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INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) FOR KNOWLEDGE MANAGEMENT

Introduction

Many people like to think that mankind is at the dawn of a new era, that of an age of enlightened communication. There are many persons who think that new digital technology will change the way people live, work, do business and interact. This leads researchers and organizations to think that the so called information age will bring great change and development, and so countries all over the world are involved in constructing the necessary Information and Communication Technologies (ICT) infrastructure, in order to meet the challenges of the information (digital)[1] society of the 21st century [Uimonen, 2003].

This paper deals with the role of Information and Communication Technologies in Development (ICT4D) with special attention to the potential of Open Source Software (OSS) in helping to bridge the Digital Divide. Herein a great amount of emphasis is paid to the role of Open Source Software (OSS) in the important development field of Knowledge Management by their input for improving knowledge management which is seen as a prerequisite to the advancement of the Knowledge Society in developing countries. The objective is to review and discuss the concept of Open Source Software (OSS) and Knowledge Management in the attempt to bridge the Digital Divide.

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[1] A digital society is a society that is well advanced in the adoption and use of digital technology into daily life at home, work and for recreation.

Defining ICT

The term IT has recently been expanded to Information and Communication Technology (ICT) in recognition of the growing significance of communications technology to access the Internet, send email to other institutions, to video conference, and so on. ICT therefore combines telecommunications, computing and broadcasting and covers any product that will store, retrieve, manipulate, transmit or receive information electronically, including telephones, faxes, computers and televisions.

In order to arrive at a working definition of ICT, it seemed easiest to make an assessment of the existing definitions, in what way they agree, and just where the big differences are. Here follows a list of definitions [STILE, 2004]:

− A convergence between computing and communications forming information and communication technologies (ICTs).
− Originally, that is to say a few years ago, one referred to IT (Information Technology). Now the Internet has infiltrated our daily lives and the transmitting of information via the digital highway has become very important. One can no longer refer merely to Information Technology, but also of Communication.
− Three major innovations gave impetus to an ongoing transformation of our economic and social environment. Those are: the swing of electronic industries to digital technology, the large-scale marketing of personal computers and the launching of the Internet. All three innovations still interact to produce ICT convergence and evolutions towards a "knowledge based economy" and an "information society".
− Activities which contribute to the display, processing, storing and transmission of information through electronic means.
− To understand the very notion of ICT, convergence is the word. Since that technical swing towards digital technologies, all electronic applications could be seen as different products of one unified technology i.e. "Information and Communication Technology". One early example of ICT convergence is the crossing of photocopy machine and telephone, leading to the creation of fax. But the most spectacular achievement in this area is convergence of computer and telephone that resulted in the upsurge of the Internet.
− Although the technology (in the form of computers) was pioneered in the Second World War, it's huge potential only became fully obvious

with two events of the 1980s. The first of these was the miniaturization that was the result of a number of important innovations in the semiconductors industry (first the transistor, then the integrated circuit, and finally the microchip). This led to small and cheap computers that could be afforded by large amounts of users. The second event was the linking of computers in networks, and the linking of these networks by existing telecommunications technologies (telephones).

– The greatest boundary breaking characteristic of ICT and its ensuing electronic networks is the possibility to efficiently store, process and disseminate information. It is upon the basis of these characteristics that a multitude of developments has been made.

In this paper, ICTs are understood to be "technologies that facilitate communication and the processing and transmission of information by electronic means". These are sometimes categorized into 'old' technologies (radio, television, telephone, etc.) and "new" technologies (computers, Internet, satellite communications, digital radio/TV, etc.) [Mathison, 2003]. This discussion, however, is restricted to electronic technologies and in particular to computers, computer programs and the Internet.

Information and Communication Technologies (ICT) and development

Information and Communication Technologies (ICT's) are a significant part of the current trend of cultural and economic globalization. Over the last few decades, enormous capital has been invested to extend the reach and application of ICTs. Those who support this "information revolution" see potential benefits in a wide range of areas and hope that Information and Communication Technologies (Information and Communication Technologies (ICT)'s) will have a positive impact for the economic and social improvement of underdeveloped countries. This hope is referred to as "the digital dividend". However, some detractors have cited the fact that this actually leads to effective exclusion from the information revolution which will only intensify the poverty levels in many countries and among nations. This fear has been expressed by the phrase "the digital divide".

