APPLICATION OF KNOWLEDGE MANAGEMENT CONCEPTS IN ARCHAEOLOGY: A PROPOSAL OF A KNOWLEDGE PORTAL FOR ANCIENT SUDANESE CIVILIZATION

[1]Fatima Ali, [2]Iram Aloshari , [3]Nada Ali
[1]Sudan Academy of Science, Department of Remote Sensing and GIS
E-mail: fatti-avectoi@hotmail.com
[2,3] University of Khartoum, Faculty of Mathematical Sciences
PO Box 321, Post Code 11115, Khartoum, Sudan
E-mail: [2]eramhere@hotmail.com, [3]sudandew@yahoo.com

Keywords: Knowledge management system, Knowledge portal, Sudanese archeology, Sudan heritage, GIS, Remote sensing

Abstract

Sudan has an ancient history that is very rich with cumulative knowledge and experience stemmed from its ancient civilizations. Unfortunately, the antiquities left behind have not been very well preserved and/or documented. Also, most of the research papers, studies etc .That were carried out are hard to locate hence making it inaccessible not only to the public, but also to those who are genuinely interested/involved in this subject matter. The aim of this paper is to look at application KM techniques and methods to the field of Sudanese Archaeology (through the introduction of a web portal) to create new opportunities in the field.

INTRODUCTION

If we had to characterize Sudan by one thing, then it would be by the "richness of its history" rather than anything else. This history is reflected in a wide range of material remains including habitation sites, cave art, temples, palaces, to pyramids glittering on the banks of the Nile and adjacent hinterland. There is also the non-material culture, as depicted on the stele and temple. These advocate values and manners from other parts of human heritage that are worth knowing and preserving. Recently the UNESCO listed two centers of Sudan's ancient civilization (Barkal and Meroe) among the list of world heritage monuments that need preservation.

If someone does a search online he/she may only find few pages about the Sudanese antiquities but nothing specialized for these valuable places or the huge knowledge we have, it`s even hard to find books about them. So, why not have all of our archaeological heritage exist online in one place? We need a place where the archaeologists and others concerned with Sudanese civilizations can meet together and exchange and share their knowledge about the Sudanese archaeology. Here all our antiques and antiquities are documented and seen by photos/videos and reports. We will then use this platform to educate people about our antiquities that are displayed both locally and internationally. Through this portal, non-specialists will find relevant and useful information (i.e. photos with simple scientific comments).Students will find a plethora of data in various formats informing them about the different phases of our history.

Definitions:

Knowledge Management Systems (KMS): are technologies that support Knowledge Management (KM) in organizations, specifically - knowledge generation, codification, and transfer (Ruggles, 1997) [1]

A knowledge management portal: integrates information, collaboration, processes, and expertise. Its basic features include:

1. The portal is the interface that interacts with the KMS to collect and distribute data based on the specifications of the end-user.
2. If a portal is to be successful, it must have as its foundation a comprehensive knowledge management system (KMS).

Major Advantages of KMS [2]:

1. Improves coordination, collaboration, and accountability.
2. Improves the ability to analyze program effectiveness.
3. Promotes standardized data-collection methodology.
4. Facilitates timely feedback and approval.
5. Generates useable reports of individual and aggregate data
6. Combines multiple forms into one online system.
7. Streamlines and tracks plan/reporting approval process.
8. Identifies contractor training needs

Relationship between Knowledge Portals and Knowledge Management

Knowledge Portals provide the framework and enabling technologies to support knowledge creation, production, acquisition, aggregation, classification, analysis, filtering, organization, transmission, dissemination, usage and/or retention. A Knowledge Portal is a fundamental building block of a Knowledge Management infrastructure. It provides both the production interface used for knowledge mapping and the consumption interface for accessing that knowledge. The evolution in portal technologies has complemented a concurrent evolution in the discipline of Knowledge Management.

Knowledge Management focuses on delivery of the right information or services to the right person at the right time. Knowledge Management can be defined and managed from a people oriented, process oriented, content oriented or context oriented perspective. It involves use of various disciplines such as process engineering and various technologies such as application delivery, data warehousing, content management, search engines, customized automated content feeds and alerts, analysis and tracking, queries and reports. [3]

Problem statement:

The land of the Sudan hosts several archeological sites which picture many civilizations that extend both in time and space. There is a great number of research papers , books , travelers notes , that is not properly authenticated and not available in easy ways, to researchers, scholar, historians, elites, commons, media and decision makers.

Objective:

To document and spread the Sudanese archaeology knowledge.

Literature review:

Many researches have been made in the field of archaeology, integrated with other scientific fields which have given effectiveness and research opportunities and ideas. An archaeological knowledge management system called iAKS is intended to be flexible for data entry, archiving and visualization system and appropriate for use in a wide variety of archaeological settings.[4] Another system "*ArchaeoKM*" which uses ontology beyond data integration. It uses the strength of ontology to reason the knowledge presented within. Additionally, *ArchaeoKM* enables archaeologists to define their knowledge of an excavation site through domain rules which they define through the descriptions and observations of the findings from the site. These domain rules are core of *ArchaeoKM* as they represent knowledge of the archaeologists. [5]

Besides, the 3D semantic modeling can be beneficial in providing documentation and interactions with precious artifacts. Furthermore, it can be efficiently employed for educational purposes [6]. The museum materialized the need to show objects coming from great private collections(paintings, sculptures, art objects and archaeological artifacts) in order to create an encyclopedic knowledge covering progressively all the cultural fields (fine arts, ancient civilizations, ethnography, natural history, etc.) and to spread this knowledge gradually to the largest number of people The virtual museum is the result of the conjunction of the traditional concept of a museum with the multimedia computer and communication technology of the Internet. The virtual museum is de-materializing the object for the benefit of providing much more information on the object: the image in all its manifestations (2D, 3D, details, physico-chemical analyses, facsimiles, etc.) and the knowledge of the image (intrinsic information on the object, extrinsic information on the context of the object, histrographical information, reference information, etc.). It de-materializes the museum itself by making possible a "remote visit". [7]

There is also Visualisation in Archaeology (VIA) project. Archaeological illustration is a major new research field, with the UK leading this important research movement. The VIA project adopts the position that images are epistemologically significant in that rather than simply communicating ideas. [8] Though no such projects had been applied in Sudan as yet, it is our belief that it is applicable and can attain fruitful results if scientifically implemented. Accordingly this will be the first attempt of its kind in this field of knowledge in the Sudan.

Method and tools:

1-Knowledge portal

Knowledge Portals enable a common platform for delivery of information. They offer users a single point of access for viewing and acting upon information, personalizing each user's access based upon individual requirements and profiles. Knowledge Portals provide the infrastructure and enabling technologies to support knowledge creation, production, acquisition, aggregation, filtering, organization, transmission, dissemination, usage and/or retention. If the computer of today is a network, the desktop of today is a portal. Knowledge Portals can reduce the cost of information publishing and distribution; increase compliance with corporate standards, rules and processes for information storage and dissemination; automate of business processes such as price quote generation or lead and forecast sharing; preserve and leverage of prior investments in back-end document management, Enterprise Resource Planning (ERP), data warehousing systems. Portals improve users' access to an enterprise's information sources by providing a Web browser-enabled single entry point to display information from various applications or databases; as well as improve the efficiency and accuracy of queries and searches, data mining and manipulation, and report writing. Portals can also enable users to

automatically track events, schedule actions and receive alerts based on pre-defined or implied data parameters. [9]

Contents of Sudan archaeology knowledge portal:

1. List monuments and antiques provided with photos.
2. Explanation documentaries.
3. Presentation of Sudanese antiquities existing in museums abroad.
4. Documentation of scientific and historical resources.
5. Listing the names and addresses of scientists and archaeologists Sudanese and non-Sudanese working in the field of Sudan archaeology.
6. Excavations news and reports.
7. Interesting links.
8. Forum for sharing knowledge in Sudanese archeology.
9. Wiki.
10. General information and description of historical events in different eras and phases with photos, maps, diagrams, etc.
11. Virtual museums.

