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Role of Information Science in Sustainable Development: Sierra Leone as A Case Study

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Abstract
IS / ICT is dictating the world in terms of service provision, and more so in education and the financial sector such as electronic money transfer. The article has provided a review of Information Science (IS) in the light of its wider interpretation in different walks of life. The current state of IS / ICT provision is also addressed and with the need to focusing attention in improving the capacity of the country in meeting global demand for services. Instrumentation used has focused on qualitative interpretation of themes with a critical approach in ensuring issues are unraveled thoroughly for the good of the nation as a whole. Recommendations have also pointed to an enhancement in the infrastructural capacity, and also human resources to address ongoing demands. IS / ICT Capacity around the world is changing and so too is the need for the country to build on its human resource potential to address potential threats posed, from within and outside of the country, while at the same time diverting attention towards improving quality in the green economy.
Keyword: Information Science; Sustainable Development; Sustainable Information Systems (SIS); Education; Economic Growth; Sierra Leone.

1. Introduction

Information science is taking its toll in all corners of the world, through transition from the archaic means of paper filing in cabinets to electronic / virtual filing documentation system. The long term sustainability and economic growth of a country, and more so the globalisation of the world as a whole rests on the smooth flow of electronic access and data sharing. Despite its downside (which may include threats of hacking), the global economy as it stand now cannot be sustained without electronic / virtual means of data transfer.

The general concept of information science is vastly used to incorporate academic publishing (through to peer review process), data modelling, biometrics, document management, human computer interface (HCI), information retrieval, intellectual property, ontology and many more (Bawden, 2001; Wikipedia, n/d). As Bawden (ibid) explains it, the concept of information science has brought the world closer in the era of computer / information literacy, which throughout the 1980s, and even up to some part in the 1990s had maintained a low volume in terms of accessibility; at the same time, the presence of media literacy was making its way in the public domain in the late 1990s, and so too with network and digital literacy in the same period.

Information science, *is studying the collection, classification, manipulation, storage, retrieval and dissemination of information has origins in the common stock of human knowledge* (Wikipedia Online, n/d). According to Benoit (n/d), "*Information science is that discipline that investigates the properties and behaviour of information, the forces governing the flow of information, and the means of processing information for optimum accessibility and usability*". Lately, the world-wide-web (www), commonly referred to by people as the 'Internet' is dominating access to information, and more so in supporting the sustainability of easy means of data sharing at a global scale (Spink et al, 2001). In every corners around the world, information science through access to the Internet is playing great part in ensuring organisations achieve their (corporate) 'objectives'[1]. Information science supports the use of information / data codes to enable easy means of transmission (both natural and artificial) of information using available devices like computer programming systems (Benoit, 2001; Borko, 1968).

In the current Information Age (dictated by the 21st century), information science is already transcending beyond filing cabinet archiving, and with a move in the direction of accessible virtual information systems which makes it possible for individuals, institutions and nations to operate at a sustainable level. Big organisations in society, for example central bank and other financial institutions rely heavily on the use of data to help model economic forecasting / predictions; the easy means of accessing information through electronic means makes life much easier for decision making to be determined in relation to the direction of economic progress. In present day, information science is perceived as an ontological process through, and which knowledge is shared by easy means of virtual / online data transfer within the shortest possible space of time.

2. Historical Literature of Information Science

Information analysis have been carried out by scholars at least as early as in the time of the Abyssinian Empire

[1] Enhancing scope for profit as in the case with private businesses or realising outcomes from 'value for money' investment as in the case with public or non governmental organisations.

with the emergence of cultural depositories, what is today known as libraries and archives. Institutionally, information science emerged in the 19th century along with many other social science disciplines. According to Wikipedia online (n/d), the concept finds its institutional roots in the history of science, beginning with publication of the first issue of Philosophical Transactions, generally considered the first. As outlined by Benoit (2001), Information Science (IS) is endeavouring to make its way through all forms of human interaction, with physical form of knowledge; its original form was based on a view of the object (such as books, computer files and databases).