The digital divide, commonly understood as the gap between information and communications technology (ICT) 'haves' and 'have-nots', has emerged as an important issue of our times largely due to the uneven diffusion of the Internet. Quantifying the magnitude and monitoring the evolution of the gap between ICT 'haves' and 'have-nots', as the issue was initially expressed, can be achieved by the absolute number of users or the overall penetration rates. As long as from one period to the next more people use the Internet, there are more 'haves' and fewer 'have-nots' [Sciadas, 2005, p. 11]. In the global perspective, divide exists between developed and developing countries. The global divide refers to the divergence of Internet access between industrialized and developing societies. Developed countries are considerably advanced in terms of IT infrastructure and access to the Internet, which give them even further opportunities for the creation of more wealth, hence outdistancing the already underdeveloped nations.

Although the Internet is not readily accessible to the majority of the world's poor at the present time, the commercial rise of the Internet has focused attention on the basic need of human beings to communicate relevant information with each other. Societies have always applied technology to meet this need: from jungle drums to smoke signals, the print media, Morse code, telephone, film, radio, television, etc. In the broadest sense, all of these are examples of ICTs. Recent discussions relating to ICTs are specifically concerned with electronic technologies that have emerged over the last century or so. However, common use of the adjective "digital" is unfortunate because, at this point in time, the most widespread ICTs are not digital technologies. For example, radio and television are primarily analogue technologies. Long before 'ICT for Development' (ICT4D) became fashionable, "old" technologies like radio and television had been used to disseminate information among the poor. As a medium for delivering information directly to the underprivileged, these technologies can achieve far wider outreach at much lower cost than Internet-based approaches. However, comparison of different ICTs should not be restricted to outreach and cost considerations. An important area of innovation in ICT for Development is to exploit the particular strengths of different ICTs by combining them to deliver a more complete communication package.

Knowledge Management

Knowledge and information are increasingly becoming the main factors of production and exchange and this has major implications for developing countries. Technological innovations are so numerous that they are radically affecting the competitiveness of endeavors, enterprises and even countries as a whole. Behind these improvements are the spectacular improvements in Information and Communication Technologies (ICT) plus developments in the tools of scientific inquiry and in the codification of knowledge.

Knowledge Management is the name given to the set of systematic and disciplined actions that an organization can take to obtain the greatest value from the knowledge available to it [Marwick, 2003, p. 40]. Although there is no agreed definition of "knowledge management", the term is used loosely to refer to a broad collection of organizational practices and approaches related to generating, capturing, and disseminating know-how and other content relevant to the organisation's business. It is generally understood to mean the sharing of knowledge inside or outside an organization. Since knowledge is not just an explicit tangible "thing", like information, but actually information combined with experience, context, interpretation and reflection which involves the full person, integrating the elements of both thinking and feeling it is felt that the term Knowledge Management is a misnomer.

As such many organizations see "knowledge sharing" as a better description of what they are about than "knowledge management". Advantages of "knowledge sharing" include its commonsense comprehensibility, along with a certain degree of interactivity implicit in any sharing. However, whatever the term employed to describe it, knowledge management is increasingly seen as signalling the development of a more organic and holistic way of understanding and exploiting the role of knowledge in the processes of managing and doing work, and an authentic guide for individuals and organizations in coping with the increasingly complex and shifting environment of the modern economy [*The role of ICTs* …, 2002].

Knowledge Management has been greatly facilitated by modern computer-based technology. The availability of new Information and Communication Technologies (ICT) – the Internet in particular which allows for the speedy access to information – has been catalyzing the Knowledge Management movement, although one must admit that the

WWW in many cases leads to an overwhelming overload of information. The development of tools that support Knowledge Management in an appropriate, easy and user-friendly way is what is needed to make knowledge sharing a reality among players in lesser developed societies.

