b. How are these documents/manuals circulated to the consumers e.g. the SMEs for ease of usage?

……………………………………….…………………………………………………………..

6. What focal points does KIRDI have for access and distribution or use of these documents/manuals?

……………………………………….…………………………………………………………..

7. How do you find the information sources at NIIC?

……………………………………….…………………………………………………………..

8. Have you used the ICTs available at NIIC for research?

……………………………………….…………………………………………………………..

9. What problems did you encounter in accessing information using these ICTs?

……………………………………….…………………………………………………………..

10. What would your office do to improve the situation?

……………………………………….…………………………………………………………..

11. How would the use of ICTs boost KIRDI's information base for the success of research work at the institution?

…………………………………………….............………………………………………..

12. How are researchers and information professionals motivated to use ICTs?

…………………………………………….............………………………………………..

13. What are the advantages of using ICTs for industrial researchers?

…………………………………………….............………………………………………..

14. What comments do you have on the effectiveness of using ICTs to access industrial information?

…………………………………………….............………………………………………..

15. What are the likely areas where ICTs can serve KIRDI better?

…………………………………………….............………………………………………..

16. What are some of the challenges that ICTs pose to researchers at KIRDI?

…………………………………………….............………………………………………..

17. What ICTs policies or regulations exist in KIRDI?

…………………………………………….............………………………………………..

18. How is KIRDI planning to address ICT policies/regulations at institutional level in regard to access to information?

…………………………………………….............………………………………………..

19. What is the institutional budget on ICTs………………………………………………….

20. What percentage of the institutional budget goes to ICTs at NIIC for researchers use

…………………………………………….............………………………………………..

21. What would be a sufficient budget for the support of ICTs at KIRDI?

…………………………………………….............………………………………………..

Thanks for your cooperation

**APPENDIX F**

**INTERVIEW SCHEDULE FOR INFORMATION AND
IT PROFESSIONALS AT KEMRI**

*All information collected will be treated with confidentiality*

**Section One – Personal Data**

Name:………………………………………………………………………………….

Date of Interview:………………………………………………………………………..

Area of specialization………………………………………………………………..

Qualification:………………………………………………………………………….

Position:……………………………………………………………………………….

Department:……………………………………………………………………………..

Duration at KEMRI …………………………………………………………………..

**Section Two – Information Needs**

1. How does your department help KEMRI in meeting her objectives?

………………………………………………........................……………………………..

2. What role does your department play in helping researchers' carry out their research activities at KEMRI?

………………………………………………........................……………………………..

3. How does your department ensure that researcher's information needs are met in order to undertake their research activities? ………………………………….................…………………

………………………………………………........................……………………………..

4. What information sources are available to researchers to ensure they get the needed information on time?

………………………………………………........................……………………………..

5. How useful are these sources to researchers as information sources?

………………………………………………........................……………………………..

6. To what extent do these sources meet their information needs?

………………………………………………........................……………………………..

7. How does your department ensure researcher's information needs are met?

………………………………………………........................……………………………..

**Section Three – Access and use of ICTs**

*(The researcher defines what is meant by ICTs to information/IT staff beforehand)*

1a. What range of ICTs are available at your department for use by researchers?

………………………………………………….............………………………………………..

1b. What are they used for? …………………………………………………………………..

1c. Where else do staff in your department access the ICTs from?

………………………………………………….............………………………………………..

1d. What plans does KEMRI have on the use of ICTs as an option for meeting researchers'

………………………………………………….............………………………………………..

………………………………………………….............………………………………………..

2a. How does KEMRI ensure that intellectual property rights of researchers are not infringed?

……………………………………….............………………………………………..

2b. How are Patents of innovations, Trade Marks, Copy rights secured?

……………………………………….............………………………………………..

3a. How does KEMRI ensure that researchers produce quality products?

…………………………………….............………………………………………..

3b. How does KEMRI relate to Kenya Bureau of Standards?

……………………………………….............………………………………………..

5a. In what format are KEMRI information products documented?

……………………………………….............………………………………………..

5b. How are these documents/manuals circulated to the consumers e.g. the rural health clinics

for ease of usage?

……………………………………….............………………………………………..

6. What focal points does KEMRI have for access and distribution or use of these

documents/manuals?

……………………………………….............………………………………………..

7. How do you find the information sources at the main library/information centres?

……………………………………….............………………………………………..

8. Have you used the ICTs available at the main library for research?

……………………………………….............………………………………………..

9. What problems did you encounter in accessing information using these ICTs?

……………………………………….............………………………………………..

10. What would your office do to improve the situation?

……………………………………….............………………………………………..

11. How would the use of ICTs boost KEMRI's information base for the success of research

work at the institution?

………………………………………….................…………………………………..

12. How are researchers and information professionals motivated to use ICTs?

………………………………………….................…………………………………..

13. What are the advantages of using ICTs for health researchers?

………………………………………….................…………………………………..

14. What comments do you have on the effectiveness of using ICTs to access health information?

………………………………………….................…………………………………..

15. What are the likely areas where ICTs can serve KEMRI better?

………………………………………….................…………………………………..