2. Geographical information systems and remote sensing

Geographic information systems (GIS) is a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world (Burrough 1986) [10]. For the purpose archaeological site mapping software of GIS will be used, this soft ware will help in easy and simple display for these sites with their names and geographical locations, it will also allow easy 3D analysis. In order to accomplish this goal we will resort to do A field visit to the archaeological sites to take the geographic coordinate with Global Position System (GPS) device to support the maps, as well as taking photos etc.

Remote sensing (RS) is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by device that is not in contact with the object, area or phenomenon under investigation (Lillesand and Kiefer 1979) [11]. We will use remote sensing science with suitable software to display digital images obtained by remote sensing for archeological specific sites, the digital image give obvious description about the topographic features of the site.

Discussion

Inhibitory limitations of archeology in Sudan:

As a third-world and developing country Sudan is confronted with a number of complicated problems and challenging issues that endanger its very existence despite this long and rich history. Sudan is a country of wide ethnic diversity some of which are believed to be marginalized coupled by religious diversity and socio-economic diversity I.e. the country needs a strong and effective "safety net". Up to now the question of identity is still hanging over Sudan and how its people view themselves "not because they are not sure of themselves but because they cannot define themselves". The ethnic and political conflict that stained our current history resulted from weakness of the state and the lack of a clear and solid nation-building program. Sudanese communities are confronted with the challenge of globalization which can be a threat to some local cultures and indigenous people [13].

A discussion session was organized by the authors and presented by Dr Gada Kadoda [12] for archaeologists and other people from different disciplines. From this discussion limitations encountered in the availability of this huge amount of knowledge to different sectors of the community. They may be attributed to many factors; some of which are sorted and organized by author given below:

1. Decision makers: Unfortunately this sector lack proper awareness of archeology. in addition to that they mostly assume that a quick benefit may be gained from archeology without putting plans , funds , training of archeologist…etc[14] . More over archeology is normally put in the bottom of priority list of development plans, if not ignored.

2. Archeologist and historians: This group include scientist working in government department concerned with archeology and university lecturers. Information is not available for this group in a systematic and organized way; because information in archeology is scattered in many countries in the world and in different languages [15]. They are not given sufficient funds to do their research. However their income can hardly be enough for their subsistence. These inhibitory factors resulted in:

a. Isolated individuals, consequently yielded lack of knowledge exchange [16].

b. Expertise leaves the country to other countries for the improvement of their financial status.

c. Their contribution to the public awareness with archeology is meager.

3. Students: Students are normally poor in English accordingly they cannot use the references which are mostly written in English.. The lectures in archeology are normally given in Arabic while the references in Arabic are rare [17]. The syllabi are deficient in some aspect such as computer skills, scientific writing, statistic, etc. [18].

4. Media: The media suffers from:

a. Loss of interest in archeology.

b. News papers are advertisement dependent, thus no places is given for archeology in newspapers.

c. Television programs don't show material about archaeology.

d. Films and video in archeology are seldom.

e. The little that is given to archeology is treated as bed time stories or without serious concern [19].

5. Public: the population is acutely suffering severe illiteracy, accordingly they cannot feel the importance of archeology due to erroneous religious concepts they assume that antiquities belong to the devils and magic [20]. It is quite normal that a villager may destroy a master piece of antique to satisfy his wrong believes , or in their best searching for gold assumed to be hidden with the antiquates.

6. Security: During the colonial period many antiquates found their way outside the country to foreign museums beside local theft and looting, lack of safe guarding the site and insufficient severity of penalties combined this creates an atmosphere in which valuable antiquities were smuggled not only as material culture but also as values , became unavailable to the public and otherwise .

7. Logistics: archeological site are scattered in remote areas and they lack:

a. infrastructure : paved roads, rest houses, inns, hotels, means of transportation, hospital, banks, etc.

b. other : tourists guidance , onsite museums , site marks, etc.

Expected results of the portal:

1. Create data base for Sudanese archeology that contains whatever is available about the ancient Sudanese civilization. This database is systematic i.e. in time and space in this way the information in this portal can be easily accessed by its visitors.
2. Connecting Sudanese archaeology with technology.
3. Provide factual evidence of the country`s past to the Sudanese people
4. Present the Sudan heritage to the outside world , place it on the world heritage map and cast light on the role played by the ancient Sudanese in world heritage
5. Play role in current national issues challenging the country (i.e. identity, nation buildings, etc.)
6. Encourage developing management and help safeguarding the country`s heritage to prevent human vandalism and natural degradation
7. Facilitate and create research for post-graduate and university scholars.
8. Encourage both national and foreign expeditions to conduct field work to fill episodes in the cultural sequence.
9. To encourage cultural tourism to play its part in the national economy.

Conclusion

The impact that we seek from this project is to attract more attention to the ancient Sudanese civilization, besides outreaching the greatness of this civilization to give an access to Sudanese archeologists to present their works on a large scale, besides encouraging the study of Sudanese civilization and also encouraging tourism to Sudan**.**

Cooperation between archaeologists, Sudanese archaeology societies and other different disciplines from inside and outside Sudan will make integrated and quick achievement of the project because last but not least this is a national work derived by the love and care for our past and our future to reserve our heritage from loss.

Acknowledgements

The authors would like to express their thanks and gratitude to their supervisors Prof. Zroog. S.A. and Dr. Gada Kadoda from university of Khartoum for continuous stream of help, valuable encouragement and facilities their offered during of this paper. Thanks to Ustaz . Mohanned Abbas reading the paper and valuable alteration he suggests.

REFERENCES

[1][3] Dorit Nevo"University of British Columbia" Developing Effective Knowledge Management Systems*"*(2003).

[2] edutechwiki.unige.ch/en/Portal.

[4] Ethan Watrall, PhD and Jeff SiartoMichigan State University "iAKS: A Proposal for a Web2.0Archaeological Knowledge Management System" confrerence paper(2007).

[5] Ashish Karmacharya, Christophe Cruz, Frank Boochs, Franck Marzani "ArchaeoKM: Realizing Knowledge of the Archaeologists" (2010).

[6] Manolis Vavalis University of Thessaly" On the impact of Knowledge Management of 3-Dimensional Archaeology & Cultural Heritage, In: Heritage in the Digital Era, ISBN 978-1-907132-25-4, MultiScience, (2010).

[7] The Contribution of theItalian National Research Council" Virtual museums and archaeology. The contribution of the italian national research council", All'Insegna del Giglio (2007).

[8] Garry Gibbons "Visualisation in Archaeology Project"report (EH Project No: MAIN5172) funded by English Heritage under the HEEP scheme March 2012.

[9] http://it.toolbox.com/wiki/index.php/Knowledge_Portals "Knowledge Portals", eKnowledgeCenter, 2000.