Information and Communication Technologies (ICTs), today play an important part in the aforementioned processes. Researchers have stressed that ICTs only serve as a catalyst to knowledge management and cannot deliver knowledge management [McDermott, 1999]. Nevertheless, it is widely believed that the benefits of specific ICTs to knowledge management are plenty. More recently, electronic databases, audio and video recordings, interactive tools and multimedia presentations have become available to extend the techniques for capturing and disseminating content. Although these tools are not yet available everywhere in the developing world, they are spreading rapidly and present a unique opportunity for developing countries to benefit most from the technological revolution now unfolding: low-cost telecommunications systems can help countries to leapfrog ahead through distance education, distance health services, and much better access to markets and private sector partners abroad [*The role of ICTs …*, 2002].

Framework of Knowledge Management

The key challenges for effective knowledge management lies in the transfer of tacit to explicit knowledge and the storage and access of explicit knowledge. Tacit Knowledge is defined as knowledge that people possess which are consequential to experiences and represent ideas and principles. Explicit Knowledge is represented by artefacts such as documents or video or audio, which have been created to communicate knowledge. The transfer of knowledge from tacit to tacit, explicit to explicit and tacit to explicit and vice versa is vital to the knowledge management process. Although some of these transfers can take place without the use to ICTs, they can certainly be well-supported and enabled using ICTs [Marwick, 2001].

The following figure (1) shows the transfers between the types of knowledge and basic Information and Communication Technologies (ICT) which can aid the process.

As can be observed from Figure 1, there is room for some use of ICTs in transfer of knowledge from tacit to tacit but the real benefits can be assumed in the case of the transfer of explicit knowledge.

Figure 1: ICTs in Knowledge Transfer

TACIT TO TACIT	**TACIT TO EXPLICIT**
− Transfer of knowledge between people − Through meetings and social interactions − Use of technologies like web conferencing and electronic meetings	− Transfer of knowledge from people to physical form − Through development of reports and manuals or answering queries − Use of technologies like word processing documents, presentation tools and email
EXPLICIT TO TACIT	**EXPLICIT TO EXPLICIT**
− Transfer of knowledge from physical form to actionable knowledge in people − Through video, audio or text presentations. Browsing through documents − Use of technologies like multimedia technologies, word processing and presentation tools	− Transfer of knowledge from one physical form to another − Through text search, queries and document categorization − Use of technologies like search tools, query languages and databases

Source: A. D. Marwick, *Knowledge Management Technology*, "IBM Systems Journal" 2003.

Knowledge management process

Knowledge in an organization goes through many steps to become part of the knowledge management system. Outlined below are the key steps in the knowledge management process.

− *Knowledge identification*

Knowledge requirements for a task or a job are defined and a list of sources of information is determined. These sources can be either in the form of existing information in books or manuals or can come from workers and other human sources e.g. meeting support systems.

− *Knowledge creation*

The information available from the different sources mentioned above must now be created e.g. by getting people together to share the information they possess or by transferring it from manuals and other sources. E.g. searching for information in on-line or offline sources e.g. Internet and intranet.

− *Knowledge codification e.g.*

In order to be of use to members of the organization through sharing the information gained from the previous stages will need to be made available in an appropriate manner which facilitates easy access by the rele-

vant future users. This can be done through the use of Content Management System for intranet or web publishing.

− *Knowledge storage*

Relevant information should be kept in an easily accessible form e.g. compendium of articles or database for efficient retrieval at a later stage.

− *Knowledge diffusion and use*

Knowledge kept in the abovementioned databases need to be accessed and used for the well-being of the organization and should be easily searchable for the location of necessary information e.g. decision support systems.

It can be clearly seen here that although knowledge management as a process has existed for many years, the emergence of information and communication technologies offers new possibilities of achieving some of the goals of such a system. In fact it is becoming hard to think of knowledge management without ICTs. As organizations increasingly rely on ICTs as their primary tool in knowledge management, and each organization with its own unique knowledge requirements, proprietary software becomes expensive and inefficient.

Since the intention here is to major focus on the use of ICTs in Knowledge Management and how OSS could further facilitate the development of knowledge management in organizations and the knowledge economy. For this, a basic understanding of the open source software and the movement needs to be understood.