The concept of information science derived its current meaning from the singular word '*INFORMATION*', which in the primitive era of human communication involved a simple method of tying knots and drawing pictures in all expressive forms; supposedly started around the 3000 BC period, the latter (drawing) evolved into four different systems of writing: Hieroglyphics by Egyptians, Cuneiform by Mesopotamians, Maya by Central Americans, and Oracle-Bone Scripture by Chinese (Xue-Shan, 2011: 511). In an excerpt from Xue-Shan (ibid), it is outlined that "*in order to meet the demand of overseas trade, around 1000 BC, the dwellers between the Mediterranean and the River Euphrates invented the Phoenician writing, based on the Egyptian Hieroglyphics and then they were spread far and wide. To the east, Hebrew and Arabic were formulated. To the west, the Hellenic came forth. In the Indo-European family, most language groups have a close relationship with Hellenic in origin, such as Latin, French, and English*".

The word 'information' is evolving, taken from the Latin verb *informare*, meaning to inform, with its noun form (information), introduced into English via the old French language at a later stage in human history (Xue-Shan, ibid). According to Craige (1931), also excerpt in Xue-Shan (ibid), "*after the word information was introduced into the English from old French, its original spelling was not information, but at least with six other spelling forms been integrated into English at different times: informatiou, informacioun, informatyoun, informacion, informacyon, and informatiod*"; the present day spelling as used in English became more stabilised in the seventh century, and now the dominant of all earlier spellings experimented. Information as used in English Literature in Xue-Shan's (ibid) citation below is very much akin to words such as "news or fact":
"*Not mentioning a word of my disgrace, because I had hitherto no regular information of it, and might suppose myself wholly ignorant of any such design (Swift, 1727).*
His mouth certainly looked a good deal compressed, and the lower part of his face unusually stern and square, as the laughing girl gave him this information (Brontë; 1847)".

Moving on, the word has become part of every sector and disciplines in life, with the earliest of this surfacing in the neuroscience field by the Spanish anatomist, Santiago Ramón Y Cajal in 1888, and that through "*information*" two nerve cells could interact with each other (Xu, 2002: 86). According to Xue-Shan (2011), the German embryologist in 1908 together with Hans Driesch (a Philosopher) introduced the term "information" into genetics at the same time with the proposition of the concept of "positional information" (also cited in Driesch, 1929). In various other disciplines, the word 'information' was and is still a commonly used terminology as expressed by Fisher (1920): "*The efficiency of a statistic is the ratio which its intrinsic accuracy bears to that of the most efficient statistic possible; it expresses the proportion of the total available relevant information of which that statistic makes use*".

As explained by Haryley (1928), the word information is considered to be elastic, meaning that it can be contextualised in the discourse of various discipline, while at the same time interpreter to mean more or less the same thing. With the advent of time, the concept of information was further enhanced through works of famous mathematicians like Norbert Wiener in 1948 through his famous works on '*cybernetics*' and Claude E. Shannon on the completion of his work on '*Mathematical Theory of Communication / Information Theory*' (Xue-Shan, 2011: 513, also cited in Wiener, 1948; Shannon, 1948).

The discipline of information science lend its origin in the late 1950s (more precisely in 1959) at the Moore School of Electronic Engineering, University of Pennsylvania, USA , with focus on computer program, and a minimal attention on the key word surrounding 'information' (Wellisch, 1972). The convening of an international conference on 'computer science' held in 1963 at the Northwestern University then adopted a new name 'Computer and Information Sciences' (Julius and Richard, 1964). According to Xue-Shan, 2011 (also cited in ACM, 1968), 'the idea was noted by the Curriculum Committee on Computer Science of the Association for Computing Machinery in 1968, which then advocated for the discipline of Information Science, or a compromise, Computer and Information Science'.