[10]Bourroygh,P.A and Mcdonnell.R.A,Principles of geographical information systems.Oxford University Press.chapter one, page11 .(1998).
[11]Hamid .A.A , Remote sensing principles and applications. UNESCO chair desertification . chapter one ,page 1.(2009).
[12] Dr.Gada Kadoda affiliated with a number of Sudanese higher education institutions teaching Software Engineering, Research Methods and Knowledge Management.
[13] Prof Abbas Zaroog ,Department of Archaeology ,University of Khartoum, University of Dongola.
[14] Habab Isa employee at National Corporation Antiquities and Museums (NCAM).
[15] Dr.Yahia Alfadul , Department of Archaeology ,University of Khartoum .
[16][19] Nema employee at National Corporation Antiquities and Museums (NCAM).
[17][20] khrasani Alamin Student At Department of Archaeology University of Khartoum .
[18] Prof Kabeir Department of Archaeology, University of Bahri .

FINANCING TRAINING IN APPROPRIATE TECHNOLOGIES TRANSFER FOR SUSTENANCE IN DEVELOPING SOCIETIES

[1]Moses Wandera
Research Student, School of Human Resources Development Jomo Kenyatta University of Agriculture and Technology, Kenya
E-mail: mosewa2005@yahoo.com Cell - +254 723 393639

Key words: Financing, Sustenance, Training

Abstract

The concept of knowledge and human resource endowed in its transfer is quite immense. The training and learning institutions have their role, formal, non-formal or informal in nurturing innovation, financing new and ultimate transfer amid the challenges for sustainability. The aim of this paper is on models and techniques of training, and available financing avenues to enhance knowledge transfer for sustainable well-being to the society and the entire community well-being. The theoretical framework of the study is the Freirean pedagogy and feminist pedagogy with post-modernity view points on development, gender, society and other concerns. The design of the paper was on content analysis and the inquiry on appropriateness of the well being in the knowledge transfer. The study emphasized on ten areas of technologies that should be emphasized in sustainable development with their financing and training options. The paper recommends policy measures both global and national on training and financing in the knowledge transfer towards the well-being of everyone in the life – long learning and living. However, further research should be on technologies that meet millennium development goals and achieve industrialization with minimum risks and maximum benefits.

INTRODUCTION

The roots of the concept of sustainable development can be traced, to a report put out by the club of Rome in 1972, entitled Limits to Development. In the same year the first United Nations conference on the environment, which took place in Stockholm drew attention to the increasing toll on the environment due to the unbridled pursuit on economic development. The second UN conference on the environment, which was held in Nairobi, Kenya in 1982, brought attention to bear on the relationship between environmental and socio-economic development. Further a strong argument emerged that environmental technology cannot resolve all the problems generated by the socio-economic impact on the environment.

The findings of the report led to the establishment in 1983 the World Commission on Environment and Development, with Gro Haarlem Brundtland as chairperson. Its mandate was to formulate a universal program for the reversal of the process of environmental deterioration. An initial four-point approach was envisaged as follows: **e**nvironmental policy, with a long-term strategy and aimed at achieving sustainable development, recommendations on ways and means to cultivate cooperation between developing countries (South – South) and cooperation between

[1] Author for correspondence

the developed countries and the developing countries (North-South) with environmental considerations as the Lynch-pin , the study and consideration of possibilities, which can make the international community act more concertedly and efficiently where environmental problems are concerned, and the formulations of a collective vision on how environmental issues are to be created in the long-term, in other words, the creation of long-term or strategic action program.

Sustainable development is characterized by being able to address the concerns of the society, the economy, the environment and political. Economic goals include; employment creation, equitable Income distribution within countries and redistribution among countries, the establishment of an equilibrium between the economy and other nonhuman systems, technology exchange, not simply technology transfer and economic self-reliance at the community and national levels.

Social and cultural goals on the other hand includes; equity and justice, emphasizing needs over wants, especially in the North, full status as participants in the polity for all regardless of race, gender, ethnicity, or class, maintenance of cultural diversity, including respect for and support for indigenous peoples, strengthened communities through tae participation of individuals and. social groups in the conduct of their own affairs - everyone will be respected at the table, revitalization nation of sustainable rural communities through the development of environmentally sensitive and economically productive agriculture, family farming, and appropriate value-added environmentally sound industrial development and revitalization of communities within urban settings.

Political goals include; political security, calling on the participation of communities in defining the problems of the polity and developing solutions, so as to protect themselves from non-democratic internal threats and to meet the needs of the inhabitants, strategic security, so that communities are able to defend themselves against external threats, coercion, or invasion, whether economic or political, environmental security, under which a viable balance is truck between a community's endowment (including its natural capital and its level of technology) and the performance, and which allows it to protect itself from environmental assaults from outside the community and a world that is largely demilitarized.

Ecological goals include; planning for ecological stability that will fit with increased general self-reliance and rely much more on renewable and recyclable supplies of resources, environmental protection through greater concentration on resource and waste repository constraints, which may require resource planning and target setting to minimize the use of resources and the production of wastes, technology assessment, management, and regulation, with particular attention to unintended consequences in the medium to long term focusing first on waste reduction and then on waste management, zero toxins-which, while it may not be a fully attainable goal in a modern society, represents a more appropriate one than "acceptable risk", balancing ecological debt within and among countries and sufficiency rather than simple efficiency as well as population stabilization. [1] Similarly on education for sustainability; the issues that are normally explored include; the society, nature, the learning involved as well as the environment and social change [2].

Further, management of issues in learning especially for curriculum design, there has been UNESCO guidelines on teaching and learning for a sustainable future through multimedia teacher education programme, the biodiversity basics as well as Education for Sustainable Development (ESD) tool kit. The pedagogy and issues for measuring learning and effectiveness are dynamic and may vary from region to region, however the change should be evident in all. Further, what is essential is that communities must be linked with the environment so as to tackle

poverty and be able to address concerns of sustainable development [3]. While on education for sustainability, then the natural should be linked with economic, social and political or who decide what; which is essential for the formal sector as it reaches the informal and non-formal aspects of education [4].

Aim of the study

The study aimed to understand models of training in sustainable development and education, explain some appropriate technologies involved in sustainable well-being as well as to enlist some financing options in the appropriate techniques involved.

Theoretical framework

The theoretical framework used for the study supports the Freirean pedagogy and feminist pedagogy, however, with some viewpoints of post-modernity like human rights and community development and empowerment towards the youth, adult, children and all the stakeholders involved and in its participation [5]. The design of the study has been based on the available contents and post modernity expectations.

Foremost is the sustainable agriculture for developing societies that should be key to any meaningful development therefore a proper agricultural development policy is the key. In Africa for instance in Sierra Leone, the agricultural policy run from the 1970s through the 1990s and this was the same that had been used in the 1940s by the colonial government targeting the demands of the world market economy and to some domestic rule elite [6]. In the same was sustainable agricultural development faces many challenges as no one factor is solely responsible for the lack of sustainable development in Africa which include among others; natural factors; drought, excessive rain, poor soil conditions and crop decline or loss of productivity due to pests and diseases, structural factors; poor infrastructure, limited access to inputs and necessary technology, inefficient domestic markets, insufficient investments, and unfavourable global trade and finance structure as well as human and socio-political factors; civil conflicts, the ever harsh legacy of colonization, bad policies, ineffective bureaucracies, generalized corruption, the use of low-yield methods of production, and the impact of human diseases.

Environmental Technologies are another type and relate to Environmental Impact Assessment, future-orientations, technological focus, comprehensive and comparative scales. However, for scientific aspects of technology ; the steps are decision-making process in government and industry, developments in science and technology as well as on societal developments. While the technologies here may include; solid wastes management, air pollution, waste water treatment, environmental pollution, urban and rural environmental issues [7].

Low income settlement technologies on the other hand are another category. They concentrate on housing settlements in appropriate technologies for low income groups and this can be financed from; loan instruments that is; conventional mortgage loans, Graduate Payment Mortgages (GPM), Variable Rate Mortgages(VRM), loan of reducible duration, and lending under indexation; similarly it includes; self-financing, adapting loan conditions to the needs of low-income groups, collateral terms and conditions as well as incremental loans. There are also the subsidies. The subsidies system would work in tax benefits, interest rate subsidies, direct subsidies as well as equity participation [8].

