INFORMATION COMMUNICATION TECHNOLOGY (ICT) INTEGRATED HIGHER EDUCATION IN INDIA

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ABSTRACT

The higher education in India is mired in tradition, ideology and incumbent interests. There is a need for a transformation in the higher education that will help make the learning that is imparted current and relevant. It is indeed a commonly agreed and accepted priority that Higher Education in India, which is a traditionally managed, lacking relevant and quality education, needs total revamping. The true revolution in higher education will come from its digitization. Across the past 10 years, the use of ICT has fundamentally changed the practices and procedures of nearly all forms of Endeavour within business and governance in India. In India, within education in general and higher education in particular, ICT has begun to have a presence, but the impact has not been as extensive as in other fields. Experiments and experiences show that there are three broad dimensions to achieve optimally ICT integrated higher education, namely, Percolation ICT culture in higher education; Development of ICT literacy and skill; and ICT supported higher educational management.

This paper highlights the emerging trends in and various impacts of ICT on education in general and higher education in particular, analyses opportunities, explores potential future developments and suggests adoption of suitable strategies. The paper advocates the role of ICT in transforming Information and Communication Technologies (ICT) have become commonplace entities in all aspects of life. To percolate ICT culture in education, everyone in the organization must develop not only ICT literacy but also relevant skills. ICT literacy and skill lay down the foundation of ICT culture in education. ICT integrated education is the central theme and spearhead in developing ICT culture. ICT literacy and skill development must include people occupying leadership positions in educational organizations, teaching fraternity, non-teaching staff etc. This will reduce the digital divide within the organization and create a common platform to share information, data, knowledge etc. ICT in educational management is essential for improving the managerial efficiency of and creating transparency within the education system.

KEYWORDS

Higher Education, Digitization, Transformation, ICT Literacy & Skill, ICT Culture, Educational Management etc.

INTRODUCTION

Education is a very socially oriented activity and quality education has traditionally been associated with strong teachers having high degrees of personal contact with learners. The education in India is mired in tradition, ideology and incumbent interests. There is a need for a transformation in education that will help make the learning that is imparted current and relevant. Today's students live in a world that is constantly connected, and alive outside the classroom. Yet, education is still delivered through traditional means. The true revolution in education will come from digitization of education so that children can learn at their own pace both within and outside the classroom. All this while, they continue to benefit from the nurturing, mentorship and guidance of teachers. Information and Communication Technologies (ICT) have become commonplace entities in all aspects of life. Across the past 10 years, the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavour within business and governance in India.

In India, within education, ICT has begun to have a presence, but the impact has not been as extensive as in other fields. The use of ICT in education lends itself to more student-centred learning settings and often this creates some tensions for some teachers and students. However, with the world moving rapidly into digital media and information with ultra-modern devices and utilities of ICT, the role of ICT in entire system and all channels of education in India are becoming more and more important and this importance will continue to grow and develop in the 21st century.

In India, Liberalization, Privatization and Globalization (LPG) have generated a good synergy and vibration for higher education (Hussain, et al., 2011). There is growing concern in the Society for Higher Educational Institutions (HEIs) about quality, standards and recognition. Consequent upon this awareness, the HEIs have to evolve for ascertaining and assuring quality, for which, the HEIs have to take initiatives to promote the concept of Best Practices in higher education and endeavour to adopt them, in a planed manner, for self-improvement. Best practices are perceived to have specific characteristics. These are important predictors of their success. The HEIs are required to be aware that any practice requires widespread acceptance by groups, social systems and by individuals to become successful to be put into practice by the organization and will, in the long run, be adopted by other institutions. In order to analyze these specific traits and implications, the following four themes are to be kept in mind.

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- ➢   Identification of best practices,
- ➢   Sustainability of best practices,
- ➢   Dissemination of best practices, and
- ➢   Adaptation of best practices.

Having regard to the above-mentioned themes, the HEIs have to identify areas of self-improvement to ensure and enhance quality, standards and recognition. The adoption of the best practices shall necessarily depend upon the criterions laid down by their respective authorities of Assessment and Accreditation on one hand, and the mission, vision, objectives, courses offered, conventions, emerging trends, opportunities and challenges in such HEIs, on the other.

In view of all these prerequisites, one of the best practices, shall be **Information and Communications Technology (ICT) penetration** at all levels, phases, spheres of their activities and processes, e.g. admissions, teaching, learning, evaluation, educational management, financial management, general administration, etc.

INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

Information and Communications Technology or **Information and Communication Technology**, usually abbreviated as **ICT**, is often used as an extended synonym for Information Technology (**IT**), but is usually a more general term that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers, middleware as well as necessary software, storage and audio-visual systems, which enable users to create, access, store, transmit, and manipulate information. In other words, **ICT consists of IT as well as Telecommunication, Broadcast Media, all types of Audio and Video Processing; and Transmission and Network based Control and Monitoring functions.**

The UNESCO uses the term ICT to describe: *"…the tools and the processes to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic and other automated means. These include hardware, software and telecommunications in the forms of personal computers, scanners, digital cameras, phones, faxes, modems, CD and DVD players and recorders, digitized video, radio and TV programs, database programs and multimedia programs"* (UNESCO, Bangkok, 2003; Bairagi et al., 2012).

"We have only one country in this universe, and that is world". -Rabindranath Tagore (Bhunia, 2011). Tagore's such powerful philosophy may ultimately be realized if today's tenet of "one world one village" is implemented.

"For India to emerge as a super power of the world in the shortest possible time it is important to convert our demographic merit into knowledge power hose by nourishing and uplifting our working population into knowledge enabled working population" - Mission Document NMECIT-MHRD (2007), and (Dutta, 2011).

JUSTIFICATIONS for ICT BASED EDUCATION

Today ICTs—including laptops wirelessly connected to the Internet, personal digital assistants, low cost video cameras, and cell phones have become affordable, accessible and integrated in large sections of the society throughout the world. It can restructure organizations, promote collaboration, increase democratic participation of citizens, improve the transparency and responsiveness of governmental agencies, make education and health care more widely available, foster cultural creativity, and enhance the development in social integration. It is only through education and the integration of ICT in education that one can teach students to be participants in the growth process in this era of rapid change.

ICT can be used as a tool in the process of higher education in the following ways:

- **Informative Tool:** It provides vast amount of data in various formats such as audio, video, documents.
- **Situating Tool:** It creates situations, which the student experiences in real life. Thus, simulation and virtual reality is possible.
- **Constructive Tool:** To manipulate the data and generate analysis.
- **Communicative Tool**: It can be used to remove communication barriers such as that of space and time (Lim and Chai, 2004; Hattangdi & Ghosh, 2010).

Main benefits of using ICT in higher education to the various stakeholders:

Summarily, following benefits can be propagated:

    a)   To the Student:

      (1)   Increased access,
      (2)   Flexibility of content and delivery,
      (3)   Combination of work and education,

(4)   Learner-centered approach,
(5)   Higher quality of education and new ways of interaction.

b)   To the HEIs:

(1)   High quality,
(2)   Cost effective professional development in the workplace,
(3)   Upgrading of employee skills, increased productivity,
(4)   Development of a new learning culture,
(5)   Sharing of costs and of training time with the employees,
(6)   Increased portability of training.

c)   To the Governments:

(1)   Increase the capacity and cost effectiveness of education and training systems,
(2)   To reach target groups with limited access to conventional education and training,
(3)   To support and enhance the quality and relevance of existing educational structures,
(4)   To ensure the connection of educational institutions and curricula to the emerging networks and information resources,
(5)   To promote innovation and opportunities for lifelong learning.

Sources: (UNESCO, 2002)

Higher education in the country is experiencing a major transformation in terms of access, equity and quality. This transition is highly influenced by the swift developments in information and communication technologies (ICTs) all over the world. The optimal utilization of opportunities arising due to diffusion of ICTs in higher education system presents a profound challenge for higher education institutions. At the same time, the introduction of ICTs in the higher education has profound implications for the whole education process ranging from investment to use of technologies in dealing with key issues of access, equity, management, efficiency, pedagogy and quality.

Higher education systems have grown exponentially in the last five decades to meet the demands of quality education for all. This aspect has further gained momentum due to swift advancements in Information and Communication Technology (ICT). Demand for skilled and competent labour is ever increasing in the contemporary globalised society. Competition in every sector ranging from access to quality in higher education has emerged as determining factor of economic growth and development. In order to increase the access to higher education and improving its reach to the remotest parts of the country contribution of open and distance learning facilities is on increase. In addition, it is catering to lifelong learning aspirations and that too at affordable cost. The last two decades have witnessed the inclusion of developments in ICTs in higher education systems around the world. Even then the challenge to develop a higher education system that is flexible and dynamic so as to holistically integrate the technology in the management and delivery of learning programmes is daunting (Snehi, 2009).

ICT is unanimously acknowledged as a significant catalyst for social transformation and National progress of any country. India has enormous geographic disparity in ICT use but at the same time, she has greater potentialities and possesses the largest ICT workforce in the world. She has recognized the importance of ICT in educational as early as 1984-85. The role of ICT is diverse in the delivery of good and highly competitive in all the four areas of education. It cannot be separated from any of the areas. Increasingly available ICT materials facilitate the learner as well as the teacher to enhance their horizon of knowledge in order to meet out the challenging competitive educational environment. Curriculum for the various levels should be modified in accordance with the changing ICT environment. The curriculum framer needs to update with the emerging trend. Educational programme consists of all the activities that are directed towards educating the citizen of the country in various modes of instruction and training. Information Communication Technologies are a very broad area in which every device facilitates learning. (S Sampath, 2011).