The birth of IBM technology also helped in the progress towards the information science discipline with the computer used as a powerful storage, retrieval and communication channel; this was also backed by Luhn's (1959) observation of a machine "*that holds all the words of a document really is holding symbols: all that was lacking was an algorithm that would match these symbols to something people wanted: information*" (as cited in Benoit, n/d). This also gave way to the librarianship movement in the discipline of information science with regard to information retrieval and storage in the 1960s, and for which Baldwin (1996) advocated for the adoption of the Library Bill of Rights, with emphasis on "access. (also cited in Benoit, n/d)". This was done in

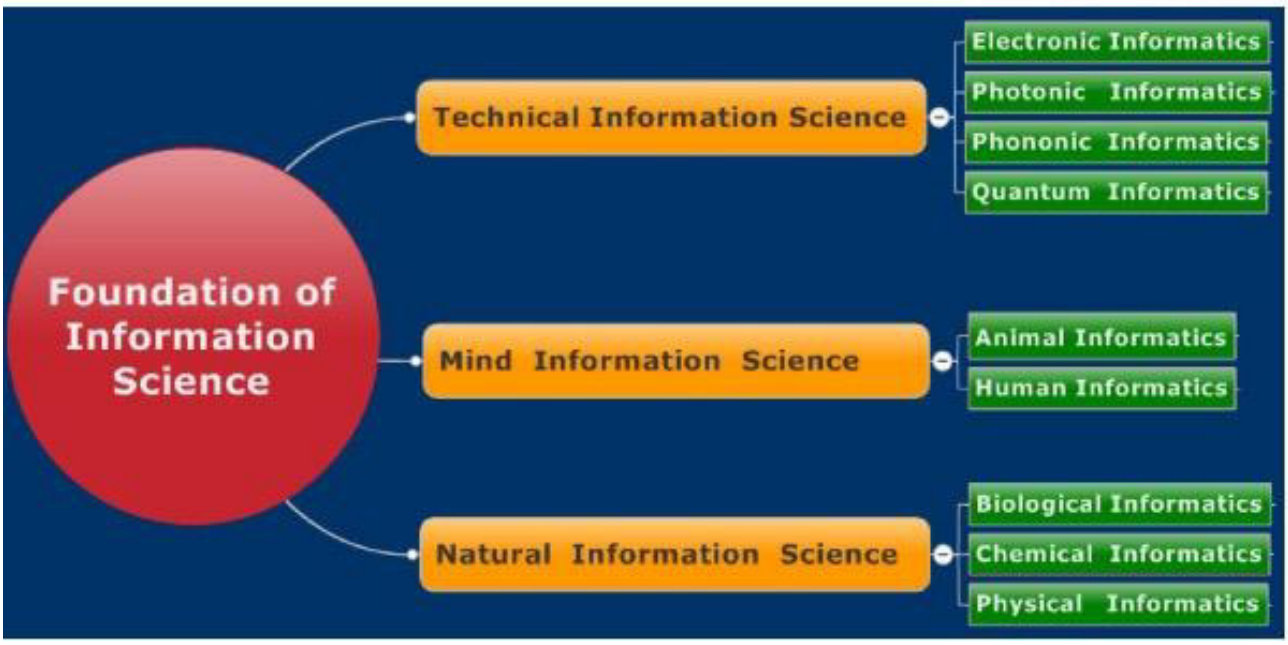
pursuit of ensuring that standardisation and codification is maintained in the pursue of intellectual freedom (Berninghausen, 1972; Samek, 1966).

2.1. Information Science in Contemporary Discourse

As the plunge continues in the quest for an explanation of the concept of information science (now generally called Information and Communication Technology - ICT), and as expressed by Xue-Shan (2011) with new information idea ranging from 'Cybernetics and Information Theory', and followed by the its wide application to concepts such as computer and communications technology, there has been a gradual shift since the 1980s on a strong note in the direction of "information theory" or "informatics" or "information science". The wide contextual usage of the concept of information science was pronounced through the work of an Austrian-American knowledge economist, Fritz Machlup in 1982 as explained by Xue-Shan (2011) in one of his eight-volume series '*Knowledge: Its Creation, Distribution and Economic Significance*', where the the concept was discussed from an economics standpoint; besides all its associated link with the words such as "Computer and Information Science" and "Library and Information Science", he unearthed 39 information-related disciplines as outlined below:

Bibliometrics, cybernetics, linguistics, phonetics, psycholinguistics, robotics, scientometrics, semantics, semiotics, systemics; cognitive psychology, lexicology, neurophysiology, psychobiology; brain science, cognitive science, cognitive neuroscience, computer science, computing science, communication science, library science, management science, speech science, systems science; systems analysis; automata theory, communication theory, control theory, decision theory, game theory, general system theory, artificial-intelligence research, genetic-information research, living-systems research, pattern-recognition research, telecommunications research, operation research, documentation, cryptography (Machlup and Mansfield, 1983: 6).