Building technologies and their financing are also important; for instance public rental housing arrangement have been successfully done in India. There has also been subsidized

financing arrangement in Bogota Colombia where maintenance cost of public housing rented to low-income groups was subsidized. Similarly, in the United Kingdom in 1982, every civilian government department was required to pay an accommodation charge and the cost of maintenance was specifically identified. In Zimbabwe; the cost-recovery practices especially in the city of Bulawayo for full recovery of building maintenance costs through a self-balancing distribution account has also been used. In Singapore the creation of a sinking fund to ensure the availability of adequate finances for maintenance of private buildings was used so much that the need for institutional finance was not felt by the private sector [9].

Renewable Energy Technologies and the promotion of renewable energy technologies have been an effective diffusion and utilization of renewable energy technologies. In developing countries there is need to have a programme of action which may include the establishment of centres to promote the use of new and renewable sources in various economic sectors of human settlements. These centres would perform other tasks such as the dissemination of information, testing, evaluation, quality control, demonstration (of projects) education and training at all levels. Further the centres could also take up comprehensive studies in cooperation with other interested agendas, on possible roles of methanol, ethanol and hydrogen as future sources of energy especially in the transport sector, assessment of technologies, their economic and environmental impacts and land-use implications, and the present status and future promise of hydrogen technology in meeting the energy requirements of human settlements among other concerns.

Training centres in renewable energy are also important. There is lack of trained personnel to organize, deploy and direct the relevant exercises. Wind programmes as wind-energy magnitudes is hindered by lack of proper measuring equipment, advising on siting, designing, selecting and installing the hardware, gathering and disseminating the field test data as well as administering outreach programmes. In order therefore to overcome problems faced by developing countries training centres then have to be set up, and should be sufficiently staffed and have access to the services of expert consultants. They should be able to develop co-ordinated plans and programmes of harnessing the specific energy source not only based on developments elsewhere but also through their own research and development activities.

Financing of renewable energy technologies is also very important. The success of the propagation of new and renewable sources of energy would depend upon the developing countries' ability to finance activities related to new and renewable sources of energy. The need to establish appropriate financial mechanisms towards this is important. Brazil, China and India have made some steps to this in renewable energy technologies; therefore there is need for international co-operation which is essential for financing the diffusion of renewable energy programmes and technologies as evidenced by various programmes in Argentina, Brazil, Nepal, Senegal and the United Republic of Tanzania, among others. Asian Development Bank has been helping in the diffusion of micro-hydel equipment manufacture in Nepal, though an outright donation of renewable energy equipment often does not help in spreading the technologies due to such reasons as the lack of working capital for complementary inputs, the absence of service and repair facilities and the lack of spare parts. Sometimes it may damage the local equipment manufacturing capability where it exists. In such cases, international assistance should involve local manufacturers and research and development institutions in the provision of technical expertise.

Therefore the training of needed personnel, the supply of raw and intermediate materials, the transfer of technical know-how, and the supply of any special equipment needed for the

manufacture are some areas where international financial assistance could boost diffusion of technologies in energy. International assistance may be used to strengthen existing local financial mechanisms to augment their ability to provide loans or grants to local entrepreneurs and projects in rural and urban-poor areas concerning new and renewable sources of energy [10].

Technologies towards women's empowerment are also important since women bear an inordinate burden as the providers of domestic and community services in human settlements, and they are most affected when services are missing or inadequate. It is therefore to note that appropriate technologies should aim to enhance women's participation to have their voices heard, and to translate their concerns into housing and community development programmes, thus improving the conditions of all people at the community level.

In the same way women's socio-economic status, access to shelter and services as well as women's participation in community management is important as women are normally responsible for household and subsistence tasks, yet they often lack legal or customary rights to land and housing. It means in financing their technologies, there is need for reduction in constraints imposed by financial organizations, special financing provisions, and reductions in constraints imposed by governments as well as measures to increase the access of women to housing finance. This has been done well in Indonesia and the Annapurna Mahila Mandal a region in Mumbai, India [11].

Livestock Assets Management Technologies are also important. Globally, more than one billion people suffer from micronutrient malnutrition (especially pervasive among women and children), which can be overcome by adding milk and meat to the diet, since livestock ownership supports and sustains the livelihoods of an estimated 675 million rural poor.

Further, it means therefore that a small but reliable income from selling milk can pay school fees or allow a mother to feed and cloth her family better. Although the developing world will be producing 50% of the world's milk by 2020, milk yields are almost ten times lower in Africa and four times in lower in South America and Asia than in North America and Europe. However, strategies dealing on the modification to manure management that reduce nutrients loss show there is great potential to increase farm incomes and sustain soils as productive assets. Similarly, new strategies must therefore fit into the farmer's system and not vice versa as farmers have their own way of doing things. On financing livestock assets, in Kenya for instance research done by ILRI showed that each kilometer of bad road separating a farmer from the market reduces the price one receives per litre of milk by about 2%. This then will call for increased credit to livestock farmers, infrastructure improvement, improving in transaction costs as well as asset building improvement in all ways [12].

Local building materials and technologies are another important aspect of development. The African Network of countries on local building materials and technologies had identified the manufacture of bricks by a semi- mechanized process which includes high drought kiln, the manufacture of bricks from alumina red mud and the manufacture of bricks from red murrum soil. Further appropriate technologies in this case should enhance their production, training and financing as they had been hindered due to less or lack of access to financial support in many countries; Ethiopia, Ghana, Kenya, Lesotho, Malawi, Namibia, Nigeria, United Republic of Tanzania, Tunisia and Zambia in the network are some of the countries who have experienced hindrances. However, credit support, particularly to small enterprises, marketing support to micro-enterprises, and technical advice to small entrepreneurs as well as procurement of raw materials, equipment among others is a factor that requires institutional strengthening so as to speed up the growth of this industry [13].

Climate change technologies are the latest and also important. Financing for adaptation in climate change in developing countries comes primarily from the dedicated climate change funds available under the United Nations framework convention on climate change (UNFCCC) and through overseas development assistance. However, in practice the funds available are at present inadequate and they do not target urban settlements. On the other hand, there is need for partnerships between public, private, civil society and other actors that are becoming critical in building urban capacity to respond to climate change as mechanisms within the international climate change framework do not indicate a clear process by while urban areas and actors may participate [14].

Education and training on innovative technologies should also be considered as of much importance in sustainability. This involves basic foods of communities in developing societies as; rice, wheat and maize. Innovative technologies will reduce poverty, hunger and malnutrition. It means global partnerships and knowledge sharing, which is the foundation for innovation and the impact created should be enhanced. Similarly, the non-governmental organizations (NGOs), the farmer groups, the community as well as self-help groups should also be emphasized while creating partnerships with the private sector to reach maize farmers, rice or wheat that need to be created. On the other hand, education on indigenous foods which are drought resistant should be given much advocacy [15].

Conclusion

To achieve appropriate technologies in development, the challenge for higher education is therefore on the sustainable curriculum to undertake [16]. However, issues of collaboration and partnerships in research, funding and labour mobility in knowledge management and transfers so as to meet the challenges of development especially in developing societies should also be considered to counter the challenges of development through appropriate training, financing and relevant techniques for the well-being of all. Training for transformation in the community, should involve partnerships between the government and community for instance; architects, builders as well as skilled workers. Models here for development may include working with all the stakeholders, working with the community leadership as well as working with co-operative local leaders [17].