ICT INITIATIVES IN INDIA FOR INTEGRATING ICT AS A CORE SYSTEM

ICT and e-learning are medium of fast connectivity and development, showing a tremendous growth since 1990. The Govt. of India as launched policies and programmes for the smooth penetration of ICT at the grass root level so that awareness can be generated at educational, social, economical and political domains for the benefit of the people. The penetration of latest technology opened a new paradigm of education system in the developing hemisphere, especially in India. The Indian government's role is quite optimistic in proliferation of e-learning and ICT. The government has framed effective policies in this direction. Some of the e-learning and ICT projects of the government are of world standard. The government has been collaborating with the developed nations and other Economics Blocs of the world for uniform ramification of e-learning and ICT throughout the country. The state governments are also not behind the race as some of them readily adopted the module for the benefit of the people (Hussain, et al., 2011). The empirical studies and experiences show that the Ministry of Human Resource Development (MHRD) and a Regulatory Body-University Grants Commission took initiatives in India in early 1970's, which launched TV Satellite programmes for educational purposes. This was the first Indian initiate as well as a policy for developing

ICTs as a vehicle for promoting education is visible since the use of satellite However, the same was only in the form of distance learning, and Use of ICT or IT was at minimum level in administration, with a very few (museumised) computers and printers, mostly show-pieces.

Thereafter, in late 80's many ministries of Central Government and Regulatory Bodies, such as UGC, NCTE, etc. took initiatives to percolate IT culture at their top levels of administration. In 90's the ICT culture was visualized. Now, particularly, from the year 1999 the ICT penetration was at a high speed in Learning process and from 2004 it started showing its existence everywhere in all spheres and levels of administration. Indian Government initiatives in the promotion of E-learning and ICT integration are encouraging. National Programme on Technology Enhanced Learning (NPTEL), National Mission on Education through ICT, National Knowledge Network, Sakshat Portal, eGyankosh, Pan African Network Project (PANP) are a few of Indian Government initiatives which can be a landmark step for the multifarious development of e-learning in the country. The government's role in this sector is quite futuristic and effective visualized from the above world standard project (Hussain, et al., 2011).

The Tenth Plan provided the necessary driving force for use of ICTs in higher education in the twenty first century. The Plan objective called for profound transformation of higher education to improve its relevance, develop closer links with the world of work, and ensure quality in its teaching, research and business and community extension functions including lifelong learning. In order to achieve this transformation knowledge and use of the new information and communication technologies is identified as one of the major contributor (UGC, Annual Report 2002-2003, p.21; Snehi, 2009).

The empirical studies and experiences show that:

- In most of the Central Universities, National Institutes, such as IITS, IIMs, IIITs, Army and Government aided National Research Institutes and Laboratories, etc., some select State Universities, and in some renowned private Universities and HEIs also, there is growing need to use ICT as an effective learning tool and ICT is emerging as the basic building blocks of modern society. Acquiring skills in ICT is fast becoming part of the core education system. ICT, emerging as a natural tool in education, offers great potential for knowledge dissemination. ICT aids the search for new knowledge that lies outside the purview of textbooks. The advantages of ICT are manifold as it enables students and teachers to expand their knowledge by using advances in information technology and tools, which enhance learning, such as the Internet, multimedia, video-conferencing, computer-aided design, animation and graphic-user interface. Noting that ICT is bound to add value to learning, its use among students should be popularized.

- ICT integrated educational management in Colleges, particularly in the rural and semi-urban areas, small and medium level cities, is still in its early infancy for a large number of reasons that include: [a] lack of personal access for and interest of teaching and non-teaching staff to ICT, [b] poor internet connectivity, [c] inappropriate location of ICT facilities in educational institutions (often centralized and museumised, namely audio-visual rooms or computer labs, without its presence in classrooms, laboratories and libraries with user terminals), [d] shortage of relevant digital contents of high quality, and [e] Teachers consider the lack of time to develop technology-based lesson a concern. Administrators identify teachers' lack of experience using technology in instruction yet another challenge.

- Most of the students, teachers and administrative employees, who face constraints of lack of PCs and restrictions from the authority to use internet face or very few of them could utilize internet facility from their institutions, have no option but to do browsing from their home and internet cafes. For very few students, browsing for their studies is done by utilizing the lab facility of the Higher Educational Institutions (HEIs), which is not free of cost. Access and use of computers at home/internet cafe is shaped by socio-economic differences. Thus, the socio-economic environment of students continues to play a significant role in their educational achievements also.

ICT PERCOLATION IN HEIS IN MAHARASHTRA: A CASE STUDY

The use of ICT in higher educational system is becoming more and more imperative. Deliberate attempts are being made to percolate the ICT culture in the HEIs in Maharashtra. Following details describe the innovative efforts made to achieve academic excellence and increase the administrative efficiency and transparency in the higher educational system, by the State Government, Universities, Colleges, etc.

a) Voluntary Initiatives reflect following features:

(1) Promotion of Organizational and Communication Skills to facilitate presentation and interpersonal Communication;
(2) Enhancing Interaction of Students with Teaching & Non-Teaching Staff,
(3) Ensuring Knowledge Dissemination,
(4) Introduction of MIS,
(5) Introduction Course Management System,
(6) Introduction of Office Management System,
(7) Smart Class Rooms, Digital Interactive Boards, Smart Projectors,
(8) Smart Office with Provision of all Equipments, Hardware & Software; and Increasing Connectivity.

b) Initiatives taken by Government of Maharashtra, for Technology Intrusion in HEIs in Maharashtra:

- Connectivity of **HEIs with affiliating University through Maharashtra Knowledge Corporation Ltd. (MKCL)** for:

- Online Affiliation & Recognition of HEIs and their Courses,
- Online Centralized Admissions: HEIs in Maharashtra have been connected to their respective affiliating Universities for Online Centralized Admissions for some selected UG professional courses, and for some selected PG courses,
- Online Eligibility: HEIs in Maharashtra are also connected online to their respective Universities for online grant of Eligibility to students of all UG and PG courses,
- Online Examination Processes: HEIs in Maharashtra are also connected online to their respective Universities for: (a) Submission of Examination form, (b) Issuance of Examination Hall Tickets, (c) Submission of Internal Marks, (d) Declaration of Examination Results of students of all UG and PG courses.

- Connectivity of HEIs with concerned Government Departments

- **Connectivity for Grant of Scholarship and Free-ships**: HEIs in Maharashtra are connected **online** to / with the Department of Social Justice of Government of Maharashtra for **online** e-scholarship system, available to all Junior and Senior College (UG + PG) students belonging to Scheduled Castes, Socially and Educationally Backward Classes, Nomadic Tribes, Minorities and the members of economically weaker sections of the society and Minority.
- **Connectivity for Entrance Test - MHT-CET**: HEIs in Maharashtra are connected **online** to/with the Department of Higher and Technical Education **for pre-admission Entrance Test to Professional Courses, under Engineering, Technology, Pharmacy** wings for: (a) Submission of Examination form, (b) Issuance of Examination Hall Tickets, (c) Declaration of Examination Results of students of all students at XII Standard (*plus* Two Level).
- **Connectivity for Entrance Test - MHT-CET:** HEIs in Maharashtra are connected **Online** to/with the Department of Medical Education and Drugs Department **for pre-admission to all courses Professional Courses, under 'Health Science'** wings, for (a) Submission of Examination form, (b) Issuance of Examination Hall Tickets, (c) Declaration of Examination Results of students of all students at XII Standard (*plus* Two Level).
- **Connectivity with MKCL:** HEIs in Maharashtra are connected **online** to/with Maharashtra Knowledge Corporation Ltd. (MKCL), which enabled HEIs in Maharashtra for various processes, such as, online Admission, online Eligibility, online Submission of Internal Evaluation on Marks, Semester/Annual Examination Forms, etc.

- Provisions in the forthcoming: "Maharashtra Public Universities Act"

Presently, all State Universities in Maharashtra are governed by Maharashtra Universities Act, 1994. With the emerging issues and challenges, advent of new avenues, tasks, the State Government appointed committee submitted a Draft Maharashtra Public Universities Act, 2011. The title of the said draft Act is *"The Maharashtra Public Universities Act, 2011: Pathway for Transforming Higher education into a Socio-Economic Development Force - Draft, 2011*. This Draft-document presents a generic Act, which provides a basic framework for achieving the above mentioned objectives of the contemporary educational system, to manage academic, financial and administrative operations of ten public universities in the state of Maharashtra in an open, transparent and flexible manner The Draft-document clearly provides and outlines the importance and adoption of ICT in higher educational system. Thus, the Nigvekar (2011) committee with its vision and dedicated mission strongly stressed the significance, deployment of and adoption of ICT culture in HEIs in Maharashtra State to make them stronger and transparent (Nigvekar, 2011).

SUGGESTIONS

Undoubtedly, ICTs are potentially a useful tool for both managing education and teaching. Application of ICT in managing educational institutions should be encouraged, as should use by instructors to gain access to educational materials. By teaching computer skills to youngsters, they may influence inward investment for the future society as well. ICTs are most likely to be cost effective when used to reach very large numbers of students; when used for research; and when used by administrators irrespective of time and place. Following are some major suggestions for ICT penetration in HEIs in rural, semi-urban areas, small cities, small scale Colleges of Arts, Commerce and Social Sciences etc.:

1. Assess skills of ICT professionals and meet gaps with targeted training programs to overcome the short-term skills shortage in the ICT industry and adopt continuing education and professional skills assessment and enhancement programs.

2. Encourage closer collaboration between academia and industry to align curriculum with market needs. Establish an ICT Center of Excellence with necessary long-term funding to teach and conduct research in advanced ICTs. Boost use of ICT tools in all levels of education, including ECDP, mass literacy, and lifelong learning.

3. Ensure access to education and research for people with disabilities and special needs using ICT tools. Establish multimedia institutes. Initiate diploma and trade courses to enable ICT capacity building for teachers. Teacher training institutes to be empowered with ICT capacity to meet the challenges. Create reliable and accessible national databases. Promote the use of ICT for training in the public sector. Initiate development of a sizable resource of globally competitive ICT professionals in order to meet local and global market requirements.