Figure 1: simple diagram showing contemporary information disciplines system



Source: Xue-Shan, 2011

According to Xue-Shan (2011), the above contemporary information discipline was formulated on the the basis of inductive philosophy, giving rise to the following three classes of information science, and followed by seven kinds of informatics:

"*I. Unary information science. This class of information science can form three kinds of information disciplines:*
(1) Subbase research: Information material science is available now;
(2) Sign research: Semiotics is available now;
(3) Information research: When we refer to it as a pure information science, Shannon's information theory, genomics, and some parts of human informatics in the future could be included. Pure information science is the most ideal information discipline among all the information studies;
II. Binary information science. This class of information science can form three kinds of information disciplines

too:
(4) Subbase research + Sign research: Electronic informatics, photonic informatics, phononic informatics, quantum informatics are available now. These information disciplines are commonly known as technical information science; their basic characteristics are that they need not inquire what information is and what information content should be studied. It is so strange that a so-called information science does not have a corpus inquiry. We believe that we shall understand this more fully someday. An information science is not an information science unless an information corpus is considered;
(5) Subbase research + Information research: Not available definitely, because all information must be nested by sign;
(6) Sign research + Information research: This kind of information science is hard to explain clearly right now. Linguistics seems to part of this exploration, but according to our preceding discussion, linguist Saussure and other philosophers, it is a kind of Semiotics;
III. Ternary information science. This class of information science can only form one kind of information discipline:
(7) Subbase research + Sign research + Information research: The current physical informatics, chemical informatics, biological informatics are the standard paradigms of ternary information science. As to mind information science, it is another complex kind, hard to explain clearly now too. Mind information science has a complicated relationship with psychology, and psychology is a representation theory of neuroinformatics. However, neuroinformatics is a branch of biological informatics according to our systematization. In a sense, psychology is a bridge that connects neuroinformatics to the human informatics".

3. Sustainable Development Explained and its Application to Information Systems

The term sustainable development is a common phenomenon used in modern day society to encompass developmental approaches in meeting the present needs of society, whiles at the same time maintaining a balance for the future generation (Jackson and Jackson - Forthcoming). According to the Centre for Environment Education (2007), the concept deigned is to "maintain a balance between the human need to improve lifestyle and feeling of well-being on one hand, and the preservation of the natural resources and ecosystems on with present and future generations depends. Under the guidance for UK higher education providers document, the term '*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (The Higher Education Academy, 2014)*'[1]. The concept historically emerged from a concerted effort by the United Nations in 1992; a reaffirmation of its conference on the Human Environment held in Stockholm, Sweden (5th - 16th June, 1972) to address a new goal and equitable partnership between states, and key sectors of society to protect the global environment and developmental systems (United Nations, 1992).

A successful sustainable development approach, whether instituted by a national government or a cooperative venture between local and international organisations, will always come at a cost, and hence those in it must ensure effective management and transparency is maintained by those on which funds is to be entrusted (for example the UN, World Bank and the IMF). Information Systems (IS) continue to dominate the world in terms of productivity / output and economic growth as a result of high quality service delivery; amidst this great development, is human fear in terms of the environmental concerns posed, which includes emission, noise and sometimes wastage (Watson et al, 2010). Sierra Leone has endeavoured to see herself through the process of engaging in IS/ Information and Communication Technology (ICT) to keep pace with the sustainable trends in the global economy; evidence produced from a survey conducted by Statistics Sierra Leone (2013) supports high demand in service usage, particularly so in ICT (for example, telecommunication which incorporate mobile phone usage and backed by wifi technology).