However, in planning for sustainability then the three E's that is, environment, economics and equity especially in post-modernity and ecological world views should still be emphasized [18]. Generally, the well being for the community is then the health which should be the consequence of the total sum of water, sanitation and hygiene education [19]. On the other hand education in health may also involve in its empowerment and promotion [20].

It is therefore recommended that societies concentrate on appropriate technologies that are life-long in need and training just like education. Further research should then be on the appropriate techniques that meet millennium development goals and achieve industrialization in specific countries, more so those that minimize the risks, maximize benefits for the well-being of all.

Acknowledgments

The author will like to acknowledge Zilpah and Apollos for their assistance in collection of materials and the environment setting to write the report.

REFERENCES

[1] Viderman, S. (1993). Sustainable Development: What is it and how do we get there? Current History (April). Pp82-183 cited in Ukaga and Afoaku, 2005: 35-36. In Ukaga O. and Afoaku G.O. (2005). Sustainable Development in Africa. A multifaceted Challenge. Asmara Africa. World Press, Inc. and in Ukaga Okachukwu(2005). Overcoming Challenges to Sustainable Agricultural Development in Africa.

[2] Scott William and Gough Stephen (2003). Sustainable Development and Learning: Framing the Issues. London. Routledge / falmer.

[3] Warburton Diane(2000). Community and Sustainable Development. Participation in the future. London. Earthscan.

[4] Huckle John and Sterling Stephen (2008). Education for Sustainability. London Earthscan.

[5] Ledwith Margaret (2005). Community development: A critical Approach. Bristol. Policy Press.

[6] Kamaarah I. Umar (2001). Sustainable Rural Development. Semantics or substance? Maryland. University Press of America.

[7] UNEP (1996) IETC Report series – issue 3. Environmental Technology Assessment (ETA) in Sub-Saharan Africa. A UNEP EnTA Leadership Training programme 25-28 Nov 1996 in Potchefstroom, South Africa, in collaboration with the Potchefstroom University for Christian Higher Education and the UNEP Regional office for Africa.

[8] UNCHS (1989). Women and Human Settlement Development. Nairobi United Nations Centre for Human Settlements (Habitat)

[9] UNCHS (1991). Report of the international workshop on building maintenance strategy. Assenovgrad , Bulgaria. UNCHC and international Academy of Architectural, Sofia, Bulgaria. June 5-6th. UNCHS (Habitat)

[10] UNCHS (1990). Use of new and renewable energy sources with emphasis on shelter requirements. Nairobi, Kenya. Habitat. HS / 183/89E.

[11] UNCHS (1989). Mobilization of Financial Resources for Low-income Groups. Habitat United Nations centre for Human Settlements. Nairobi, 1989.

[12] ILRI (2000). Greener pastures for the poor: Maximizing assets. Report to the Ford Foundation from the International Livestock Research Institute. Nairobi, Kenya. ILRI.

[13] UNCHS (1995). Women's Empowerment: participation in shelter strategies at the community level in urban informal settlements: key indications and procedures for their application. Nairobi. UNCHS (Habitat) and UNCHS (1994). Journal of the Network of African countries on local building materials and technologies. Vol. 2, No.2, No 4, Dec 1993. Nairobi: ISSN 1012-9812.

[14] UNCHS (2011). Cities and climate change. Global Report on Human Settlements 2011. London. Earthscan.

[15] Cimmyt (2004). Seeds of innovation. Cimmyt's strategy for helping to reduce poverty and hunger by 2020. Mexico International Maize and Wheat Improvement Centre.

[16] Blewitt John and Cullingford Cedric (2004). The Sustainability Curriculum: The Challenge for Higher Education. London . Earthscan.

17] Hope Anne and Timmel Sally (2001). Training for Transformation: A Handbook for Community Workers. ITDG Publishing.

[18] Kerr Charles (1990). Community Health and Sanitation. London. Intermediate Technology Publications (ITDG).

[19] Wheeler M. Stephen (2004). Planning for Sustainability: Creating Livable, Equitable and Ecological Communities. London: Routledge / Taylor and Francis Group.

[20] Breckon J.D, Harvey R.J. and Lancaster B.R. (1994). Community Health Education; Settings, Roles and Skills for the 21st century. Maryland, Aspen Publication.

THE EVOLUTION OF JEF FROM COMMODORE VIC 20s TO HIGH PERFORMANCE COMPUTING

Jesse Bemley
Joint Educational Facilities, Inc.
2528 Naylor Road, SE, T-3
Washington, DC 20020 USA
Voice +1 202-584-1898 Fax +1 202 727-7226
E-mail: jbemley@jef.org

Key words: Pre-college, Advanced computing, Expert systems, Neural networks, Artificial intelligence, High performance computing, Cyberinfrastructure

Abstract

The Joint Educational Facilities, Inc (JEF) is a community-based STEM research program that has been training high school students in advanced computing since 1985. Here it is shown that the training at this Center by its professional adults rose from a rudimentary level. Because of the flexible staff and changing directions, the training has evolved over the years to reach greatest heights such that pre-college students are prepared to the extent that they are competitive with the advanced current trends needed for STEM fields.

INTRODUCTION

It will be shown here that after 27 years of existence of a community-based organization called Joint Educational Facilities (JEF), there also occurred an evolution in computer hardware, computer language, and its users. Parallel with these changes was the noted evolution of the students trained by this community-based program which is located in a low-income area of a large urban city. This paper is important because it points out that such interventional programs are mandatory if the United States wants to train more students to meet the essential needs of the STEM fields.

Short History

JEF was first conceived by a group of college students and their professor at a local institution. The primary object was to train local youth how to use computers. At that time, only the Commodore VIC-20 was popular [1] and the computer language BASIC was used in writing programs. As time passed, the group organized into a more formal structure led by a Board of Directors. Meanwhile, the arrival of a personal computer known as the IBM PC caused it to become a very popular item. The JEF Board of Directors decided to take the lead in acquiring these machines and their new concepts and make them available to the local community. Thus, the use of the new hardware and its software were added to the curriculum and offered under the heading of "Community Computer Literacy."

The marketing of personal computer moved ahead and JEF introduced the concept of "Artificial Intelligence (AI) and then later, "Knowledge-based Expert Systems Software Development" to it's students. The JEF Board of Directors agreed to jump on board and began training the interested students in these new directions which included expert systems (ES) and its application using the AI language Prolog. Meanwhile, it was soon recommended to the JEF Board of Directors that the JEF high school students who were being enrolled should also be

trained in communicating their newly gained knowledge to the outside world. The next step taken was to transport and expose students to conferences and meetings where they continued to learn the art of public speaking. The advanced students were prepared to the level of being able to publicly make a presentation. Once they reached that level, they were expected to learn to make presentations of their research findings in the use of new computer languages and the use of recently marketed hardware and software at local, national, and international meetings of various professional organizations [2, 3, 4, 5, 6, 7, and 8].

Charts Showing JEF Statistics

Charts 1 and 2 show the number and types of conferences in which JEF students participated at the local, national and international levels from 1984-2001. Chart 3 shows the variety of subjects that the students selected in the year 2002.