4. Develop seamless telecommunication network for the unhindered implementation of ICT policy.

5. Ensure public access to information through setting up of kiosks. Encourage the participation of private sector for ICT implementation.

6. Create an e-Education Cell for coordinating and mainstreaming ICTs in education system.

7. Training for all levels of teachers, assistants who are involving in educational institutions. Establishment of lab facilities and internet availabilities for all the students, teachers and assistants is necessary. Basic ICT course should be compulsory in all form of educations. Personnel with basic ICT knowledge should be appointed in all form of educational institutions. Use of ICT and multimedia in the education makes it interesting and fruitful Website of the institution should be compulsory along with regular updates.

8. Central registration system for the students should be implemented mandatorily. Use of student database, automated account in the institutions for faster administration should be employed. Facilitating electronic professional research journal and periodicals access to foster the level of technology savvy mind of the people and more importantly featuring the educators and students to access the emerging arena of knowledge.

9. Establishment of digital libraries or information repository may also be done by the educational institutions, which may provide invaluable materials to the researchers, educators and students as well as other interested people.

10. In disseminating ICT and new technologies, which may improve the overall life style of the mass people, may be acquainted through conferences, workshops and other technical gatherings arranged by the educational institutions in collaboration with other agencies.

11. Focusing on blended learning, rather than insisting on teaching students at my place at my pace using an industrial model that is now becoming obsolete is what they need to look at. Universities need to leverage their competitive advantage in term of the ICT revolution and the new model of e-education has to be relied upon in the future (DIGITAL-Learning, 2012).

12. Recognizing the importance of ICT in education, the integration of ICT in education curriculum, intrusion ICT culture in entire system and organization has no option or shortcut or alternative. The empirical studies and experiences strengthen the opinion that there is need for chalking out a curriculum including ICT.

13. *"The foundation of every state is the education of its youth", Denis Diderot (1713-1784), French Author & Philosopher.* This must be the only solution and suggestion for the developing nations to go for ICT based schools, colleges and universities.

14. Technology is never an alternative for teaching. Without trained instructors, no electronic deliveries can accomplish good results; hence, the trained staff availability for ICT is prerequisite for penetration of ICT culture in the educational institution.

15. Only audiovisual facility is not sufficient. Development of Computer Laboratory is minimum bare essential step in this endeavour. Computer Laboratory helps in developing scientific temper. Virtual laboratory is necessarily required to be developed using ICT. Lab facility maintenance of the computers, sizable classroom and computer lab for ICT and availability of one computer / student are minimum requirements. Charts, Posters used as teaching aids, Power Point presentations etc., and necessary during their courses are prepared by the students outside the institutions. Various skills of using new technology such as presentation of the content of seminars using Power Point, or demonstrating content through Flash or sending assignment papers to moderators still need to be introduced and practiced during the sessions. Web browsing is usually done outside the campus.

16. Our Higher Education system, in the rural and semi-urban areas, small and medium level cities, is still to exploit the full potential of ICT for optimizing human learning on one hand and its use for educational management, i.e. e-governance on the other hand. Availability of educational web portals, blogs and wikis, face-books (where teachers and administrative staff can actively participate both as a beneficiary and benefactor), will be instrumental in development of ICT culture in admissions, teaching, learning, evaluation, educational management, financial management, general administration, etc. ICT can optimally play its role only when it is a part of Institutional Culture and that there are three broad dimensions that can generate ICT culture in education, namely:-[a] ICT Literacy and Skills for All in the Sector of Higher Education; [b] ICT Integrated Higher Education; and [c] ICT Supported Educational Management (ICICT, 2012).

17. To ensure digital empowerment, Students teaching and skill training should encompass ICT skills along with a full understanding and complete mastery of ICT s as pedagogical tools. HEIs should be ensured with financial and human resources with training for successful incorporation of ICTs. It is also necessary to extend a stronger understanding of future learning needs and future environments for ICT skills. A constructive atmosphere must be there to provide an occasion for all stakeholders to form a part of the information society. Efforts should be taken to promote broadband, computers and internet access down the cost. Progress and planning is still needed in providing attractive learning content and learning technologies.

18. The last but not the least, it is necessary to minimize the 'DIGITAL-DIVIDE'.

CONCLUSIONS

Diffusion of ICTs in Indian universities and colleges would respond to the twenty-first century demands. The contemporary higher education systems are aiming for acquisition of ICT skills as part of the core education system, provision of infrastructure/ fully equipped labs, professional assistance and other support needed to enhance quality of education. Application of ICTs in managing higher education institutions and use of the technology to homogenize quality of education in the highly diverse scenario across the colleges and universities established in the country would benefit many students. The arguments against the introduction of ICTs have pointed out that ICTs would benefit the urban and already advantaged sections of society at the expense of rural communities. The situation of limited budget allocations, which were barely enough to meet the salary expenditure leading to developmental activities taking a back seat, is improving. The time is right to push the driving forces hard as it is expected that implementation of initiatives to integrate ICTs bring about improvement in higher education organization and quality education through ICT would be realized.

India is making use of powerful combination of ICTs such as open source software, satellite technology, local language interfaces, easy to use human-computer interfaces, digital libraries, etc. with a long-term plan to reach the remotest of the villages. Community service centers have been started to promote e-learning throughout the country (Bhattacharya and Sharma, 2007). ICT in Education has come some distance in India. Starting with its integration in education (ICT Literacy and Skill Development) of late, it has found major space in matters of governance (ICICT, 2012). The Indian institutes of higher education should also critically appraise what he meant to say as educational institutions in the western world and think of making the best use of ICT for their respective institutions. Technology coordinators view the problems of insufficient hardware, software, and training as major obstacles.

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CLOUD COMPUTING SECURITY VIA GRANULAR ENCRYPTION

A. Srinivas[2] Goutham B.[3] Bharathi R.[4]

ABSTRACT

Cloud Computing is the emerging technology now a day is which is being followed by so many organizations throughout the world. Therefore, we have to provide sufficient security for the data, which is going to be place in the cloud over different, sever throughout the world. Granular Encryption will be a salient factor in protecting data on the cloud.

KEYWORDS

Cloud Computing, Cloud Security, Convergent Key Encryption, Granular Encryption, Homomorphic Encryption, Secret Key Encryption, Split Key Solution, Storage as a Service, Security as a Service, Threats etc.

INTRODUCTION

For quite some time now, organizations have sought quicker, better and cost effective business models in the areas of application development, deployment and management. **Cloud computing**, which is the convergence of these independent technologies [1]. The name comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams**. Cloud computing** entrusts remote services with a user's data, software and computation. **Cloud Security** is set of techniques from network, computer and mainly information securities. We have different controlling techniques [2] for providing security for the cloud services.

Figure-1

Sources: Authors Compilation

Granular Encryption is an advanced technique which combines encryption techniques from cryptography and granular computing [3] which on applying together we implement it to cloud computing. Fig-1 describes granular encryption. Granular Encryption is a combination of granular computing and encryption techniques. In this method, we apply encryption for information granule. An information granule is nothing but a small entity of complex data which is obtained from processing or mining the data in the cloud.

Encryption is an approach in cryptography, process of encoding and decoding a message in such a way that eavesdroppers cannot read it but the authorised persons can read. In encryption we use several algorithms for the generating ibid. Authorised users uses decryption algorithms to decode the ibid. Encryption is nothing but generating key in both encryption and decryption for accessing the date safely and securely.

In cloud computing we basically have several threats but the most important and vulnerable threat is information threat. An information threat can be occurred due to loss of packets in the network and misusing it, breaking the firewalls or hacking the keys related to particular data and accessing it. However in cloud computing we place our data in different servers all over the space available to us on cloud. Information threat can occur due to natural calamities, DoS attacks, failure of IaaS or Paas or Saas. At some stages cloud service providers may lose the control on the services and security measures they offer. Providing security mainly lies on service providers like:

  SaaS   The control lies maximum with the service providers.
  Iaas   The control lies partially with the service providers and primarily with the customer.
 Paas   As the customer is deploying the services provided by service providers, is sole responsible.

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Different types of threats which we encounter in cloud computing are represented in Fig -2 as follows:

Figure-2
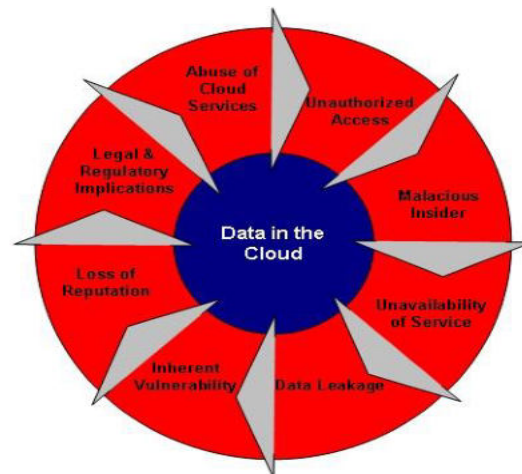
Sources: Authors Compilation

Few examples for the **threats** occurred till now are:

1. Two consultants took down SMB's network using Amazon's EC2. [4]
2. Recovering 22 Million emails 'lost' during Bush's era. [5]
3. Accounts of Salesforce.com employees and customers were compromised in 2007. [6]
4. Group of students from University of California had installed their eavesdropping onto the servers and monitored the cache memory in order to steal data hosted on that particular system. [7]

By considering all these examples we can say that although we produce some controlling mechanisms for evading threats, we are not completely evading threats. One way or the other we are attacked and our data hacked or vulnerable to threat. Therefore, we need to follow all existing techniques and improvise them, if possible implement new mechanism to evade the threats especially.