Despite the stride towards effective use of information science in the country, its capacity to keep pace with globalisation in the market economy is very limited (Mangesi, 2007; GOSL / Ministry of Information & Communication, 2009), more so as a result of weak infrastructure and information-use policy, which so far is a deterrent to attracting foreign investments, and the unlikely stability in the political environment which is a common phenomenon in the African sub-region. It is the wish of post-conflict successive governments in Sierra Leone to integrate ICT in the stride to ensure effective collaboration between government departments, and also its dealings with the private sector and the internationalisation of effective governance in the economy; this is rooted in the country-wide objectives (Political, Social and Economic) for ICT usage, which is strongly supported by The Telecommunications Act 2006, and managed by the National Telecommunications Commission (NATCOM) to ensure licensing is effectively issued and regulation with regard to

[1] This is also rooted on the three pillar of sustainability (economic, social and environmental factor) emanating from the United Nations World Summit held in 2005, and for which IS / ICT is a contributing factor in modern day society for sustained progress and development in society.

telecommunications usage is in line with the sustainable use agenda (GOSL / Ministry of Information & Communication, 2009). Information service in the country is managed through NATCOM, and more so competitively to ensure quality in service provision is determined through the open and competitive market which has the potential of enhancing scope for sustainable usage by users in all sectors of the economy.

Since the publication of the ICT use document (GOSL / Ministry of Information & Communication, 2009), the government has made effort to highlight the following 11 pillars / areas as integral to the sustained socio-economic growth through information services (ICT):

· Private Sector Business Activity
· Capacity Building and Human Resources in ICT
· Infrastructure
· Health
· Education
· Natural Resources and Environment
· Agriculture and Food Security
· Good Governance
· Gender, Youth and Social Services
· Media and Civil Society
· Tourism

Amidst the above pillars, it is worth noting that the long-term sustainability of information science / service / ICT hinges greatly on an effective management of system to cope with highlights of '***threats***' from the International Telecommunication Union (ITU - 2015) Connect 2020 Agenda Goal 3 target as stated below:

"*the first of which is concerned with threats to the integrity and security of ICTs and the Internet, seeking to minimise the negative impact of cybersecurity risks, including potential harm to vulnerable groups, while the second and third are concerned with negative impacts on the environment, specifically e-waste and greenhouse- gas emissions*". In the given state of the economy, it is very unlikely that the Sierra Leone government will be able to meet costs in addressing capacity to sustain (e-)security threats posed, and for which if not addressed efficiently, possess the potential of infiltrating into every sector in the economy.

4. Justification and Objectives of the Study

This article brings to the fore importance of information science in the sustainable development of the Sierra Leone economy, more so in the current Information Age. Sierra Leone has gone through turbulent times, more so in her stride to gain equilibrium after a decade of civil crisis that ruptured the fabric of the nation. The post-war economy is trying keep pace with the global economy through the incorporation of modern means of information systems, more so by means of mobile / digital telecommunication establishments in ensuring sustained (though at a rather slow pace) sectoral progress in the country. There is still milestone to cross through, but the mere consideration of the way forward in initiating discourses will help unearth present setbacks, and hence proposals for taking the entire information science fabrics forward into the future.

In this vein, the objectives on which this is to be achieved is based on the following highlighted points:

1. Assess the wider impact of Information Science (IS) in the sustainability of the Sierra Leone economy.
2. Evaluate IS scope for integration in the internationalisation of the global economy.
3. Recommend suggestive actions in addressing the way forward on IS usage in the sustainable development of the SL economy.

5. Methodology

5.1. Study Area

The study addresses a bigger picture of the entire country, particularly with regard to information science in present and future sustainability in keeping pace with the global economy. The country currently has a population of 5.8million (with different towns scattered across the Northern, Southern, Eastern and Western Area as shown in Figure 2), and with great potential in potential for expansion due to the country's natural resource wealth capacity (Statistics Sierra Leone, 2013).

