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Barriers for Implementing ICT on Higher Education in Underdeveloped Countries "Sudan: Case Study"

Ayman Abd Elmotti Suliman
Multimedia University, ayman.abd.elmotti.06@mmu.edu.my

David Yong Gun Fie
Multimedia University, gfyong@mmu.edu.my

Murali Raman
Monash University, nurali.raman@buseco.monash.edu.my

Nafis Alam
Monash University, nafis.alam@buseco.monash.edu.my

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Ayman Abd Elmotti Suliman
Multimedia University
ayman.abd.elmotti.06@mmu.edu.my

David Yong Gun Fie
Multimedia University
gfyong@mmu.edu.my

Murali Raman
Monash University
nurali.raman@buseco.monash.edu.my

Nafis Alam
Monash University
nafis.alam@buseco.monash.edu.my

Abstract
Information and communication technology (ICT) has become, within a very short time, one of the basic building blocks of modern society. Many countries consider understanding skills and concepts of ICT and mastering it as essential element of education process, alongside reading and writing. Within the past decade, the new ICT tools have fundamentally produced significant transformations in industry, agriculture, medicine, business, engineering and other fields. They also have the potential to transform the nature of education-where and how learning takes place and the roles of students and teachers in the learning process. This conceptual paper will highlight the importance and the role of ICT in Higher education in context of underdeveloped countries taking example of Sudan. The paper will further investigate the barriers to the growth of ICT in underdeveloped countries in general and Sudan in particular.

Keywords
ICT, Higher Education, Under Developed Countries & Education System, ICT Barriers.

1. Introduction
Educational development and reform for any nation have always been characterized by the government's efforts to adapt education to national development needs. The heart of educational development and reformation, as it is in for developed and developing countries, has always been basic and technical education development with an aim to provide quality education for human resource development to meet the needs of the social, economic and political development of the country.

Information and communication technology (ICT) has changed the nature of work and the types of skills needed in most fields and professions. While they have, on the one hand, created a wide array of new jobs, many of which did not even exist ten years ago, they have also replaced the need for many types of unskilled or low-skilled workers. These trends pose new challenges to educational systems to prepare students with the knowledge and skills needed to thrive in a new and dynamic environment of continuous technological change and accelerating growth in knowledge production.

This conceptual paper will highlight the importance and the role of ICT in Higher education in context of Sudan. The paper will further investigate the barriers to the growth of ICT in underdeveloped countries in general and Sudan in particular.

2. Importance of ICT in Education

Over the past few decades, there have been major transformations occurring in the formal education sector, as well as in other areas that are important for enabling people to develop new capabilities necessary for the knowledge/information society (Mansell and Wehn, 1998) and (Butcher, 2001). These changes are partly due to the development of ICTs, as well as the forms of networking, knowledge sharing, and interactive learning that ICTs facilitate (Heppell, 2002). Haddad and Jurich (2002) noted that change is required of schools (and education systems more broadly) which were originally developed in the context of the industrial age and which now must meet the educational needs of the current global knowledge environment.

3. The Impact of ICT on Education in the Underdeveloped Countries

The potential advantages of the information revolution have prompted efforts by governments, the private sector, corporate entities, and nongovernmental organizations across the globe to support changes in the nature and reach of information delivery infrastructure. Furthermore, it was noticed that this process is being speedily conducted in the developed world, while under developed countries progress in this regard has been slow (Castells, 1999). The reasons for the impeded progress in under developed countries include an unsupportive global economic environment, poverty, and lack of resources in poor countries.

For many under developed countries however, the potential of ICT for economic development has not been fully realized. Numerous studies have attempted to examine the underlying problems from different perspectives, among those, Addo (2001), Hafkin (2001) and Jensen (2002). While these studies are extremely useful, few examine the situation in its entirety. Therefore, a need for concerted studies that investigates how all the different aspects of ICT interrelates to influence economic development. Such an analysis will help under developed countries to direct their efforts and resources towards ICT.

In his report to the UNDP, Ali (1998) observed that the challenges of the information age are not confined to any one sector but pervade all sections of society. Technological changes are leading to pressures on politics, work, education and social organizations. And these changes are going to force change as profound as that shaped by the industrial revolution, but at far faster pace. The question is not whether profound change will happen, but how our existing social structures will adapt themselves to these inevitable changes. The use of training and education will largely determine how these structures can deal with today’s rapidly changing society.