16. What are some of the challenges that ICTs pose to researchers at KEMRI?

………………………………………….................…………………………………..

17. What ICTs policies or regulations exist in KEMRI?

………………………………………….................…………………………………..

18. How is KEMRI planning to address ICT policies/regulations at institutional level in regard to access to information?

………………………………………….................…………………………………..

19. What is the institutional budget on ICTs ...………………………………………….

20. What percentage of the institutional budget goes to ICTs at the library/information centres for researchers' use?

………………………………………….................…………………………………..

21. What would be a sufficient budget for the support of ICTs at KEMRI?

………………………………………….................…………………………………..

Thanks for your cooperation

**APPENDIX G**

**OBSERVATION GUIDE**

Date: ……………………………………………………..

**Section One – Information Needs**

1a. Range of information materials for carrying out research:

- Directories……………………………………………………………………
- Patents…………………………………………………………………………
- Standards………………………………………………………………………
- Reports…………………………………………………………………………
- Journals………………………………………..………………………………
- Indexes…………………………………………………………………………
- Books…………………………………………………………………………
- Newspapers……………………………………………………………………
- Internet…………………………………………………………………………
- CD-ROM………………………………………………………………………
- E-Journals……………………………………………………………………
- Personal Digital Assistant (PDA) ……………………………………………

1b. Use of the materials

  Entertainment…………………………………………………………………

  Research purposes……………………………………………………………

1.c  What research activities is performed with available materials?

  Correspondence ………………………………………………………………

  Teleconferencing ……………………………………………………..………..

  Internet ………………………………………………………………………..

2b.  What sources do you consult whenever you need information?

  Radio………………………………………………………….

  Television………………………………………………………………………

  Videos      ……………………………………………………………………

  Mobile phones      ………………………………………………………………..

  Telephone (i.e. fixed lines and wireless)………………………………………

Internet……………………………………………………………………………

Websites ………………………………………………………………………….

Computer…………………………………………………………………………..

CD-ROMs………………………………………………………………………..

DVDs………………………………………………………………………………

Flash disks………………………………………………………………………

**Section Two – Access and use of ICTs**

1a. Range of ICTs used to access information?

- Computer
- Online Databases/e-resources
- Internet
- Personal Digital Assistant (PDA)
- CD-ROMs
- DVDs
- MP3
- Flash disks
- Diskette (8" x 5" or 5" x 3")
- Mobile phones
- Telephone (i.e. fixed lines and wireless)
- Fax
- Flatbed Scanner
- Book Scanner (Tower type e.t.c)
- Microfilm Machine
- Microfilm Reader
- Microfiche / Microfilm Rolls
- Radio / Radio Cassette
- Gramophones
- Cassette Tape
- Television
- Videos Decks
- Video Cassette (Technology being phased out)

1c. ICTs Access point for the interviewee?

- Office……….
- Lab………….
- NIIC…………
- Home………..

1d. How helpful are the above ICTs in terms of your information needs?

- Main Reference tool for research
- Complementary research tool
- Basic working tool

2.Who and under what circumstances does someone conduct information search for you?

- Library staff
- Their duty to do information search
- Am too busy
- I can't succeed in information search by myself
- I do not know how to use the ICTs

3. What access problems do you encounter when using ICTs for information search?

- Equipment too old
- Software compatibility  or consistency with existing values (e.g. from WordPerfect to Microsoft Word)
- Speed of internet too slow
- Pay per use too expensive because in dollars
- IT skills
- Keeping up-to-date with technological changes

5. Identify policy documents on ICT / regulation restricting the use of ICTs?

- Institutional ICT policy on use of diskette
- Clearance procedure to use equipment
- Committal signature on fair use of ICT (e.g. no virus, password e.t.c)

6. Identify what hinders access and use of ICTs?

- Lack of computer training
- Lack of ICT skills
- Cultural taboos
- Affordability
- Infrastructure e.g. electricity, Technological advancement e.t.c

7. Advantages of ICTs over other sources of information for industrial researchers?

- Ease of information retrieval (use of multiple access terminologies)
- Speed of information retrieval
- Employs simple language

8. How else is ICTs serving the researcher better?

- Research purposes

- Data processing

- Modelling innovations

- Reference searches

- Distance education

- To keep in touch with peers/friends

- Internet/related services

- Business agencies

- Communication e.g. Email, Entertainment, News alert, Getting Trade information, Web sites, OPAC)

9. List challenges that ICTs pose to you.
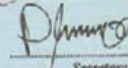
- Continuous training

10. Suggestions on possible ways of solving the problems

- Training (user and library staff)

- Continuous IT skills

- Expansion of bandwidth

- Subscription to e-journals

- Improve Budget allocation

- Policy on disposal of old equipment (after how long)

# APPENDIX H

# RESEARCH PERMIT AND AUTHORISATION LETTER

# APPENDIX I

# ETHICAL APPROVAL LETTER FROM STUDY ORGANISATION 1

**APPENDIX J**

**INTRODUCTORY LETTER FROM STUDY ORGANISATION 1**

KENYA INDUSTRIAL RESEARCH AND
DEVELOPMENT INSTITUTE
(KIRDI)
P.O. BOX 30650 00100
NAIROBI

9TH MARCH 2009

Dear Sir,

Re: Introduction Letter

I am Owano Ashah Hassan, a student at Moi University, Nairobi Campus undertaking a Doctor of Philosophy Degree in Information Science at the Department of Library, Records Management and Information Studies. I am seeking permission to interview KIRDI researchers from 16th March 2009 to 30th September 2009.