Figure 2: Map of Sierra Leone

Source: The World Fact Book (Also cited in Mangesi, 2007)

During post war era, the country made a great stride in sustaining strong economic recovery (4.3% GDP growth in 2002, 9.3% in 2003, and 7.4% in 2004), propelled by confidence in business, more so from foreign investment in the extractive industry, increase in land under cultivation for agricultural production (Mangesi, 2007). The country continued to enjoy steady growth rate up until 2012 as a result of the exploration of the Iron-ore deposit around the Northern region of the country, with an estimated / projected growth rate of 15.2%; all these ended in a gloom with slow down in global demand for steel production in the latter part of 2012 to the 2013 (Statistics Sierra Leone, 2013).

5.2. Design of the Study
The study is based more on qualitative investigation (more so participant observation and interviews) during the time spent around the country in 2015. Observation was also carried out on how best people are able to make use of the limited facility of information systems available at their disposal to get in with their daily activities in all sectors of the economy. Investigation was also carried out through access made around public documentation centres like libraries (both the national library based in the centre of Freetown and higher education establishments, both in Freetown and the North).

5.3. Study Population and Sample
The population on which this study (article) is based, covers activity pertaining to the use of information science (in this case technology access that facilitate data transfer and modelling) by both public and private institutions to enable effective and sustainable use of technology in the current Information Age. In this vein, discussion around such population is to incorporate usage by educational establishments to support the continued progress of teaching and learning, other public institutions such as government departments (for example the central bank in carrying out its duty of economic management in the country, and also business institutions like commercial banks, and many more).

5.4. Instrumentation, Data Collection Process and Analysis
The instrumentation was heavily based on qualitative interviews around technology usage in the country (based on the themes and issues highlighted below in the analysis section), more so in supporting sustainable growth and development in the entire fabrics of the economy. In addition, this was also augmented through observation and documentary extraction from public sources like libraries and published articles about the current state of information science usage in supporting sustainable growth across the country. Given the nature on which data were retrieved, the analysis was mainly based on qualitative interpretation using NVIVO and also critical discourse analysis of information retrieved from public domain / sources.

6. Analysis of Themes
Based on the highlighted instruments, the **scope** for data investigation has emerged around the following themes with details of emerging discussions provided below in the next section:
- **Theme 1**: Ease of Access to Educational Resources (at all stages)
- **Theme 2**: Access to information via Public Libraries
- **Theme 3**: Integration / Partnership between Public and Private establishments
- **Theme 4**: International Trade Partnership and Cooperation

The above themes was made possible to analyse using NVIVO, a qualitative application with added features that allows themes to be addressed and categorised.

Issues Emanating from the above Themes
- Costs
- Poor network facilitation by providers
- Illiteracy
- Ineffectiveness and poor management of IS / ICT facilities by users / institutions

7. Critical Discourses Based on Themes
With reference to the above themes, it is worth noting that discussion is to be addressed critically so as to ensure the facilities for Information Science (IS) or ICT (as it may be referred to) integration into the system is robustly covered. With reference ***Theme 1 and 2*** (ease of educational resources and access to information via public learning resource centre respectively) it is with all intent that information analysed has pointed to the relevance of IS / ICT in making it possible for educational resources to be tapped into by learners regardless of location. The advent of digital learning, for example, virtual / MOODLE learning platform, and also mobile learning gadgets (iPad), as addressed by Jackson (2015a; 2015b and 2015c) in three independent studies, has made it possible for learning resources to be easily accessed. Digital learning is not only confined in the classroom context, but with high level of competition faced by both public and private establishments, the use of IS / ICT is also considered an integral part of the sustained development of an entire economic system. Critical to the sustained reliance of IS / ICT is the need to ensure that the system is sufficiently reliable and backed by technical expertise to manage its continued existence in meeting the needs of users, both at national and international level. Sierra Leone is still plagued with issues surrounding some of the aforementioned points which include poor network provision by providers and ill equipped manpower system (also highlighted in Mangesi, 2007). Based on observation from the Learning Resource Centre at various higher education institutions in the country (for example, UNIMAK and FBC, the then Athens of higher education in the West African region), there are obvious issues; very little or no ICT facilities were at the disposal of qualified staff to execute their duties in

assisting users in accessing learning resources. The situation as observed was diabolical, and considered regressive in a 21st century digital economy, where learning is to be easily facilitated through digital means, for example, book loans to be renewed in the confines of the users' environment.