Ali (1998) also noticed that the Third World Nations need to develop an effective science, technology and innovation policy to spearhead this drive. Such a policy must be directed at specific actions such as research and the transfer, diffusion, rapid absorption and application of technology, with particular emphasis on the greater use of information technologies.

Therefore integration of ICT into education, together with the enhancement of educational opportunities, is essential for achieving real access to ICT for the African continent. Without appropriately educated and skilled people, the areas of capacity, relevant content, integration, and trust in technology are going to be difficult to achieve. Further, there is also a need for

careful economic and policy direction to incorporate beneficial use of ICTs. This requires well-educated people ready for the information society who will then be able to mobilize an African response (for African benefit) to the global knowledge economy. Therefore, one of the greatest challenges for the developed countries lies in education and human resources development to service the knowledge economy (Hafkin and Taggart, 2001).

4. The Role of ICT in Higher Education

While educators would be content with traditional technologies for knowledge transfer through content delivery, and constructivists pushing for technology that would encourage knowledge construction, both sides seem to agree on the positive effects that ICT has on the quality of teaching and learning in higher education. The educator and thinker, Alavi (1994) stated that "Many educators, students, and employers intuitively feel that the integration of the computer into the learning experience will enhance learning. This should increase the student's ability to apply knowledge and skills to future problem solving situations". UNESCO (1998) stated "The rapid breakthroughs in new information and communication technologies will further change the way knowledge is developed, acquired and delivered. It is also important to note that the new technologies offer opportunities to innovate on course content and teaching methods and to widen access to higher learning".

The Rector of the Swedish University of Agriculture (Rosswall, 1999), observed that the ICT enhances higher education in a number of ways:

- It enables the effective storing/sorting of information, and can offer new fast ways of communication;
- It enables the reduction of information quantity towards a higher quality and better structure;
- It can be integrated into teaching and learning strategies – and used to support relative learning theories; and
- ICT (computers, Inter and Intranet) can be used to create new types of interactive learning media for improved quality, equity, and access in higher education.

The researchers found that computers enhance teaching and learning via Presentations, more opportunities to practice and analyze, and more access to source material via Internet (Brown, 2002). Computers and Internet connectivity has been found to enhance communication and interaction between colleagues within faculties, between classmates, and between faculties and students. Recently, Hawkins (2002) of the World Bank Institute published Ten Lessons for ICT and Education in the Developing World. According to Hawkins, the use of technology motivates students and energizes classrooms and empowers girls. Mr. Hawkins argues for the development of computer labs in higher education institutions in developing countries. They may take time and money, but they work well in improving access and usage providing the accessibility of good technical support.

Furthermore, ICT, when used wisely such as Internet can help unite people and create powerful and synergistic partnerships at local, regional and global scales (Derek and Darries, 2003). The use of Internet has enabled the formation of various forms of virtual universities within and between countries across the globe. This makes a clear point that internet as a communication medium cannot be limited by time and space. Internet is enabling new local and global education synergies on teaching and learning for enhanced higher education to unlimited audiences, beyond time and distance boundaries, easily and conveniently.

5. Barriers to the Growth of Communication Technologies in Under Developed Countries

There are several barriers that hinder the growth of ICTs in education in the under developed countries such as Sudan. Some of these barriers are:

A) Infrastructural Factors

The under developed countries have a significantly lower level of diffusion and use of ICT than in the developed countries. Also the under developed countries are also constrained by resource scarcities. This lack of resources hinders information flows. In this context (Sida, 1999) concluded that although countries like Botswana, Mauritius, Rwanda and Gambia are leading to infrastructural advances in areas such as digital telecommunications systems and Internet connectivity, many countries with large rural populations such as the Democratic Republic of Congo, Chad and Cambodia are yet to significantly modernize their communications infrastructure.

B) Governments Policies

The successful adoption of ICT for education depends largely on the policies designed to popularize ICTs in the educational sector. Various governments have given importance to radio, television, and computers, networking and making education online.

C) Political Factors

The political power of any nations affects to a great extent the introduction of any new technology. If the political leaders favour the technology, it will bloom. It is also important that the countries which are democratic and are ready to share information, have shown progress in the adoption of ICT, whereas in the places dominated by dictatorship or autocratic form of government, the ICT may not find due to significance and the State may have more control over the medium.