CLOUD STORAGE

In Cloud Computing, cloud storage plays a prominent role. Basically a user uploads his/her data onto cloud which virtualises that data is being stored on a physical device but cloud provides virtualized infrastructure in terms of elasticity, availability, scalability. Cloud storage has been classified into two as follows:

- Enterprise Storage,
- File Hosting Service.

Basically cloud storage is made up of many distributed resources which behave as single storage space, also eventually consistent along with duplication of data. Cloud Storage services provide following **security measures** for data:

- Data Encryption,
- Accessibility & Integrity issues,
- Super Stability.

As we know the data is stored in cloud as a single file in user point of view. But actually when we place the data in the cloud, service provider may place the whole data as a several parts in severs all around the world.

*TRADITIONAL ENCRYPTION*

Chart-1
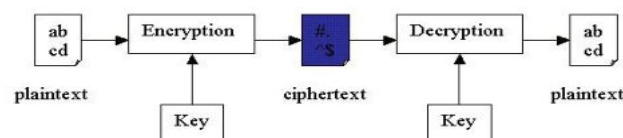
Sources: Authors Compilation

Basic encryption technique is **Secret key encryption.** In this encryption user can only access the data by decrypting it since he is the only person who is provided with a unique key. This results a high level security in cloud storage but it also results in usage of more storage space. In secret key encryption same key should be used at both the levels.

Other technique is **Convergent technique** which is less protective of data on the cloud. It is also called as 'Content hashing' [8], produces a cipher text for a plain text. Due to this it is very weak in security provisions and can be easily hacked by hackers.

Along with these we have several techniques such as **Homomorphic Encryption** [9] etc. It is used by "Porticor cloud security providers". In this encryption technique mathematical operations are used on encrypted data to produce two keys i.e. **Split Key solution.**

Figure-3
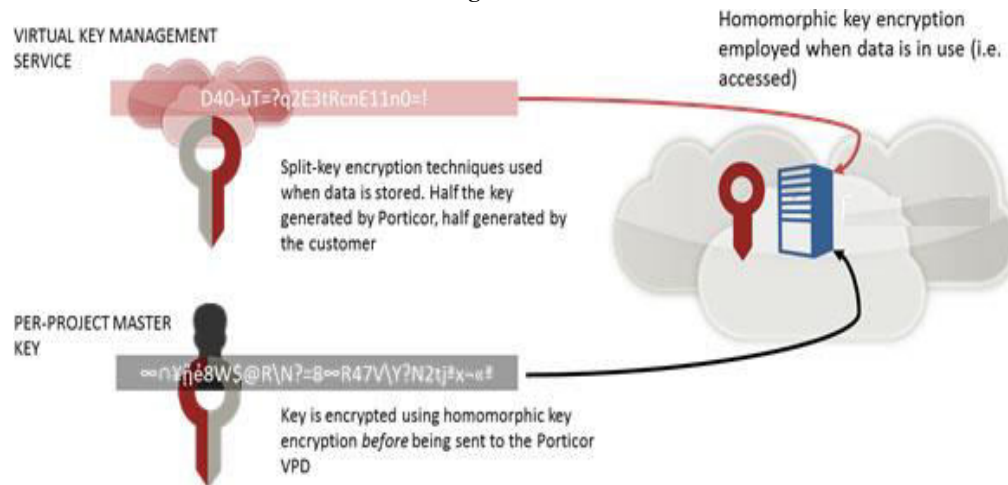
Sources: Authors Compilation

GRANULAR ENCRYPTION

At present Granular Encryption is more a theoretical method rather than an implemented encryption technique. A granule is small part of a particular thing; in our case, we consider an information granule. As we have seen that data is placed as small parts in different servers all over the cloud. Using traditional techniques, we have provided security to data up to some extent. Consider the part of data placed in a server from the whole data, divided the data into information granules. Place these information granules in that server chaotically such that it consumes less space than before. Now apply any of the traditional techniques of encryption say 'Secret Key encryption'. In this process, we generate a unique set of key for encryption and decryption for information granules, which generates unique files resulting in data duplication[10] impossible but consumes less space as we are applying for granule amount of data. All the unique keys of every information granule are combined into a master key, which is known to only user but not to service provider too.

Actually, in homomorphic encryption, mathematical methods are used on encrypted data for generating two different keys i.e. "Master Key" and other part of the key. In our context we can consider an information granule is encrypted, generation of key is done on information granule. At present in homomorphic encryption, when application on user system and the virtual appliance on provider site will combine both the keys at startup of the service. However it is secure, the master is ever stolen it cannot be used to access the data because for every legal operation a user log in, a new key is generated. Even if a system is breached, the part which user is working will be available to hacker but not the entire data is revealed. If this granular encryption is implemented to homomorphic encryption, then we could say, "Cloud Computing is the most secure technology". Any encryption technique is applicable to these information granules, which ultimately increases the security of either enterprise storage or file hosting services.

Pros and Cons of Granular Encryption

Pros:

In granular encryption using information granules for storing and retrieving the data helps us to feel secure in data integrity. Due to small granules we place the data in a server chaotically ensuring it consumes less amount of space. Due to this stability also increases. By using several techniques for providing security exclusively through data storage we can consider it as **"Security as a Service"** along with **"Storage as a Service".**

Cons:

At present the only problem which is popping out is access speed and rate of data stored. Using Granular Encryption we can increase the security but encrypting and decrypting each and every granule while storing and retrieving makes delay as the encryption produces unique files for every encrypted key it generates. Therefore number of files to be processed will be more. It is effective if and only if a user has low speed connectivity to cloud otherwise it is negligible.

CONCLUSION

Granular Encryption is the significant factor for cloud computing security in the near future. It is playing a major role in XML and SOAP Security where a selected key can be generated with encryption of data, element, and fragment. Using hierarchy of keys, public cloud can be granularly encrypted for better security.

ACKNOWLEDGEMENTS

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Source Links

11. Table Caption: *Security provided by different Services in Cloud Computing*.

Figure Caption and Links

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<u>REACHING OUT THE USERS WITH WEB2.0 TECHNOLOGY IN ACADEMIC LIBRARIES</u>

Dr. Sujit Kumar Pandey[5]

ABSTRACT

Education and Research in Higher education excel with advent and continuous flow of information and knowledge into the system. Information and knowledge system of an organization has to be understood, collated and stored in a manner to make a string of generation source to user source. Generation of information from faculty, students and researchers has to be identified in an organization. In this chain process, information need of the faculty, students and researchers in various activities and projects has to be anticipated and processed timely. The paper discusses the involvement of Web2.0 Technology in Academic Library Development.

KEYWORDS

Web2.0 Technology, Academic Libraries, Faculties, Students, Researchers, Library Resources, Communication etc.

INTRODUCTION

The right information and sufficient information to the nascent thoughts must get inputs in the form of right human resource, knowledge base and at users' desk. The whirl of data, information and knowledge travels from generation source to utilization source with light speed using various channels of communications. The First such channel in an organization is information resource centre or Library. University Library in a higher education play significant role in teaching, learning and research.

LIBRARIAN AS FACILITATOR IN TEACHING

Academic librarian identifies various courses offered by the organization and provides the relevant course references to the faculty to facilitate them in teaching. Classroom notes and other e-resources from the faculty should be collected and put into the Course Resources in a library.

LEARNING OBJECTS FOR STUDENTS

Graduate and Postgraduate students should be provided with Course Resources to help them in learning and preparing their assignments and projects.

PARTICIPATING IN RESEARCH

E-Journal Databases and subject portals should be made available to the researchers. The researchers should be provided with specific bibliographic resource relevant to their research topics.

COMMUNICATING WITH LIBRARY USERS

The way we communicate with each other is changing rapidly. Use of mobile phone, laptop, ipad, Kindle and other communicating devices becoming integral part of fast changing library users. Library has to develop automated system to communicate with these devices and make the users comfortable in getting requisite information at their end. Library has to develop its website compatible with mobile computing devices. Information notices related to resource circulation, overdue notices, availability of resources, reservation facilities should be provided to the users using their mobile devices. Human resource sharing and institutional repository must be available using social media for knowledge sharing.

WEB 2.0

The Web has never been a purely static experience, but it has not been very interactive either. With the vast majority of web pages, when a user arrives at the page of HTML code, displayed through an Internet browser, there is usually little more than text to be read and images to be viewed. Movement through the website is accomplished through user-initiated mouse clicks, to which the web server responds with a repeatable, usually predictable, response. The delivery of content is predominantly a one-way conversation, with the website, as proxy for its author, the speaker and the web surfer the listener. A productive experience with the Web requires the user to be able to locate and pull the appropriate web pages out of the vast sea of possible websites. This is the familiar world of Web 1.0 to which the majority of us have grown accustomed.

The concept of Web 2.0 promises to be very different. **Tim O'Reilly (2005)** has presented five principles or concepts about the web 2.0. The first is the concept of "the Web as platform." In the Web 1.0 world, a website with its static text and images is the

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deliverable. In the 2.0 world, however, the Web is just the platform or foundation, which supports the delivery of myriad dynamic services. For example, Google's service is not a server-though it is delivered by a massive collection of internet servers-nor a browser-though the user experiences it.

The Web has become a computing platform that can deliver a dizzying array of services through little more than a web browser, thereby eliminating the need for the end user to install special software on her own personal computer. As Google makes incremental changes to its product, we never have to download or install new releases. Rather, the web platform hosts these product changes on our behalf.

The second principle of Web 2.0 is the "harnessing of collective intelligence." In the 1.0 world, when a user arrives and engages a website, that interaction has little consequence for the website, except to add another hit to the usage statistics. With Web 2.0 products, it is the user's engagement with the website that literally drives it.

The third Web 2.0 principle is the primacy of data and the databases that house it. At the core of Google's service is an immense database of metadata for billions of web pages. The successful firms of Web 2.0 are those that not only have the best data but also know how to harness it well.