With reference to ***Theme 3***, which addresses the importance of IS / ICT in the establishment of partnership between public and private corporations is very important for the Sierra Leone economy to keep pace with the global community. It is clear through observation to see efforts made by the government in incorporating IS / ICT into its strategic operations, and thanks to the international community for their efforts through financial grants / aid. A bigger part of this is key to the operation of institutions like the central bank which is required to capture essential macroeconomic data of all sorts to model present and future state of economic performance(s). The independence of IS / ICT systems in corporate institutions like commercial banks is very important in enduring rapid electronic transfer of data in the digital financial economy. Amidst all the aforementioned point addressed in theme 3, there is still a long way to go in the country's capacity to keep pace with its international counterparts in public-private partnership in facilitating the digital economy. Given the difficulty faced by the country in stepping out of a decade of civil turmoil, and more so the extortionate cost involved will render the hopes very remote in this present decade. For it to be a reality, strategic objectives will need to be focused in high level of investments in education, and backed by the right level of infrastructural architecture to cope with on-going developments in global technology. The present low rate of human development, which according to Mangesi (2007) was 35.1 (% people aged 15 and above) will need to be reviewed with robust learning goal set in place to address the way forward, and more so, enabling adaptability of a sustainable information system is capable of detecting and dealing with changes taking place between the system and its environment (Maruster, et al, 2008) . This will ensure that systems set in place is created to take cognisance of the dynamic environment of global IS / ICT, and with relevant cost-analysis factored in order to endure the sustainability of systems set in place.

Theme 4, was incorporated as part of the need to ensure international partnership with bodies such as ITU is established so as to make it possible for the country to review its progress / performance on IS / ICT provision at an approved international benchmark / standard. The annual report of the ITU provide robust review of progress in IS / ICT and issues pertaining to its long term sustainability, and particularly how threats facing systems is to be addressed, and also issues on the well-being of information systems users through radiation (be it through telecommunication or other forms of data transmission) and concept around the green economy. In the case with Sierra Leone, various issues such as the low educational attainment, and low cost investment in maintaining systems are some of the problems faced - as already addressed in other themes, the situation can be reduced through robust quality assurance system set in place.

8. Conclusion and Recommendations

IS / ICT is the at forward in the current Information Age, both in terms of supporting national economies and corporate establishments move their systems at a sustainable level to address the marketisation of IS service in the global economy. Sierra Leone, amidst all its complexity of problems (ten year battle of political turmoil and lately slow down in growth rate resulting from low income from mineral resources) is continuing to make some strides in keeping pace with the global need for IS / ICT services through investment in IS infrastructure, in the open and competitiveness market of business operating under the guidance of NATCOM. The country still have a long way to catch up with trends and development in technology to support its infrastructure, and the sustainability of service provision, for example, continue low cost IS / ICT services provision to educational establishments needed to promote teaching / learning, particularly intensive research and development.

Proposed recommendations for this will need to take cognisance of the current infrastructure of IS / ICT in the country as a whole, and the way forward in addressing areas of concerns, for example, a review of IS / ICT curriculum / provision at all levels in the educational system. Review of present provision and capacity will also be needed in the light of future demands in services, but most importantly requiring the right level of financial investment to support research and development to maintain a balance in the call for a sustainable green economy, both in the present and future. As outlined by Kargbo (2005), the country is still faced with ongoing emerging challenges with regard to a comparatively low level of financial investment to keep pace with the advancement in technology; this is making it very difficult for areas such as the education sector to feature well in sustaining global competitiveness in the marketisation of services such as education. Unless a proper review of provision for IS / ICT investment is done (in line with country's needs), there is no way in which the country (particularly so, public and private / corporate) institutions will be able to surface competitively in the current information age where virtual services seemed to be the dictate of every walks of life.

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