D) Economic Factors

Cost is another important issue that decides the guides the adoption and growth of Communication Technology. Thomas (1987) pointed out four major economic considerations that could affect the adoption of ICT in a country:

- Financial Strength of the society.
- Attitude of policy makers.
- Budget Allocation for the technology.
- Cost-efficiency of the technology.

Under developed Countries are often deficient in the funds to make reasonable investments in ICTs. Barton and Bear (1999) found that one of the constraints was the access to capital money for equipment or raw material, a shortage of adequately skilled personnel; and a lack of efficient business management expertise or business model, irrespective of the fact that ICT is in use or not. The under developed countries are reliant on substantial foreign assistance to ensure the development of ICTs. Therefore, the cost-efficiency of an ICT is another chief issue that determines its growth. Under developed countries have to make certain to adopt such a technology that is easily accessible to them and which caters to the need expected of it.

E) Cultural Factors

There are certain context specific and socio-cultural variables such as gender, age, caste, class, ethnicity and educational attainment that affect the access to and use of ICTs. These factors must be recognized and analyzed for the ICT based initiatives to be properly implemented. Contractor, Fulk et al. (1986) stated that culture is a complex whole comprised of knowledge, beliefs, arts, morals, laws, customs and any other capability and habit acquired by a human being as a member of the society.

Furthermore, Thomas (1987) identified that the cultural element of languages is one of the most significant factor in the implementation of ICTs in under developed countries. The elements of human factors like language barriers, cultural differences, gender issues and nature of society must be addressed to meet the challenge. The radio and TV programmes, computer software and the printed texts are created in different countries having different cultural backgrounds. As such, these programmes may not succeed to impress students of another country.

F) Other Factors

The most notable of the barriers to the use of ICT in education in under developed countries seems to be the political will of the people in the power corridors. The allocation of sufficient funds for educational sector and ICT does not seem to be much attractive to the leaders. The priority of the budgetary allocations in the third world countries was mainly allocated to defense forces rather than education. Level of knowledge of the teacher towards the use of technology is another concern. Then there is a gap between the various sections of society like rural and urban, working in IT industry or other services and getting easy access to the IT products, social and cultural factors where women are excluded from the education revolution and were expected to attend to the domestic culture is consider one of the essential barriers for the social and economic development.

6. Motivation of the Study

- In recent years, there has been growing concern about higher education in Sudan as a promoter for labour productivity, growth and social development and for better quality of life.
- Expansion of higher education within the context of Sudan development faces the failure to nurture conditions in which the individuals with high education qualifications can be productively employed.
- No similar study has been done in the area of barriers of using ICTs on Higher Education in Sudan. The barriers of using ICTs in Sudan Higher Education are a problem domain of central significance.

7. Methodology

A multiple case study was chosen as the preferred research method for this study, as it allows specific contexts to be studied in greater detail to obtain knowledge that is "useful" and not merely interesting (Olivier, 1999:121). Denscombe (2001:30) argues that a case study approach has certain features associated with it and when brought together they form a broad approach with an underlying rationale for the direction and planning of the investigation that separates it from the other research methods. Particularly, for this study, it will enable the researcher to benefit from the past experience of the universities is Sudan.

As a form of qualitative research, case studies were defined by interest in Universities cases. This included (ComputerMan University College, Alahfad University, University of Dalang and Khartoum University). The case studies were done on the following basis:

- Universities which are like the front-runners, quite advanced in the integration of ICT into their campus-based teaching such as ComputerMan University College.
- Universities With medium level of ICT integration in the organizational and educational setting, but show a more limited use of digital services such as Khartoum University and Alahfad University.
- Universities which are observed to be lagging behind the rest of the higher education institutions in almost every respect. They are characterized by a limited use of digital services, limited ICT integration in their on-campus teaching such as University of Dalang.

As part of the case study, the following data collection techniques were used:

- Structured interview. (See Appendix)
- Internet, Government publications, literature review and other documents from Ministry of Higher Education.