The "end of the software release cycle" is the fourth principle. Successful Web 2.0 companies do not have rigid, predetermined software releases. Instead, the software is tweaked and improved on an ongoing, sometimes daily basis, dependent upon a continuous flow of user feedback. This feedback is obtained by direct means, such as through a customer comment system, but also indirectly via the real time monitoring of user behavior to see just which new features are used, and how they are used. This continuous cycle of improvement actually places website users in the role of "co-developers," whether they are conscious of this or not. Moreover, it means that a Web 2.0 product is in "perpetual beta" because there is never an official, finished product.

Fifth principle is the reliance on lightweight programming models. A website undergoing continual change requires simplicity. Instead of tightly intertwining the various components of a website, Web 2.0 products strive for loosely coupled, often-modular systems that allow pieces to be swapped in and out easily. The sixth principle pushes this flexibility of options to the end user. The Web is no longer limited to personal computers but can embrace a whole suite of devices.

When these principles are combined and actualized, the Web becomes a more interactive, dynamic experience for all users. There is, in essence, a continuous dialogue between the users and the web pages they encounter, and the result is an increasingly personalized, customized experience. This rich user experience need not, however, stop at the outer edges of an academic library's website.

Miller (2006) says, "Library 2.0 is a concept of a very different library service, geared towards the needs and expectations of today's library users. In this vision, the library makes information available wherever and whenever the user requires it, and seeks to ensure that barriers to use and reuse are removed". In other words, the same concepts and technologies that are creating the Web 2.0 experience should also be used to build the Library 2.0 experience. Actualizing Web 2.0 is a growing set of simple yet powerful tools that are turning the Web into an interactive, context-rich, and highly personalized experience.

RSS

RSS, an acronym for Really Simple Syndication or Rich Site Summary, denotes a class of web feeds, specified in XML (Extensible Markup Language). In layperson's terms, RSS is a way to syndicate the content of a website. From a user's perspective, this means that you do not have to visit a website continually to see if there is new information. Instead, you subscribe to the RSS feed, and every time the website changes an RSS feed is sent, alerting you to the change.

An RSS reader is the receiver and aggregator of all RSS feeds user is receiving. The RSS reader can come in many different forms. Some readers work by sending the RSS feed through e-mail. As an example, "Blog Alert" is a free system that sends daily e-mail notifications of new RSS feeds. No special software is needed. Just enter the URL of the RSS feed and e-mail address into the web form, and the e-mail alerts start arriving daily.

Blogs

The term "blog" is actually a shortened version of the word "weblog." **Wikipedia** describes a blog as "a type of website where entries are made (such as in a journal or diary), and displayed in reverse chronological order. Blogs are simply online journals in which writers can easily jot down their thoughts or comments, accompanied by any related link.

The mechanics for creating a blog entry are quite simple. Through a straightforward, web-based form, the author enters text and adds any relevant links and images. When the entry is complete, the author submits the entry and it then automatically appears at the top of the blog, date and time stamped. The blog owner / author can elect to make the blog public to the world or available to just a subset of people and can decide whether to allow others to comment on the blog.

Wikis

Blogs essentially follow a diary metaphor, with the entries in reverse chronological order and "penned" by a single, primary author. Wikis, on the other hand, are subject-driven information sites that deliberately have a shared and distributed authorship. Wiki is the Hawaiian word for "quick," which characterizes the speed with which a person can use a wiki. A wiki, as described by the world's most popular instantiation of it, Wikipedia, is a type of website that allows the visitors themselves to easily add, remove, otherwise edit, and change some available content, sometimes without the need for registration.

The basic component of a wiki is a web page with some informational content. Without the use of any special locally hosted software, a person can click on a page's "edit" button, make changes to the content, and then save those changes. All of the older versions of the page are saved in a history log, whereby errors or malicious acts can be corrected by simply reverting to an older version of the page. Because wikis can allow literally anyone to add or edit their content, one might presume that the outcome would be of poor quality or chaotic form. In reality, it is the highly collaborative nature of wikis that ensure both quality and order. Wikis harness the power of collective knowledge, because presumably no single person could possibly create all the content. Rather, anyone with expertise, knowledge, interest, or enthusiasm can contribute to the effort. In addition, the numerous sets of eyes that work with the content ensure a high level of quality: "It is community of users acting as quality control that keeps content in-line and on-topic" **(Guenther, 2005).**

Wikipedia has the potential to be the greatest effort in collaborative knowledge gathering the world has ever known, and it may well be the greatest effort in voluntary collaboration of any kind.

RSS, BLOGS, AND WIKIS IN ACADEMIC LIBRARIES FOR REACHING OUT THE USERS

Academic libraries can harness the power of RSS feeds, blogs, and wikis in numerous ways. For example, libraries can use RSS feeds to push information out to their patrons. Many libraries post news and events items on their home page, which can be turned into RSS feeds.

New book lists can also be distributed via RSS feeds. It is also possible to add RSS feeds to the library catalog whereby students can sign up an alert whenever the results of a particular search have changed. A library can also add RSS feeds to its subject guides and course pages. Many of the subject guides developed by the academic Library include an RSS feed sidebar of recent acquisitions in the respective subject area.

The integrated library system can provide below mentioned applications:

- Lists of new books,
- Warnings that an item will become overdue in the next *x* days,
- New reading lists,
- Advice that a requested item is now ready for pick up,
- End-of-term reminders,
- Alerts that potential charges have reached a given amount,
- Virtual book groups' shared reviews,
- Distributions of sound samples for newly available music CDs,
- Library news such as changes to opening hours".

Libraries can also aggregate the RSS feeds of other sources and repackage them in useful ways. Libraries can brought together the RSS feeds of some of its e-journals onto a single page that a student or faculty member can browse and then subscribe to where interested. Another way to capitalize on the power of RSS is by syndicating the library's content and news in order to increase the places where users can encounter it. If a library provides RSS feeds, others can repackage them into services that are more comprehensive.

There the library's feeds are available through the college's course management system, where they are prominently displayed. Through these feeds, the library is able to push notices about recent book acquisitions that are directly relevant to the curriculum of the course. As a result, not only is the information delivered into a digital tool that the students use regularly, but also the library is able to place its resources directly into a context that is highly relevant to the students and their courses.

RSS feeds are also a valuable tool to help library staff stay current. There is an ever-growing corpus of library-related blogs that highlight news, events, innovations, and best practices important to librarianship. RSS feeds and blogs can be used to keep a finger on the pulse of one's campus as well. Librarians should regularly read the blogs of students on campus, which are often identifiable by their academic affiliations **(Mathews, 2006).** This provides opportunities to answer reference-like questions, market library services and library workshops, and keep on top of problems and criticisms of library. Instead of forcing patrons to interact with us, we can enter their domain and seek new ways of providing assistance. By monitoring blogs, librarians can step beyond their traditional role and serve as teachers, mentors, and counselors.

Stephens (2006) suggests that many types of blogs a library could consider adding to its web presence, including these:

- Library news blogs,
- Materials/resources blogs that highlight different parts of the library's collection,
- Project-specific blogs,
- User-specific blogs that focus on patron subsections,

Blogs can be added to subject and class resources guides, but they can also serve as the guide itself. Librarians can build resource guides with blogs, thus eliminating the need for them to -learn how to edit website pages, which can be a technology barrier. Blogs are a way to invite comment from your user community, literally, through the blog's comment feature. Still, a blog has a primary author, and commenter's play a secondary role. If academic librarian wants a true, collaborative partnership with academic community, then consider a wiki. As students research a topic for a course, they could collaborate with the subject librarian on a wiki of relevant library resources. A wiki could also be used to gather student comments and feedback about library services or website redesign. For example, a library's subject and course resource guides could be built with a wiki and together the librarian and users of the guide could work together to create and maintain it.

Library-hosted blogs need not, however, mandate librarian participation. It can be equally as important for academic libraries to provide blogging platforms for students but then take a backseat and let the students be the drivers. "Libraries should explore blogs as mechanisms for students to exchange information on valuable information resources they find for particular course assignments" **(Lippincott, 2005).**

RSS feeds, blogs, and wikis are just a few of the tools that are transforming the Web 1.0 experience into Web 2.0. RSS feeds are a way to begin the process of pushing library content beyond the walls of the physical and virtual academic library. However, doing this requires us librarians to relinquish some control over how this library information is presented. For example, RSS feeds about new materials purchased by the library may be useful to many within your academic community. However, once that information is openly distributed and shared, it can invite students and faculty to question the library's purchases. Or, in another case, may disagree with the placement of the library's RSS feeds in the university's portal; perhaps it has been clustered with parking and other auxiliary services, when you believe it should be a part of the academic cluster. Pushing library content beyond a library's walls means that your community can interact with it at point of need or in a more convenient and efficient manner. However, it also means that you must relinquish control over how that information is used and where.

Currently there are few examples of academic library applications of wikis, because they require a high degree of trust that users, particularly undergraduate and postgraduate students, will take the building of a resource guide as seriously as experts do. On the one hand, wikis are attractive because they are both transparent and inclusive. They provide an open forum where anyone can contribute. On the other hand, some people are wary about engaging an academic community, particularly students, in such an open, uncensored dialogue. Well, if Wikipedia can trust the entire world with its endeavor to create an online encyclopedia, why shouldn't we be able to do the same with our students and user community?

Starting a blog or wiki can be threatening because it forces librarians out of the role of expert and into the more vulnerable role of guide and collaborator. Nevertheless, guides and collaborators, not experts, are what Next Generation students seem to be seeking, because of their team-focused upbringing.