The purpose of this study is to investigate how researchers use ICTs at KIRDI to access industrial information to improve productivity and professional practice. I have chosen your institution because it is one of Kenya's leading industrial research institutions that is well equipped with the current information communication technologies.

Your contribution to this study is important in helping me obtain credible information that will influence the government and other research institutions to have a deeper understanding of the role and use of ICTs in accessing information by researchers for research and development.

The outcome of this research will provide an insight into some of the problems and challenges facing researchers at KIRDI and will offer recommendation on remedial measures that need to be taken to improve work performance when using ICTs to access industrial information.

I take this opportunity to assure you that any information that you provide will be kept confidential and will not be used for any other purpose except for academic pursuit.

Yours Faithfully

Owano Ashah Hassan
PhD Student, Moi University
P.O. Box 12072 00400, NAIROBI

Cell Phone: 0722773856

**APPENDIX K**

**ETHICAL APPROVAL LETTER FROM STUDY ORGANISATION 2**



ETHICAL APPROVAL LETTER FROM STUDY ORGANIZATION 2

**KENYA MEDICAL RESEARCH INSTITUTE**

P.O. Box 54840 - 00200 NAIROBI, Kenya
Tel: (254) (020) 2722541, 2713349, 0722-205901, 0733-400003; Fax: (254) (020) 2720030
E-mail: kemri-hq@nairobi.mimcom.net; director@kemri.org; Website: www.kemri.org

KEMRI/TR/11/15/ Vol III                                July 17, 2009

Ms. Owano A. Hassan
PhD Student
Moi University
**ELDORET**

**RE: PERMISSION TO INTERVIEW RESEARCH
SCIENTISTS IN KEMRI**

Our letter dated 6th April 2009 refers.

This is to inform you that you have been granted authority to interact and interview our Research Scientists specifically on how they use ICT within the Institute in carrying out their research activities.

It is noted that this information is going to assist you in your PhD work.

We wish you success.

Melly P.K.
**For: Ag. DIRECTOR, KEMRI**

*In Search of Better Health*

**APPENDIX L**

**INTRODUCTORY LETTER FROM MOI UNIVERSITY**

**MOI UNIVERSITY**

Telephone Nairobi (020) 2211206
Fax No. (020) 220247
Telex. No. MOIVASITY 35047

P.O BOX (00200)63056
NAIROBI
KENYA.

11th March, 2009

Kenya Medical Research Institute
(KEMRI)
P. O. Box 4840-00200
**NAIROBI**

Dear Sir/Madam,

RE:    OWANO ASHAH H. – REG. NO. IS/D.Phil/03/07

The above named is a bonafide Doctorate student of the School of Information Sciences, Moi University.

Ms. Owano is currently carrying out research as part of the requirements towards fulfillment of the requirements for the Doctorate degree in Information Technology. Her research Topic is: "The Use of ICTs to Access Information in Selected Research Institutions in Kenya".

Any assistance accorded to the researcher will be highly appreciated.

For any further information, please contact the undersigned.

DR. J. KIPLANG'AT
CO-ORDINATOR
MOI UNIVERSITY
NAIROBI CAMPUS

DR. J. KIPLANG'AT
COORDINATOR,NAIROBI CAMPUS

# APPENDIX M

# PARTICIPANTS' CONSENT FORM

### EXPLANATION LETTER

Ashah Owano
Moi University
School of Information Sciences
E-Mail: oasha2002@yahoo.com

Dear Participant,

RE: THE USE OF ICTs BY RESEARCHERS TO ACCESS INFORMATION IN SELECTED RESEARCH INSTITUTIONS IN KENYA

I am a student at Moi University carrying out research on the use of ICTs to access information for research. This research is a partial fulfilment for the award of a doctoral degree at Moi University.

The target group consist of (1) Directors & Deputies (2) Researchers (3) IT Professionals (4) Information Workers in order to have a clear picture of how ICTs have are being adopted and used in accessing research information. It envisaged that the results will provide a basis for considering the actions that can be taken to overcome barriers and improve access to relevant information and knowledge by researchers in Kenya.

Your participation in this project is greatly appreciated. Confidentiality will be maintained provision of names is not a must response. Feel free to contact me on 0722 773 856 or at the above address in case of any questions.

Thank you.

**Ashah Owano**

-------------------------------------------------------------------
**Consent for Participants**

This is to confirm that the objective of the research has been explained to me. I have noted that my confidentiality will be respected and there will be no risks in my participation.

The fact that my participation will positively contribute to the improvement of access to industrial and health information for researchers, I herewith voluntarily agree to participate in the study.

Signed: …………………………………………

Date: ……………………………………………