Universities	Total No. of Students	Total No. of Staff	Total	Type of Ownership
ComputerMan College	1330	101	1431	Private
Alahfad University	6081	120	6201	Private
Khartoum University	26262	1396	27658	Public
University of Dalang	4582	111	4693	Public

Table 1: Details of the Participants

In total, 35 respondents (Top decision makers and management) were interviewed and their distribution over actor groups and universities was as shown in Tables 2, 3:

Actor Groups	Number of Respondents	Percentage of Total Response
Decision makers	25	71.5%
Top Management & Selected Instructors	10	28.5%
Total	**35**	**100%**

Table 2: Distribution of Respondents over Actor Groups

Institute	Number of Respondents	Percentage of Total Response
Computer Man College	10	28.5%

Ahfad University	10	28.5%
University of Khartoum	10	28.5%
University of Dalang	5	14.5%
Total	**35**	**100%**

Table 3: Distribution of Respondents over Higher Education Institutes

8. ICT Development in Sudan

Sudan experience of the last two decades in building and capitalizing on ICT as a gateway for sustainable development is a landmark in Sudanese history. The experience tells how the institutional, legal and regulatory frameworks were reformed to advance ICT as tools for integrating the economy into the global market spheres. Development in ICT in Sudan is represented by a gallant expansion of infrastructure and capital investment including management systems and human capital. Still areas pertaining to expanding the ICT markets in terms of product, distribution, quality of ICT products measured by their suitability to broader use, and affordability of the services.

ICT Applications	2000	2005
ICT expenditure (% of GDP)	**1.1**	**3.1**
E-government readiness index (scale 0-1)	**0.10**	**0.14**
Secure Internet servers (per 1 million people)	**0.4**	**1.9**
Universities connected to the Internet	**1**	**54**

Table 4: ICT Expenditure in Sudan
Source: Ministry of Finance and National Economy (2005)

As the nature and dimension of socio-economic and cultural factors have significant bearing on the quality of life of people, bringing about desirable improvements has to be through a process of careful search of solutions in which the role of human resources development through education is duly emphasized. The development of human resources, the impact of which is intensive and pervasive on all sectors of growth, is closely associated with the system providing education and enhancing skills of the manpower in the country. The effectiveness of higher education system, primarily dependent on the availability of adequate resources to meet the requisites costs of the provision for the development of higher education and research. Thus the system of higher education, being chiefly responsible for preservation, generation and dissemination of knowledge and skills of the highest order, exercise a determining influence on the socio-economic and cultural development in the country.

In view of the technological advances and the sweeping changes in the techniques of offering educational programs, the vitality of higher education institutions is essential to address successfully the challenges of the new century. The importance of human resources in the transformation and in sustainable development has been stressed since 1980 in a number of

regional and international programs and strategies on Africa. The higher education authorities in all African States are aware that reduced budgetary allocations to higher education, and the tremendous drop of the values of these allocations, have caused massive reduction in the supply of equipment and learning materials. Hence higher education contribution to development in Africa is being subverted by an inappropriate mix of outputs of low quality, socially inequitable and economically inefficient.

9. Higher Education in Sudan

The issues of higher education in Sudan were addressed in two reports, one by the National Committee for the Study of the Future of Higher Education (Ministry of Higher Education and Scientific Research, 1988) and the other by the Higher Education Conference (Ministry of Higher Education and Scientific Research, 2001). Both reports of 1988 and 2001, endorsed the general principal of enforcing higher education on developmental needs of the country. Both reports recognized the role that could be possibly played by the private sector and ICTs in the provision of higher education. On this understanding, private universities are deemed relevant and instrumental in breaking new grounds, which is creating new disciplines of study and untapped areas of research.

10. Barriers for Implementing ICT on Higher Education in Sudan

After analyzing the data collected from structured interviews, the following main themes with related conclusions consistently appeared in the results (Table 5 shows a summary of the respondents' results). This part will subsequently present the outcomes of the interviews in a thematic way reflecting these themes and conclusions.

10.1 Human Resources and Academic Staff Situation

A) Staff Training and Development:

While the opening of new colleges and universities, whether public or private raised the demand for high level manpower in all fields of specialization. The thinly spread of available academic staff among higher learning institutions had a negative impact on the quality of teaching, research and management of institutions. Under the existing economic crisis and under the scarcity of funds made available to staff development the pedagogic and research capacities of academic staff were greatly hampered due to inability to meet essential requirements. Also with the increasing rate of inflation and the rising cost of living, many members of the academic staff started to look for better prospects in neighboring Arab and African countries. This brain-drain became more alarming during recent years when teaching assistants and other technical staff of higher education followed suit in the process of migration (Ministry of Higher Education and Scientific Research, 2004). Due to the lack of adequate number of competent academic staff in all colleges and universities, the system of part-time teaching has flourished. It is now an accepted norm of shuttling staff among colleges in a trial to cover as many of the offered disciplines. With such shortage of staff, universities and colleges enlisted the help of specialists on part-time basis from government and private agencies. Unfortunately these specialists are not competent and did not fulfill the minimum requirements of a teaching staff, mainly expertise and pedagogical skills.