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TRENDS IN TECHNOLOGY BASED LEARNING

Dr. D. N. Venkatesh[6]

ABSTRACT

The world of business has transitioned significantly due to three key factors, i.e., Competition, Customer and change in pace of communication. Organizations have devised and are devising response strategies to address all these factors. In order to address these challenges, organizations are focusing on grooming the sole competitive differentiator i.e., the quality of talent by continuously honing their skills/competences and helping them to adapt to situation with changed attitude. The above objectives are met focusing on learning & development processes in the organization. Technology has brought in several changes in learning processes to address the changed need of learners. This paper has captured developments the in the area of learning & technology and its impact on work place more specifically the workplace learning.

KEYWORDS

Learning, Organizational Learning, Workplace Learning, Technology Based Learning, Technology etc

INTRODUCTION

In the competitive environment, when the organizations are facing changing and dynamic market conditions, there is increased need for adaptability of individuals and organizations, which can only come through learning. There are several studies and researches conducted by OL and OD theorists. There is recognition by resource based view that resources encompass both tangible, material assets as well as intangible and tacit assets (Prahlad and Hamel, 1990). Idiosyncratic bundles of knowledge and skill – clearly within the domain of organizational learning e.g., Huber, 1991) – can be legitimate firm specific resources. Further, in the management literature, learning is presented as source of competitive advantage (e.g., Redding and Catalenello, 1994; Senge, 1990; Stata, 1989), but the definitions have not been clearly defined.

Researchers have pursued the elusive phenomenon of Organizational Learning for years (for e.g., Argyris, 1982; Hayes et al., 1988; Huber, 1991, Schein, 1993b; Senge, 1990; Stata, 1989). Organizational learning is presented as occurring at different levels of analysis – from individuals (Argyris, 1982) to organizations (Levitt and March, 1988). The various processes involved for diffusion of information include individual interpretative processes and interpersonal communication (Argyris and Schon, 1978; Daft and weick, 1984; Weick, 1979) Some studies view OL as *prescriptive* and being manipulable (for ex, Argyris, 1993; Hayes et al., 1988; Senge, 1990) and elsewhere as *descriptive,* documenting factors which influence or impede organizational adaptation are viewed (Huber, 1991; Levitt and March, 1988). The two models tried to address the organizational learning needs, *Inform Much Management Theory* (Morgan 1986), and the consequent advice preferred by consultants in the area of organizational improvement. Alternately, third approach which compares organizational learning with organic evolution by natural selection between replicators; a process enhanced by the punctuation of genetically imposed equilibrium. (Pewley Fort, Pewley Hill, 1996). The organizational evolution (learning) can be considered as a selection process between mental replicators. The biological metaphor of 'survival of the fittest' (usually wrongly attributed Charles Darwin rather than Herbert Spencer) is natural replica to market competition.

The fundamental parallel between evolution and learning was expressed by Gregory Bateson (1973, 1979) whilst Hull (1988), who argues that science can be viewed as natural selection process between competing scientific ideas, and scientific codes of behavior as a logical, self-evolved outcome of that process. The current trend of organizational learning is not new (Chandler 1977), but what has changed is the rate at which organizations must evolve to remain competitive.

The mantra for survival and growth in the nineties is dependent on the fulcrum called Organizational Learning (OL). The OL related activities during the nineties were largely focused on incremental improvement of already existing processes, while the leadership and organizations of the present are grappling with the facing with new set of challenges, which cannot faced with traditional methods and concepts of OL. The classical methods of OL are all variations of the same Kolb life cycle (1984), based on reflecting on the experiences of the past. However, organizations aiming at business leadership cannot continue to depend on traditional approach, but would require new cognitive capability, the capability for sensing and seizing emerging opportunities (Arthur 1996, 2000). Both organizations as well leadership must develop by engaging in a different kind of life cycle, one that enables them to learn from future as it emerges rather reflecting on the past.

Scope & Hypothesis

The scope for the study is to cover all facets of learning, its varied dimension, the process of evolution, the impact of technology at work place and more specifically its impact on learning at workplace.

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The hypothesis for study is:

- Learning processes in organizations have been evolving to adapt to external / environmental (business needs) and internally the employee's learning & development needs
- Technology has affected the learning processes at workplace to facilitate better learning by the employees.

RESEARCH METHODOLOGY

Keeping in view the topic for this research study, it is imperative to capture clearly and comprehensively varied facets of learning, the dimensions, and the evolution of information technology. It is for this purpose that the research methodology chosen is secondary research.

REVIEW OF LITERATURE

Many researchers have observed that the literature on OL is fragmented, built of multiple constructs and cross-fertilization of thoughts from various streams. A few of them are based on interventionist models while some are based on Descriptive theory. Definitions of OL found in the literature include a) Encoding and modifying routines; b) Acquiring knowledge useful to the organization; c) Increasing organizational capability to take productive action; d) Interpretation and sense making; e) Developing knowledge about action - outcome relationships; and f) Detection and correction of error.

The focus of some researchers has been to study how Organizations Learn – that is how the social systems adapt, change or process incoming stimuli. The outcomes are functional of typical individual cognitive properties or otherwise of the organizational policies or structures. Some researchers study the learning phenomenon by understanding the response of individual in terms of their development, adaptation and update cognitive models. Thus, the focus of any of these approaches is determination of causality and the objective is to identify managerial actions aimed at improving organizational effectiveness.

The following two-by-two matrix (by Bertrand Moingeon and Amy Edmondson) indicates several learning phenomena i.e., a) Organizations as embodiments of past learning, individual learning and development in organizations, b) Organizations increasing their capacity for change through active, intelligent participation, and c) Individuals gaining awareness of personal causal responsibility and developing interpersonal skill.

Chart-1: Typology of Organizational Learning Literature

RESEARCH OBJECTIVE	Organization	Individual
Descriptive Research	Levitt and and March : Competency Traps Huber; Cyert and March; Nelson and Winter: routines. Shrivastava: Individual learning as poor metaphor for organizational learning. B.C.G., Epple et al. learning curves. Weick: organizations as interpretive systems. Daft and Weick, Duncan and weiss: language and interpretation.	Brown and Duguid: becoming an insider is learning Pedler et al.: flatter organizations create a tension that elicits new learning. Pedler et al.: flatter organizations create tension that elicits new learning and personal development. Pettigrew and Whipp: widespread individual learning is a kind of organizational capability. Stata : Individual learning makes organization more flexible and responsive
Intervention Research	Hayes et al.: institute 'people first' assumptions. Ciborra and Schneider: question formative context to enable organizations to adapt. Schein: Culture as learning and as malleable.	Senge: individuals can learn to experience awareness of personal causal responsibility. Isaacs and Senge: simulations that help individuals diagnose causality. Argyris: understand and change individuals' theories in use to promote effectiveness.

Sources: Authors Compilation

The approaches to understand organizational learning is focused on two levels i.e., individual level and organizational level. The focus areas can be perceived as under:

Chart-2: Categories of Organizational Learning Research

Primary Unit of Analysis

	Organization	Individual
Research Objective	(1) Organizations as embodiments of past learning.	(2) Individual Learning and development in organizations.
	(3) Organizations increasing the capacity for change through active, intelligent participation.	(4) Individuals gaining awareness of personal causal responsibility and interpersonal skill.

Sources: Authors Compilation

The growing need for work place learning has become necessary due to advances on technology and its affect on organizations. The sophisticated work processes created by technology require sophisticated workers. According to a 1996 survey of American Society for Training and Development (ASTD) 73% of the employees said that computer skills were essential for employment. More than half the new jobs created between 1984 and 2005 will require some education beyond high school. Learning has been shifting from classrooms to corporate training centers of work place. Knowledge workers now out-number industrial workers by 3 to 1. Some of the interesting connectors that are emerging between technology and learning, between technology and the work place are a) there is increased convergence between work and learning, with technology becoming a connecting tool. b) The learning component of work has become huge c) 'Life Long Learning' has come to characterize the lifelong challenge and life long process for employees as well as organizations.

The use of technology and telecommunications has added new dimensions to the learning environment i.e., *Modular, Multisensory, Portable, Transferable* and *Interruptible.*

The management and leaders are increasingly conscious of the need for integrating technology, learning and organizational life. During a recent survey conducted by ASTD, the human resource executives expressed concerns regarding a) Need to keep pace with the rate of change at workplace as well as technologies, b) Assessing the effectiveness of new learning technologies c) Knowing when and where to apply new learning technologies c) Integrating existing technologies with new learning technologies and d) Getting top-management to buy-in on learning technologies.

Organizations worldwide and specifically in India are grappling with several driving forces for change. The primary being the rise of Internet based "new economy", the Digitization (Castells, 1998; Kelly 1998) and secondly the processes of Globalization and Individualization. The advent of networked structures and web-shaped relationships are the interactive forces whose interplay has major impact on the Organizational Learning. At behavioral level, the Organizational Learning response in organizations, change occurs at five levels i.e., a) Level 1: Reacting by Focusing on Organizational Structure b) Level 2: Restructuring the Organizational Structure and Hierarchy c) Level 3: Redesigning the Core Processes, (Reframing): d) Level 4 Change: Regenerating The change initiative (Learning process) and e) Level 5 Regenerating: The approach to change focuses upon deep intention, purpose and will.

The responses levels 0,1,2 and 3 (action, structure, process and mental models) become integrated with contextual variables, referred as purpose (Hock 1999), shared vision or common will (Scharmer 1999) Hence, the level 4 effort implies allowing for flexibility in action, structure, processes, and mental models (level 0,1, 2 and 3) by focusing on redefining the purpose and uncovering common will.