Open Source Software (OSS) solutions for Knowledge Management

In the face of rapidly changing technological advancement, and the exorbitant cost of proprietary hardware and software solutions, which discriminate against under-developed countries in attempting to participate in Information and Communications Technologies (ICTs) for development, the need for Free and Open Source Software (F/OSS) solutions has emerged. There is a global trend toward FOSS solutions, which have become viable, cost effective and sustainable options for their participation in the ICT4D movement [Kagai, Kimolo, 2004].

Free, Libre and Open Source Software (FLOSS) represents a new and growing phenomenon, which is much discussed these days as it implies a radically new method of production, cooperation and exchange. Here it is argued that Open Source Software (OSS) besides its technical

advantages has a special importance in the context of development cooperation.

In the area of Knowledge Management there are some Open Source Software (OSS) solutions available. These include but are not limited to the following programs: Mbone, Convea, Digger, Intranet Open Source, MySource, OpenCMS, Midgard, eZ Publish, MySQL and Dicodess. However the most important examples of Open Source Software (OSS) which can be cited as playing an important role in mainstream Knowledge Management are Linux, Apache Web Server and the Mozilla Web Browser. Linux is probably the most well known open-source project today with its popularity being due to the fact that it is platform-independent (it operates on wrist watches, cellular phones, mainframes, servers) and most of the software programs that run on it are provided for free. Additionally it needs fewer resources to operate than other proprietary solutions, which makes it ideal for the developing-world situation.

Apache is an application that runs the servers that stores and delivers documents on the World Wide Web. It runs more than 60% of the web servers [Netcraft, 2007] used in the world and it can be tailored to meet the requirements of individual sites, allowing it to serve the needs of both small and large sites. The (Mozilla) Web Browser is a free, cross-platform Internet software suite, whose components include among other things a web browser and an email client which can be considered most basic for the development of Knowledge Management.

PHP and MySQL both are part of the open source community and any system developed using this can easily be implemented in any server like Windows, Linux, Unix and many other servers where PHP and MySQL can be installed. All the knowledge Management tools requirement for processing logins, storing contributions posting messages, feedbacks, expert approval etc are managed by using PHP script and data storage is taken care by MySQL database.

Mbone is currently of practical use for shared communication such as videoconferences or shared collaborative workspaces and Moodle is a Free, open source PHP application for producing Internet-based educational courses and Web sites on any major platform (Linux, Unix, Windows and Mac OS X). Courses are easily built up using modules such as forums, chats, journals, quizzes, surveys, assignments, workshops, resources, choices and more. Moodle supports localization, and has so far been translated into 34 languages. Moodle has been designed to support modern pedagogies based on social constructionism, and focuses on pro-

viding an environment to support collaboration, connected knowing and a meaningful exchange of ideas.

A Wiki or wiki is a website that allows any user to add content, as on an Internet forum, but also allows that content to be edited by any other user. A wiki enables documents to be written collectively and hosted on the internet. One of the defining characteristics of wiki technology is the ease with which pages can be created and updated. Generally, there is no prior review before modifications are accepted, and most wikis are open to the general public — or at least anyone who has access to the wiki server.

A weblog, or simply a blog, is a web application which contains periodic, reverse chronologically ordered posts on a common web page. Such a web site would typically be accessible to any Internet user. Blogs run from individual diaries to arms of political campaigns, media programs and corporations, and from one occasional author to having large communities of writers. A weblog is often run through a content management system or CMS.

Document manage systems (DMS) are used as a repository of organizational documents. User can upload new documents to folders, change them and make searches. A good system should provide a way to create a hierarchy of documents, user access rights to folders and full text search. Usually these systems provide version control modules whereby multiple versions of the same document are stored. This allows for looking at changes between different versions and retrieving old versions of documents.

Anyhow, despite the attention given to open software and its potential benefits to organizations and governments, the situation at present would suggest that there is a long way to go before it can be widely used and network externalities comes into force. Theoretically, the benefits of OSS are obvious and organizations and governments would be tempted to adopt but the practicality of OSS remains an issue.