Factor	ComputerMan College	Ahfad University	University of Khartoum	University of Dalang
Human Resources and Academic Staff Situation	Disagree	Neutral	Strongly agree	Agree

Internal Financial Resources	**Disagree**	**Disagree**	**Agree**	**Strongly agree**
Funding of Higher Education and Financial Resource Mobilization	**Agree**	**Agree**	**Strongly agree**	**Strongly agree**
Lack of ICT Infrastructure	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
The Lack of a Clear and Shared Understanding of Informationisation	**Disagree**	**Agree**	**Strongly agree**	**Agree**
The Immaturity of the Educational ICT Industry	**Agree**	**Agree**	**Agree**	**Strongly agree**
Lack of Financial Resources for ICT Education	**Neutral**	**Agree**	**Strongly agree**	**Strongly agree**
Lack of a coordinated ICT Master Plan	**Strongly agree**	**Strongly agree**	**Strongly agree**	**Strongly agree**
Lack of Knowledge Base for ICT	**Agree**	**Agree**	**Agree**	**Agree**

Table 5: Respondents' Outcomes

Universities, like the University of Khartoum, ComputerMan College and Ahfad University being conscious of staff development and training, established a specialized unit for such purpose. Staff development is intended to improve the ability of the teaching force and to provide them with new skills and teaching methods, pedagogy and psychology, application of teaching aids and the use of instructional computers. With the increase of enrolment, due to the new policy and in the light of dwindling financial resources, universities staff development programmes came to a halt.

B) Staff Retention:

Sudanese universities suffer in varying degrees from the problems of staff retention. A decade ago the university used to enjoy a high status proportionate with the high value of its worth in national affairs. Over the years, that status has been eroded by several factors which have had an adverse effect on the university capacity to retain its staff, particularly the academics such as un-remunerative salaries, insufficient benefits, lack of job satisfaction and the institutional frame-work of universities.

Respondents from the ComputerMan College and Ahfad University as private institutions to some extend did not agree that both the staff development and retention are major factors in implementing the ICT in their institutes because of their financial strength and staff development strategies. On the other hand most of the respondents from University of Khartoum & University of Dalang agreed that these factors are one of the major obstacles for the public universities because of low salaries and the limitation of their financial resources.

10.2 Internal Financial Resources

The economic crisis that has gripped the country has led to reduced financial allocation for higher education and reduced foreign exchange fund for badly needed books, laboratory equipment and supplies. The decline in financial support has resulted in the deterioration of educational infrastructures and the obvious decline of the quality of education. Universities therefore need to investigate the expenditure patterns with a view of re-distributing resources and substantially increasing the expenditure for the provision of teaching/learning materials.

Thus, internal University resources allocation requires significant rationalizing, if the goals of efficient teaching and research are to be attained. Private universities (ComputerMan College and Ahfad University) have their own strong internal financial resources thus discarded this factor as one of the barriers for implementing ICT. One the other hand public universities respondents (University of Khartoum & University of Dalang) agreed that due to the lack of internal financial resources the implementation of the ICT is far from reality. Under such dim financial situation, it is imperative that the universities search for alternative sources of funding. These sources of funding include commercial and semi-commercial undertakings by universities such as university farms, bookshops, conference halls, cafeterias and consultancy firms.

10.3 Funding of Higher Education and Financial Resource Mobilization

Budgetary allocations of the government to higher public education constitute the major source of funds for universities. These are provided in the form of annual allocations for recurrent and development expenditures. The prevailing economic crisis, with the consequent reduced public spending (including spending on education), has meant huge gaps between the estimated expenditure and the actual allocations by the government over the years. This situation has given rise to wide range of problems, including inability of universities to secure essential supplies in adequate quantities (e.g. spare parts, laboratory chemicals, stationary, etc...).

All the respondents from both the public and the private institutions collectively agreed that one of the major factors affecting the implementation of the ICT in their institutes is the lack of proper government funding and supports. The essential lesson emerged, especially after expansion in opening new universities and colleges in every state that these institutions would continue to face a financial resource crunch in the foreseeable future. Thus, a need for revision of policy of random expansion of higher education, and programmes offered need to be scrutinized; and degrees to be restructured to eliminate duplication and wastage of resources. In addition to such measures, the government should not abdicate its responsibility to provide urgently needed support, to already established institutions which are instrumental in human resources development in the country.