The researchers have defined organization learning as a process by which organization expands its repertoire of actions. Huber (1991) defined Learning as 'a process that enables an entity to increase its range of potential behavior through its processing of information." Organizational Learning can then be defined as occurring when any of its units acquire knowledge that they recognize as useful to the organization. Because of the potential for performance improvement, learning becomes imperative for organizations. Learning curves have been studies extensively in manufacturing contexts (Epple et al., 1991). Learning constitutes improvement of routines (Cohen, 1991) and is transferable across organization. In a way, it is a stored knowledge that becomes useful to the organization. The focus of research has been methods to enhance learning curves to increase competitive advantage**.**

Organizations per se, can be understood as interpretive systems (Daft and Weick, 1984), in constant flux – artificially stabilized through interpretive processes, routines and standard operating procedures. In the context of traditional psychologist definition, Weick observed that organizations are rarely able to satisfy its condition of producing a 'different response' in the 'same situation'. The non-traditional method of defining organizational learning favors an information-processing view of learning, in which the stimuli are the actual physical events, but rather are interpretations of events (Weick, 1991).

Some organizational learning theorists have examined the individual learning as an adaptation method in organizational context. For instance, Brown and Duguid (1191) describe learning as becoming 'an insider' by acquiring tacit or '*noncanonical knowledge'*. Through researchers have studies the process of work groups' formation as '*communities of learning'*, it is the individuals who actually learn and make a difference to the group's contribution. Some CEOs have observed that individual learning is source of competitive advantage for their organizations. (Stata, 1989). The descriptive theory at individual level of analysis include models which specify condition that facilitate and elicit individual learning and the benefits accrued to organizations, through individual learning activities.

Flatter organizational structures create a tension that elicits learning and personal development by employees (Pedler et al., 1990). The new interpersonal challenges encountered in less-hierarchical, more team-based organizations engage individuals to engage in developing their communication and other interpersonal skills. Organizations would be able to implement activities that develop knowledge and skills of the individual, creating a kind of institutionalized learning or 'Organizational Capability' (Pettigrew and Whipp, 1991). The learning of individual employees enhances the capability of the organization. Research studies suggest that explicit plans and structured processes contribute to effectiveness, and the individual learning becomes relevant in this context.

New species evolve by natural selection operating in small, reproductively isolated, populations. The winners of ever-increasing competition to change are realizing that change does not happen in large corporate meme pools any more than it occurs in large gene pools. Change programmes usually do not change anything (Schaffer and Thompson 1992) and seventy percent of cooperate re-engineering efforts fail precisely on account of this reason. Punctuated Equilibrium concept supporting this argument argues that real changes are more likely to happen when smaller populations can evolve free from prevailing, and stabilizing corporate metallic's. Results and Changes, not programmes and theories, drive real learning.

Genetically, replication occurs without providing scope for transformation of other genes. For evolutionary change to happen, mutations must occur, to lead to genetically superior or luckier strategies. Similarly, in case of corporate, for facilitating learning, they need to change their mental modes, their prevalent mental models and unwritten rules that they create. Only then can new set of behavior evolve. Just as animals have five ways to change, organizations have parallel phenomenon namely, first *Random Selection,* second is through conditioning employees behavior by reward mechanism. Third is by *Training paradigm* through which employees learn new skills sand competences. Fourth method is *selective breeding* through movement to build shared values and purpose amongst all the employees. The fifth method is genetic engineering through organizations modify their unwritten rules to allow cross functional collaboration, allow objective learning & decision making and also a proper use of helpful systems and development of managerial capability. The strategic possibilities are limited by genetics or metallic's, which is supported by *Classical rational thinking on strategy* (e.g. porter, 1980), which explains *niche* approach. The presumption of unlimited movement across industries has been questioned by (Hamel and Prahlad, 1989) through their 'Core competency' theory. The important prerequisite is that for improving focus and efficiency of corporate body, it is vital to preserve the flexibility of corporate mind.

The most succinct insight into change management may still be Machiavellis 500 year's old observation that 'Change is difficult because of the incredulity of mankind who do not truly believe in anything new until they have experienced it for themselves'. People do not learn at the level that generates different actions, from the lectures, advice or papers of others. The propulsion for change is released when people discover a possibility for themselves (Goldratt and Cox, 1989). The quotation has been realized due to Argyris (1982, 1991), as defensive routines. Real learning, double-loop learning; occur only when people enquire their own role in causing the situation. Double-loop learning requires that we unlearn some deeply ingrained beliefs about ourselves. Senge explained this aspect with his definition of Mental Model (Senge, 1990). Unwritten rules obstacle the learning process. In organizations where individual profile and reputation is critical, reflecting on, and learning from, the past is reputation is quite damaging. Asking for help is viewed as indication of weakness and giving it a sign that your help is not worth having. Unwritten rules and mental models create a corporate mindset, which – without conscious design – acts to preserve the status quo. The stable mind set which evolves organically strives to preserve itself, even in the face of opposition and demand from external environment, which is akin to DNA (De Oxy Ribonucleic acid) based organic systems. Both tend to create self-perpetuating, self-replicating systems. Few corporate strategies are either (Mintzberg 1994). Viruses are essentially free strands of DNA. Many viruses have evolved mutually beneficial symbiotic relationships with their hosts. It is to Darwin, that we owe the suggestion that the evolution of the human brain, an organ of far greater processing power relative to body weight than any previous species has achieved, created condition for the evolution of second natural replicator: **the meme.** Memes, he proposes, are the new replicators in the soup of Human Culture. As Dawkin has proposed, 'when you plant a fertile meme in my mind you literally parasitize the brain, turning into a vehicle for the memes propagation in just the way a virus may parasitize the genetic mechanism of host cell'.

Further, studies in intervention research, suggest that despite the explicit focus on effectiveness, they do not focus on change implementation aspect, to produce the desired changes. On the contrary, change process is mooted through a) *Organizational complexity and cognition interacting* b) *Learning about culture and culture as Learning* and c) *Capacity increasing for change through intelligent participation:*

Media Influences on Individual Learning - Implications for Organizational Learning: A growing number of organizations have reported significant improvement in performance, when they have encouraged their employees to learn and share knowledge. For facilitating organizational learning, individual learning needs to be communicated to others and ultimately the entire organization

(Crossan et al. 1999). Communication plays a vital role in work place learning and knowledge development (Weick and Westley, 1996) and the advanced communication technologies such as e-mail and video-conferencing play an important role in organizational learning by facilitating (or inhibiting) flow of learning among individuals and groups in organizations (Crossan et al. 199). Individual learning and information processing is frequently associated with communication which provides time to allow individuals to engage in important cognitive activities such as encoding, rehearsing, and reasoning.

Individuals communicate in organizations for two distinct reasons i.e., primarily reduce uncertainty and secondly to reduce equivocality (Daft and Lengel 1986). Reduction of uncertainty needs more information, while reduction of equivocality requires clarification of information. A review of constructivist learning perspectives leads to insight of the need for learners to interact with environment. The constructivist theories with insights from *cognitive psychology* propone that mind of the learner produces interpretation of reality through processes of attention, encoding, rehearsal, elaboration, retrieval, reasoning, and problem solving. The key driver for individual learning process is cognitive-based interactions (i.e., those that engage deep level thought processes like reasoning and problem solving.

According to Oliver and McLoughlin (1997), the five types of interactions between two parties, which result in learning, are social, procedural, expository, explanatory and cognitive. The individual learning theory helps in hypothesizing that individuals who use communication media support for feedback and get time for reflection would perceive greater communication richness and hence greater learning outcomes.

Reg Revans (1997) architect of action learning believed that it is difficult to describe, because, it is so simple. Mc Gill and Beaty (1995) defined it as "a continuous process of learning and reflection, supported by colleagues, with the intention of getting things done". Similarly, Inglis (1994) defined AL as "a process which brings people together to find solutions to problems and in doing so, develops both the individuals and the organization".

Action learning is often confused with "learning by doing" (Wallace 1990). Revans himself contributed to the confusion by loosely defining AL's essence as learning from and with peers while tackling real problems (O'Neil and Marsick 1994). AL is not synonymous with project work, job rotation, or any form of simulation such as case studies or business games. Inglis (1994), indicated that AL differs from other methodologies through a) Learning is centered around the need to find solution to a real problem b) Learning is voluntary and learner driven c) Individual development is equally important as finding solution to problem d) Action learning is a highly visible, social process, which may lead to organizational change and e) Action learning takes time of around 4-9 months, excluding implementation period. There are five basic elements of all namely; problem, set, client, set advisor and process are detailed.

Learning Organization - Integrated use of Information System and Knowledge Engineering: Knowledge is a fundamental asset within the business context, working as decisive variable influencing the performance of the organization. The mechanisms of creation, representation, diffusion, marketing and exploration of knowledge provide competitive advantage to the organization and can briefly be termed as knowledge management. Learning Organization has been defined by (Malhotra, 1996) that "Learning organization is to have an ingrained philosophy for anticipating, reacting, and responding to change, complexity and uncertainty". In order to manage the knowledge management process and the organizational learning, it is prerequisite that an appropriate Information architecture and IT tools are in place in the organization, facilitating these processes. (Jaao Vasco Furtado, Cesar Colera, Secrel) proposed a strategy called MC2 strategy which was inspired by ideas from Management Systems about learning organization and knowledge management and is characterized for making integrated use of information systems and knowledge engineering to support these processes. To induce people's participation the learning process, it is important to implement, within the organization, efficient and structured ways in which the attributions, roles and responsibilities are clearly defined. The use of IS as tool for enabling for employee participation is fundamental (Huber 1990; Davenport 1997). IS are important in LO for serving organizational memory and for distributing information.

Knowledge Management focuses on the creation of *explicit Processes* that increase knowledge and learning throughout the organization (Alavi and Leidner, 1999). It requires systematic attention to learning processes, culture technology infrastructure and measurement aspects. The process of KM involves generating, capturing and organizing, accessing and sharing, and applying knowledge encompassing supporting individual and organizational learning. The Information Technology (IT) in organizations is specifically designed for sharing and integration of knowledge through Knowledge Management Systems (KMS) (Alavi and Leidner, 1999). Technology applications such as Internet, Intranet and GroupWare are being increasingly used to facilitate accessing and sharing of information and knowledge.