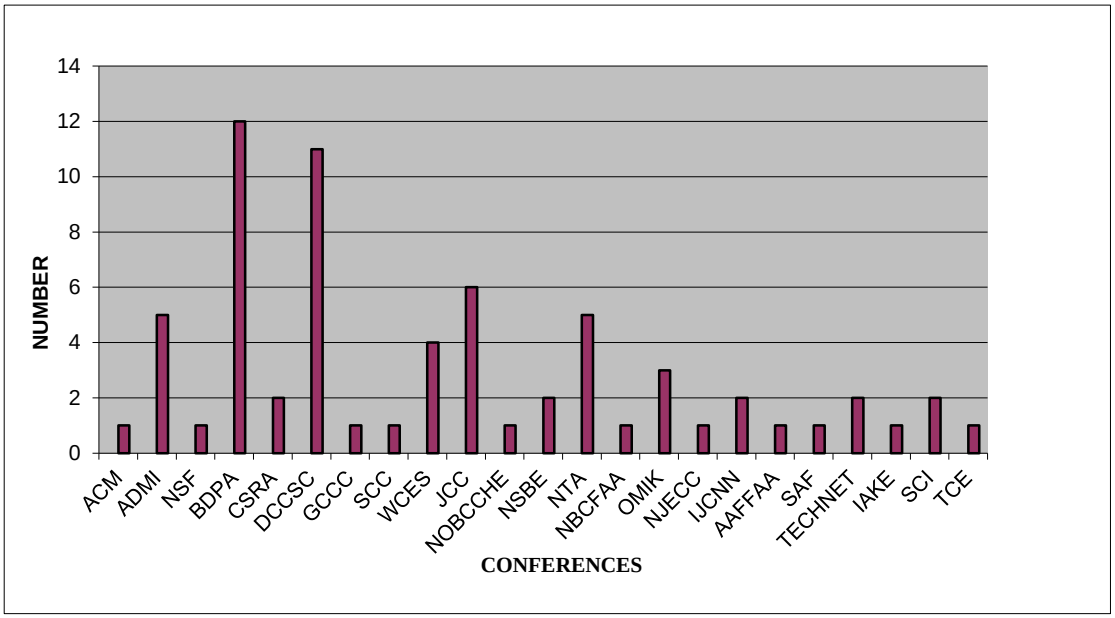

Chart 1. Number of Conferences

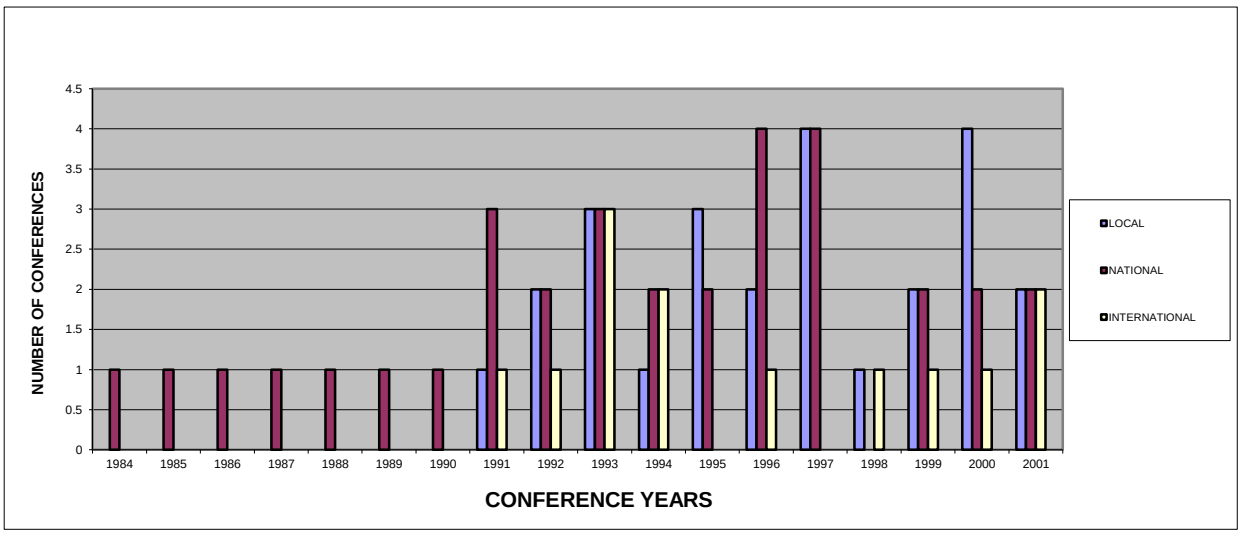

Chart 2. Conferences by Type and Years

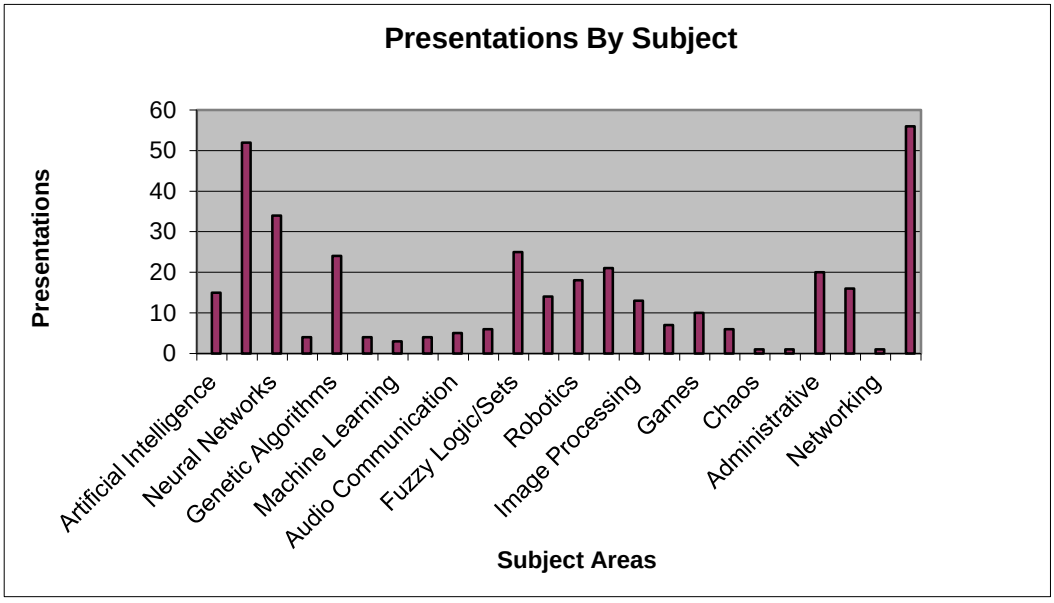

Chart 3. Presentations by Subject

A Revolutionary Change In The Direction Of JEF

It soon became apparent that there was a need for changes in several components of a training module of neural computing for the junior high and high school students. It was time to shift directions from just learning to use available hardware to learning how to supplement their knowledge of expert systems with neural computing in other areas of soft computing. These steps were taken in order to better prepare the advanced students who were heading toward college. In other words, the students needed to become better acquainted with artificial neural networks (ANN), their derivation, applications, and relationships to fuzzy logic and genetic algorithms. What also was needed was the introduction of mathematics in the module at the level that students could use. Since the target group was composed of pre-college students, the material had to be drawn from literature that was fairly easy reading. It was decided that module mathematics would be at the algebra level. Several websites provided the needed material [9, 10, 11].

The goal of the module was to give an introduction to the field of neural computing by providing an intuitive understanding of how ANNs work. It is called learning by discovery. It was, also, assumed that the student would better understand the theoretical treatment at the university level after having gone through this exercise at the high school level. All of the work here led to a generalized framework which fits the overall JEF process. This generalized framework came to be called THE JEF MODEL. The model contained a box of technologies which initially contained the various subdisciplines of AI, (e.g., expert systems, natural language processing, computer vision, voice recognition, etc.) but was expanded to include areas of soft computing, contemporary mathematics (e.g., fractals, rough sets, etc.) and graphics and web technology and was used to develop projects in Artificial Life, Fuzzy Logic/Sets, Robotics, and Virtual Reality.