While identifying the opportunities that open source offers for development, it must also be recognized that there are some challenges involved. The relative novelty of open source, in terms of business and development models, requires a certain degree of adaptation by providers as well as users. Moreover, compatibility with existing systems can be problematic. With regard to practical difficulties it is worth noting that the number one challenge is that the open source model is very new. Developing countries may have difficulties in acquiring enough technical com-

petence to develop their own software and to share alike at the same level as other participants. Another challenge is migration, which can be expected when moving from proprietary systems to open source. The greatest challenge may not be technical, but human since most people do not like to change from one system to another: they just resist any change.

There are many reasons why this movement is not gaining as much ground as it should in the developing world. Among these:

− The lack of focus on user interface design which causes users to prefer proprietary software's more intuitive interface.
− Open Source software tends to lack the complete and accessible documentation that retains users. These projects tend to have a major problem with providing decent documentation — if they provide any documentation at all. Because they don't have a contractual responsibility to provide this documentation, it's usually intended to be a general guide rather than a complete manual that you could hand to a novice.
− Developers focus on features in their software, rather than ensuring that they have a solid core.
− Open Source programmers also tend to program with themselves as an intended audience, rather than the general public.
− Lastly, there is a widely known stubbornness by Open Source programmers in refusing to learn from what lessons proprietary software has to offer.

If Open Source software wishes to become widely used and embraced by the general public, all five of these issues will have to be overcome.

Conclusion

Over the past few years, open source software has matured into a serious alternative when considering new software. Organizations in developed and developing countries are increasingly considering replacing proprietary software packages with open source packages. Governments in developing countries too are looking to formulate ICT policies based on open source software. Open source software offers many advantages but it has its disadvantages as well. Here is a short list of some of the advantages and disadvantages of OSS.

Advantages:
- Reduced costs and less dependency on imported technology and skills.
- Affordable software for individuals, enterprise and Government.
- Universal access through mass software rollout without costly licensing implications.
- Ability to customize software based on unique requirements.
- Lowered barrier to entry for software businesses.
- Lower security risks because of custom made packages.

Disadvantages:
- Lack of technical support.
- Most open source software is not very user friendly.
- Difficulty in finding the right package, as open source software is not marketed well.
- Lack of critical mass as few users exist and not many applications are designed to be compatible with other open source software.

The above factors make OSS a complex phenomenon that is difficult to understand by traditional thinking [Pedersen, 2000]. It is first necessary that the concept of open source be understood well before it can diffuse into economies and organizations. OSS can play a big part in effective knowledge management in organizations, as an increasing number of tools are being designed and developed for the purpose. But, for the popularity of OSS to grow, especially in developing countries, governments must formulate ICT policy accordingly to improve awareness and integrate an OSS policy with its education, administration and e-governance policies.

But, before governments are entirely convinced to move forward several issues, such as those illustrated above, need to be addressed. Nevertheless, OSS is set to play a major part in taking the benefits of digital age to organizations and economies in developing countries.

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Summary

This paper deals with the role of Information and Communication Technologies in Development (ICT4D) with special attention to the potential of Open Source Software (OSS) in helping to bridge the Digital Divide. Herein a great amount of emphasis is paid to the role of Open Source Software (OSS) in the important development field of Knowledge Management by their input for improving knowledge management which is seen as a prerequisite to the advancement of the Knowledge Society in developing countries. The objective is to review and discuss the concept of Open Source Software (OSS) and Knowledge Management in the attempt to bridge the Digital Divide.

Rola otwartego oprogramowania (OSS) w zarządzaniu wiedzą

Streszczenie

Praca ta zajmuje się znaczeniem technologii teleinformatycznych (ICT) w zarządzaniu wiedzą. Koncentruje się w szczególności na roli, jaką odgrywa wolne czy darmowe oprogramowanie (F/OSS) w tym procesie. Przedstawia w skrócie niektóre z najbardziej przydatnych oraz popularnych rozwiązań z tego zakresu oraz sposób, w który mogą przyczynić się do poprawy dostępu do narzędzi ICT dla krajów rozwijających się. Celem pracy było omówienie koncepcji OSS oraz roli tych narzędzi w zarządzaniu wiedzą jako sposobie redukowania przepaści cyfrowej.