10.4 Lack of ICT Infrastructure

The current telecommunications infrastructure does not allow for high-speed information access, and telecommunications access is lacking outside urban areas. There is also an insufficient legal framework for e-commerce and related ICT laws. In addition, there is a lack of Sudanese Web based content. ComputerMan being the pioneer in the ICT in Sudan did not agree with this factor but on contrary all other universities under investigation agreed that the lack of the proper infrastructure is one of the main reasons hindering the implementation ICT in their institutes.

10.5 The Lack of a Clear and Shared Understanding of Informationisation

The different levels of government and administrators, as well as students, teachers and parents, often lack a full understanding of educational informationisation. Thus local governments often fail in their efforts to direct and promote educational informationisation because of impracticable plans and measures.

10.6 The Immaturity of the Educational ICT Industry

Once again all the respondents have similar notion about the immaturity of the educational ICT industry as being one of important factors affecting the implementation of the ICT on their institutes and outlined some of the factors that creating obstacles to the development of the educational ICT industry. These includes the lack of ICT products both as quantity and quality, which are needed to support the development of informationisation; the shortage of talented people; the lack of coordinating policies, competitive mechanisms, and evaluation of results; and the immature stage of the development of information criteria and success indicators.

10.7 Lack of Financial Resources for ICT Education

Sudan is one of the least developed countries in the world, ranked 141st out of 177 countries in the UNDP (2006) Human Development Index. Gross domestic product (GDP) per capita in Sudan is roughly US$ (1,949). While international isolation and donor country sanctions restrict the government of Sudan's access to foreign aid, the government main spending priority is its military. Public expenditure on the military is roughly six times greater than spending on education.

10.8 Lack of a coordinated ICT Master Plan

Although several ministries such as The Ministry of Technologies & Ministry of Higher Education & Research with higher education institutes have developed ICT plans and projects, there is a lack of co-ordination among these parts. This created uncertainty about the roles of these parts and about which part is in charge of overall ICT planning. Such a lack of coordination results in numerous independent initiatives without a clear prioritization of the government's ICT needs.

10.9 Lack of Knowledge Base for ICT

All the respondents highlighted their concern that the government of Sudan lacks the necessary ICT expertise to formulate and implement a coordinated national ICT policy. Among the general population, there is also a considerable lack of ICT awareness and practical experience. UNDP Human Development Indicators (2006) show that educational attainment overall is low in Sudan with an adult literacy rate of only %60.9 and a combined gross enrolment rate of %36.7. In addition, Sudan lacks local ICT training facilities and manpower. Most ICT personnel from the government and private sector received their training abroad. Those who get training within Sudan do so through private colleges and companies.

11. Study Limitations

This study has several research limitations due to the constraint of the qualitative data collection and analysis techniques. Because of the location and financial constraint, I was only able to interview decision makers and top management people in Khartoum state universities only, which add bias to the analysis. In the analysis, being a student from Sudan has helped in interpreting and understanding the data better as well as adding my own bias to it. Moreover, the number of interviews was very small compared to the large number of higher education institutes in Sudan.

12. Conclusion

The barriers that affecting the use of ICTs in Sudan higher education are partly financial and technological, but to a larger extent they result from a lack of policy formation, implementation and inter-agency role definition and collaboration. Constraints also exist as a

result of the variance between the need for access and the actual access, and between market demand for trained personnel and the actual courses being offered.

ICT penetration at higher education institutes is very limited, with only a limited number of universities having ICT facilities available for education. Initiatives for increasing penetration are generally hampered by a paucity of funds. There is a huge discrepancy between market demand and the ICT training courses being offered. On-the-job training is provided to a small extent, but given the limited presence of software companies in the country, long-term training is difficult to provide. Because of the many exciting limitations in the system there is an alarming trend towards outward migration of ICT specialists and students. There is significant number of private ICT training institutions in Sudan. It would be an advantage to the country if these institutions could cater to the demand for ICT training, but instead they are concentrating their efforts on software development. Graduates from these institutions prefer to seek employment outside the country, largely in the Middle East.

Besides the lack of trained people, there are the predictable constraints faced by most developing countries. These include lack of adequate infrastructure, cost of accessing the infrastructure that is in place, lack of content, particularly in the local language and, perhaps most significantly, lack of capital to invest in the development of ICT.

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