Results: Advanced Computer Project

The JEF computing research program which was initially PC based, advanced to a higher level known as High Performance Computing (HPC) based research projects. The first project

developed by four students at JEF included the use of Cyberinfrastructure tools such as cluster computing, access grid and visualization applications. Their work called, "The Workshop" involved their working all summer long with each participant developing separate end products. At the end of the summer they gave their presentations and the final papers were published [12].

Summary

Students who were properly trained by an interested group of professional adults as those at JEF, a community-based organization, acquired skills that enabled them to participate in modern and advanced fields of computer science.

Conclusion

It has been clearly shown here that if the staff of a community-based program keeps abreast of the existence of current computer hardware and is dedicated to instructing those skills to the youth, it can serve as a conduit as well as model for leading more students toward the STEM fields. High school students who live in low-income or deprived areas are not commonly exposed to this availability and are possibly left out of such opportunity. Recognition of this kind of success could also lead to broadening of the pool if more funding opportunities were made available for such efforts. It would then be more beneficial to everyone.

REFERENCES

[1] Murray S and Bemley J, The Neighborhood Computer Club, Proceedings of the 23rd Annual Technical Symposium of the Washington, DC Chapter of the ACM, Gaithersburg, MD 1984

[2] Bemley J, High School Students Build Knowledge-based Systems, Proceedings of the Third Annual Symposium of the International Association of Knowledge Engineers, 1992, pp. 816-820.

[3] Barnett D, A Teenage Girl's Shopping Habits, Proceedings of the First Annual District of Columbia Computer Science Conference, Washington, DC, 1992, pp. 6-11.

[4] Brooks J. Neural Networks, Proceedings of Black Data Processing National Conference, 1991

[5] Brown O, Neural Computing: A Program That Learns, Proceedings of the First Annual District of Columbia Computer Science Conference, Washington, DC, 1992, pp. 12-16.

[6] Berry L, JEFBAS: The JEF Expert System, Proceedings, The Second World Congress on Expert Systems Vol 5(1994)

[7] Brown O, Integrating the Neural Network and the Expert System into Hybrid Models, Proceedings, The Second World Congress on Expert Systems Vol 5(1994)

[8] Simmons N, How to do a Research Paper: An Expert System, Proceedings, The Second World Congress on Expert Systems Vol 5(1994)

[9] Caudill M, Using Neural Nets: Hybrid Expert Networks, *AI Expert*, VOL 5, No. 11 (November 1990)

[10] Caudill M and Butler C, Understanding Neural Networks: Computer Explorations, Cambridge, MA, MIT Press, 1994

[11] Medsker L and Liebowitz J, Design and Development of Expert Systems and Neural Networks, New York, Macmillan, 1994

[12] Bemley J, Proceedings of the Cluster Computing Project, Joint Educational Facilities, Inc., Washington, DC 2004

QUANTUM APPROPRIATE TECHNOLOGIES

Isra E. Mohammed
Garden City College for Sciences and Technology, Department of Information Technology, Khartoum, Sudan
E-mail: israelamin@gmail.com

Key words: Quantum Computer, Quantum Appropriate Technologies, Quantum Applications, Quantum Robot.

Abstract

This research paper discusses the development of the current technologies under quantum computer environment. Although we might have to wait a while for commercial quantum computers, but the modality of implementation of quantum appropriate technologies must be marked. This paper shows that quantum computing contributes in the improvement of the governments and organizations performance. Implementation of quantum appropriate technologies requires exertion to settle quantum technologies and introduce quantum concepts through training courses. Due to the high cost and obstacles of building quantum computer architecture, it can be used to perform complex operations in the government and the big organizations and using digital computers to perform simple operations. This paper gives an overview for some of quantum appropriate technologies such as quantum programming and the compilation of quantum programs, and then quantum databases, quantum cryptography, quantum artificial intelligence and quantum software engineering shall be discussed. Advanced capabilities will be shown through the discussion of quantum appropriate technologies.

INTRODUCTION

Quantum systems can be manipulated to use the quantum effects in the implementation of quantum computer which can effectively increase the efficiency of data processing. Due to the high computational capabilities in the quantum computer, it can be an appropriate environment to execute the complex computations.

Quantum computing techniques can be developed to fit the social and economic conditions to be applied, and promotes self-sufficiency on the part of those using it.

The fundamental unit in the quantum computer is a quantum bit (Qubit) which has a quantum nature and it can be zero, one or in a superposition state. The set of qubits can be used to process quantum algorithms through quantum gates to produce quantum applications. Quantum appropriate technologies can be implemented using quantum programming.

Quantum computer is based on the superpositional logic of quantum mechanics so it will be very powerful because it processes the operations in a parallel manner which is provide professional data processing and prevent time consuming.

Building the architecture of a quantum computer represents an important step to provide the environment for quantum appropriate technologies which can revolutionize the information technologies systems so there is a great need to increase the development of research in this field to design the structure of quantum computer.

Quantum Appropriate Technologies

Operation mechanism in quantum computer allows implementing of exciting appropriate technologies which is facilitating the governments and organizations functionality because it performs the required operations with an excellent performance. The next subsections start with discussing of quantum programming and compilation of quantum programming which will be an important tool to implement quantum applications. Then a different appropriate technologies which are: quantum databases, quantum cryptography, quantum artificial intelligence and quantum software engineering shall be discussed.

Quantum Programming

Quantum applications development requires quantum programming skills which is support quantum appropriate technologies. This subsection gives an overview for quantum programming. A quantum programming language is designed to identify the problems conceptually rather than thinking about technical details. Quantum programming languages can be divided into [2]:

- Imperative quantum programming languages: "also known as procedural languages are fundamentally built upon the use of statements to change the global state of a program or system of variables" [2].
- Functional quantum programming languages: "also known as declarative programming languages do not rely upon the update of a global system state, but instead perform mathematical transformations by executing mappings from inputs to outputs" [2].
- Others which include mathematical formalisms.

The next points illustrate some quantum programming languages:

- **Quantum Computation Language (QCL):** "QCL is a high level, architecture independent programming language for quantum computers, with a syntax derived from classical procedural languages like C or Pascal" [3]. Quantum Algorithm can be implemented and simulated through QCL.
- **Q Language:** Q stands for eQuation and it has important features of quantum operators at run-time [2].
- **Quantum Guarded Command Language (QGCL):** "It was proposed by Sanders & Zuliani as a derivative of Dijkstra's guarded command language, intended more for algorithm derivation and verification rather than programming"[2].
- **Quantum Flow Charts (QFC):** It uses Flow Charts to represent Quantum programs [2].
- **Quantum Programming Language (QPL):** "It is a simple quantum programming language with some high-level features such as loops, recursive procedures, and structured data types" [4].
- QPL is free from run-time errors and this is the most important feature in QPL which can characterize this programming language. QPL separates the classical control and quantum data.
- **Quantum Meta Language (QML):** QML designed for quantum computations on finite types. It has quantum data and quantum control structure, and a measurement operator. It focuses on the elimination of weakening and implicit measurement. QML syntax is based on linear logic. A QML program is a sequence of function definitions [4].

- **Lambda calculi:** "It consists of a single transformation rule (variable substitution) and a single function definition scheme" [2]. The computable function can be defined by lambda calculi [2].
- **Compilation of Quantum Programs:** Compilation of quantum programs represents an important aspect to develop quantum programs which require quantum mechanics to understand its operations and optimization. Compilation of quantum programs discussed by many researchers who suggested some designs for a quantum compiler based on different approaches.

Qubiter is an example for one of the suggested compilers. It is a very rudimentary program written in pure C++, and has no graphical user interface. Qubiter takes as input a file with the entries of a unitary matrix and returns as output a file with a sequence of elementary operations (SEO). In its "decompiling" mode, it takes a SEO file and returns the entries of a matrix [5].

Quantum Databases

Searching an entry in a Hugh database is one of the big data problems. This process can cause time consuming if it performed in a conventional computer, but quantum computer can overcome this issue i.e. while supercomputers needs about month to find phone number from world's phone book, quantum computer with forty qubits need just 27 minutes. Searching process in a quantum databases can be performed efficiently since quantum computer uses the superposition state to perform the search, so multiple operations can be performed simultaneously to find the required item.

Searching algorithms in a quantum databases require a probability distribution over various states**.** Also quantum databases don't require to be sorted before searching process that speeds up the quantum search. Grover's algorithm can be used for searching in a quantum database entry after providing the access to the database and the search criteria. Algorithms for quantum databases can be simulated via Quantum Information Decision Diagram (QuIDD) data structure. "A QuIDD is a directed acyclic graph with one source and multiple sinks, where each sink is labeled with a complex number. Matrix and vector elements are modeled by directed paths in the graph" [6]. Protection of information in quantum databases requires an observation for databases blocks via control system thus exposing the attacker [7].

Quantum Cryptography

Quantum Cryptography insures secure transmission of data, so the national and private organizations can trust it to transfer the important data. Quantum cryptography combines the conventional cryptographic methods and quantum effects to realize high-precision secrecy communication between sender and receiver. Quantum cannels ensure secure key exchange between sender and receiver and increase capacity of communication channel, but the transmission of qubits occurs in the conventional communication lines [8]. BB84 protocol is the first quantum cryptographic protocol was invented in 1984 by Bennett and Brassard [8]. Quantum cryptography systems encode information in the quantum properties of photons, using one of the cryptographic protocols which are BB84 encoding scheme, B92 encoding scheme or Ekert encoding scheme [9], their advantages include:

- Random secret key generation which performed through quantum cannels.
- Eavesdropping detection through observing the interrupted qubits in the quantum channel.

"The laws of quantum physics make QC secure because of the following principles:

- Anyone directly trying to measure the bit value of a photon will introduce errors that can be detected by both the sender and the receiver.
- A single photon cannot be divided, which means that an eavesdropper cannot split a quantum photon to make measurements secretly.
- A single photon cannot be cloned, copied or duplicated so no one could clone a photon to measure it while passing another" [9].
- Although quantum cryptography techniques insure that the communications between the sender and receiver has not been interrupted, it can't prevent the communications from attacks. There are three attacks can affect the quantum communications: a non-traditional man-in-the-middle attack (MITM), denial of service (DoS) attacks, and an attack proposed by Adi Shamir which based upon sending a large pulse of light to the sender between transmitted photons[9].
- "The Swiss have successfully used quantum cryptographic in securing the ballots of a public election when the ballots are transferred from the voting centers to the counting and archiving center, which is only a portion of actually securing electronic ballots" [9].

Quantum Artificial Intelligence

Quantum artificial intelligence requires high computational capabilities so the quantum computations can produce quantum artificial intelligence applications with efficient performance. There are many artificial intelligence applications can be implemented under quantum computer environment such as: Simulating economic systems, human behavior, speech and language processing applications, decision-making, game theory and facilitating applications like face, fingerprint, and voice recognition, corpus search, and data-mining [10].

Quantum Robot

Quantum Robot is one of the most important quantum artificial intelligence devices which can be implemented through the utilization of quantum theory concepts and robot technology. Quantum robot can be used in many fields such as: aviation and spaceflight to Mars and Moon, biomedicine, military affairs and national defense, experiment research of physics, chemistry and safety engineering. The most amazing utilization of quantum robot is it can be injected into body, moves along with blood circulation, and detects potential pathological changes in body [11]. The conception of quantum robot has been presented by Benioff in 1998.It is composed of three fundamental parts: multi quantum computing units (MQCU), quantum controller, and information acquisition units [11]. "The theoretic results show that quantum robot can reduce the complexity of $O(N^2)$ in traditional robot to $O(N\sqrt{N})$ using quantum searching algorithm, and the simulation results demonstrate that quantum robot is also superior to traditional robot in efficient learning by novel quantum reinforcement learning algorithm" [11]. The performance of quantum robot can be improved through equipping it by quantum sensors which speed up the robot learning and support behavior decision using powerful parallel computing, fast searching ability and efficient learning of quantum algorithms.

Quantum Software Engineering

One of quantum computation challenges is to extend classical software engineering into the quantum domain and build the corresponding languages, tools and techniques for quantum

software engineering. Since quantum devices have a quantum nature, it can produce genuine random numbers while classical digital simulations can produce only pseudo-random numbers.
A higher level structuring techniques and architectures must be developed to be suited for quantum software. Testing of quantum programs requires implementation of debugging and testing techniques for these Q-languages [12].

Conclusion

In the Light of the above, quantum physics phenomena such as superposition and entanglement give the quantum computer its power. We can notice the powerful capabilities of quantum computer if we know that doubling a classical computer's register length will doubles classical computing power, but adding just one bit to a quantum computer's register doubles quantum computing power so quantum computer can overcome most of the classical computation problems. On the other hand, there are challenges faces quantum technologies. The first challenge is the lack of quantum computer structure to provide a real environment to run quantum algorithms. The second is the decoherence problem which affect collapsing of superposition quantum state into a classical state if it measured. Consequently, using of effective quantum algorithms can exploit the power of quantum computer to help in data management, data backup and data retention. According to researchers' estimations, quantum computing hardware will be available by 2020 so the development of quantum appropriate technologies must be ready to run in the new quantum machine.

REFERENCES

[1] Haym Hirsh, A quantum leap for AI. pp. 1-2. (1999).
[2] Donald A. Sofge, A Survey of Quantum Programming Languages: History, Methods, and Tools. pp. 66-71. (2008).
[3] QCL - A Programming Language for Quantum Computers available at: http://tph.tuwien.ac.at/~oemer/qcl.html [Accessed on 7 June 2012].
[4] Jonathan James Grattage, A functional Quantum Programming Language. pp. 18-126. (2006).
[5] Qubiter available at: http://www.ar-tiste.com/qubiter.html[Accessed on 23 August 2012].
[6] George F. Viamontes, Igor L. Markov and John P. Hayes, Is Quantum Search Practical? pp. 23-29. (2005).
[7] Y. Ozhigov, Protection of information in quantum databases. pp. 223-232. (1997).
[8] Gerald Scharitzer, Basic Quantum Cryptography. pp. 3-10. (2003).
[9] Lester Houston, Secure Ballots Using Quantum Cryptography. pp. 2-6. (2007).
[10] Kyriakos N. Sgarbas, The Road to Quantum Artificial Intelligence. pp.473-479. (2007).
[11] Dao-Yi Dong, Chun-Lin Chen, Chen-Bin Zhang, Zong-Hai Chen, Quantum Robot: Structure, Algorithms and Applications. pp. 1-15. (2005).
[12] John Clark and Susan Stepney, Quantum Software Engineering. pp. 1-4. (2000).
[13] Peter Selinger, A Brief Survey of Quantum Programming Languages. pp. 1-6. (2005).
[14] Lov K. Grover, Quantum Computers Can Search Arbitrarily Large Databases by a single query. pp. 1-8. (1999).
[15] Lov K. Grover, A Fast Quantum Mechanical Algorithm For Database Search. pp. 212-219. (1996).