Organizational learning focuses upon the ability of organizations to adapt to changing conditions (Huber 1991) and improve actions (Fiol and Lyles 1985). The OL has been researched from three perspectives, i.e., a) *Summative:* It suggests that individuals learning can be aggregated into organizational level of analysis (Simon, 1991), through linkage with knowledge management. Organizations can provide learning experiences, to employees or hire new employees possessing knowledge beyond that of current employees (Epple, Argote and Devadas, 1991; Huber, 1991), b) *Interactive:* It suggests that mere aggregation of individual learning, by itself is not organizational learning (Nonaka and Takeuchi, 1995). It argues that as a pre-condition to learning, there must be process of knowledge exchange between individuals (Cohen and Levinthal 1991). Through exchange, new knowledge is created for use by the organization, *and c) Role-Related:* Learning is determined by the role occupied by the individuals in the organization. Organizational learning is a function of role-related learning behavior, and is thus distinct from the

individual occupying the role. At the core of the knowledge is learned and possessed by individuals, groups and organizations through capability to access, acquire, assemble, adapt and apply knowledge in pursuit of organizational goals and objectives. The enablers of the process include knowledge management system, culture, and leadership roles. The metrics developed (Susan A. Brown, Anne P. Massey) is as under:

Chart-3
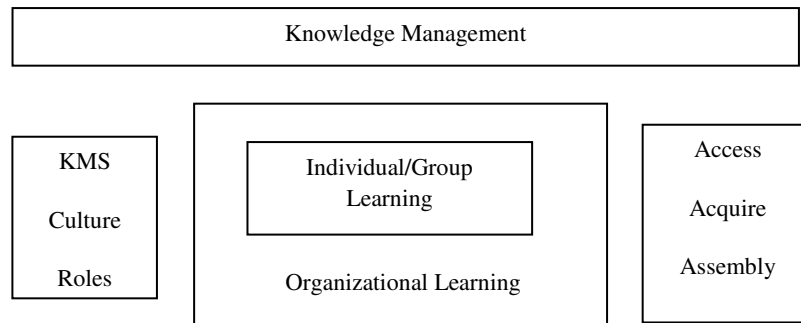
Sources: Authors Compilation

A probative research to answer these queries would enable the organization to plan and institute an enabling KMS, which facilitates and supports learning process in the organization. The *Knowledge support systems* (KMSS) have been researched by Perrow (1967) noted that *Technology* facilitates the interactions among employees, which ultimately take the shape of Organizations' structures. The Model framework for KMSS research proponed by Nicole Haggerty and Scott Schneberger:

Chart-4

A Model for the study of Knowledge Management Support system
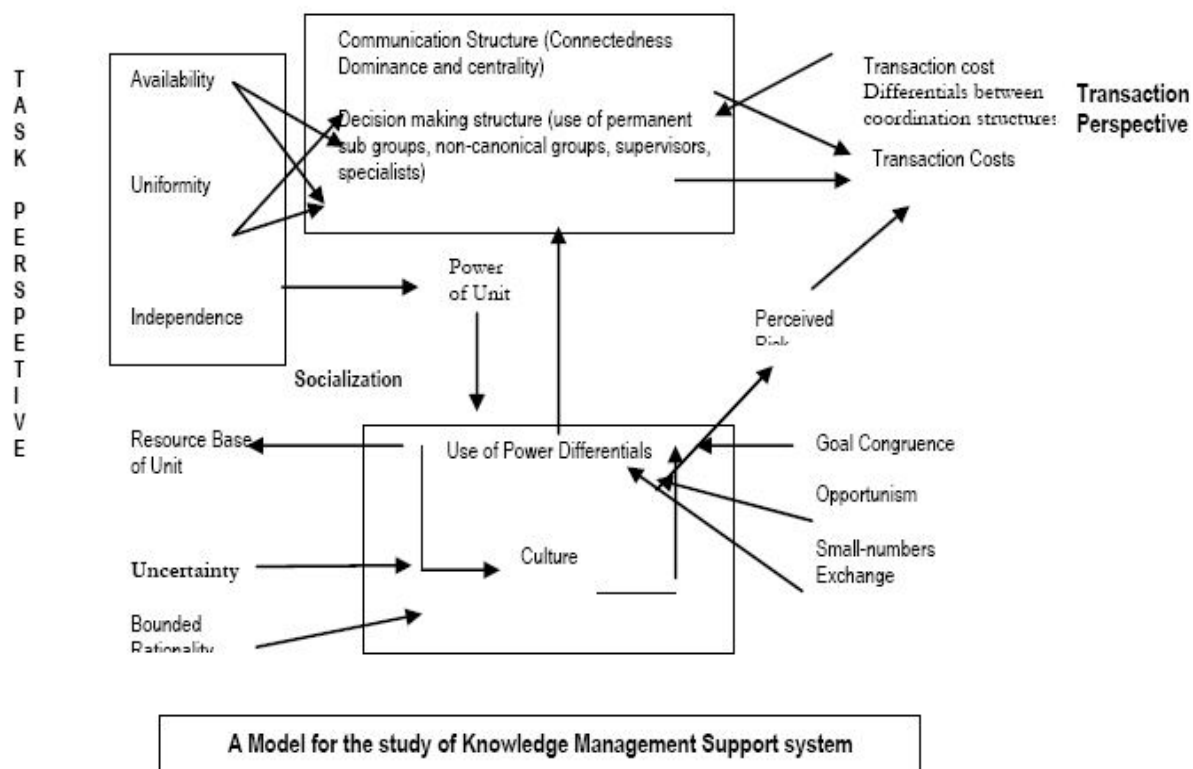
Sources: Authors Compilation

Facilitating effective and efficient knowledge sharing among organizational members is the primary objective of organizational knowledge management research and practice. Perrow's framework provided a seminal foundation for later research. Van de Ven and Delbeq (1974) extended Perrow's (1967) analysis to formulate a task contingent model of work-unit structure based upon *Task difficulty* and *task variability. Task difficulty* corresponds to the "degree of complexity of the search process in performing task, the amount of thinking time required solving related problems, the body of knowledge that provides guidelines for

performing tasks. *Task variability* corresponds to "the number of exceptional cases encountered in the work requiring different methods or procedures for doing work. Poole began by extending Van de Ven and Delbeq's task-contingent model with Thompson's (1967) concept of *task-interdependence*. He then applied that extension to communication structure. This task model was constructed upon mediation information task constructs of *availability, uniformity,* and *independence. Availability* refers to perceptions of suitability and obtainability of information. *Uniformity* refers to perceptions that information requirements are consistent in term of amount, type, and report timing. *Independence* refers to ability of a work unit to meet its knowledge requirements.

Technology & Workplace Transformation: Technology has changes the way works is being done, be it the production, coordination, or management work. The Coordination Work, which implies, distance and time (time zones) can be shrunk to zero. Users from can maintain the organization's memory for accessibility and usage across the globe. Management Work is more flexible because of aid and support of technology, in sensing the external environment.

Technology has made it possible for fuller integration of business functions across four directions i.e., *within the value chain, End-to-end links of value chains*, *value chain substitution* and *Electronic markets*. The structure of the organization needs to be redefined and recreated to allow the re-distribution of power, function and control, where they are economical and efficient. Organizations can become clusters/adhocracies, the technology-driven networks and databases will replace the multi-tiered hierarchy with a wide breadth, and depth of that is sum of employee's collective experience. The new *organizational architecture* will evolve around autonomous work teams and strategic work alliances. Technology enables the organization to 'stretch', to democratize the strategy creation process; to tap the imagination of majority of employees. It allows managers to lead their organizations through a complete transformation process. It allows for strategic opportunities for organizations to re-assess their missions and operations. *Charles Handy(1999)*, sees the popularity and success of sizing and restructuring organizations as an effective way of dealing with six paradoxes i.e., 1) Power and control, 2) being big and small at the same time, 3) being autonomous within bounds, 4) encouraging variety but, within shared purpose, 5) individuality but also partnership and 6) global and yet local. The shift generated by technology has defined by *Michael J. Marquardt & Greg Kearsley (1998)*, as under:

Chart-5

Organizational Shifts Generated by Technology		
Dimension	**Bureaucratic**	**Network**
Critical Tasks	Physical	Mental
Relationships	Hierarchical	Peer-to-peer
Levels	Many	Few
Structures	Functional	Multi-disciplinary
Boundaries	Fixed	Permeable
Competitive thrust	Vertical integration	Outsourcing and alliances
Management Style	Autocratic	Participative
Culture	Compliance and tradition	Commitment and results
People	Homogenous	Diverse
Strategic focus	Efficiency	Innovation

Sources: Authors Compilation

The structural aspects have the additional benefits a) Release of energy due to autonomy b) Allow people to be informed c) Binding of units by trust and common goals rather control. d) Delegation of power to the lowest possible point e) Elimination of risk of centralized bureaucracy, due to spreading of power. f) Right and responsibility with people for their work g) Flatter organizations without losing efficiency.

In precise technology facilitates the transformation of organization into flexible, agile and responsive to the meets the demands of the competitive scenario.

Virtual Organizations are a temporary network of independent companies, suppliers, customers, even rivals linked by information technology to share their skills, costs, and access to another's markets. They neither have central office, organizational hierarchy, but consist of teams of people working in different companies routinely who together on project-based assignments and are disbanded at the end of the project. Virtual organizations mix and match, the best of other organizations, with the power of technology and can becomes an excellent competitor, with the speed and muscle of lead-edge technology.

The employees of today are technology savvy and are continuously striving to learn and assimilate the technology in work place. Technology provides for quicker and better transfer of knowledge throughout the organization for various reasons a) First, it can improve the ability of people to communicate with each other, since it blurs the boundaries of the organization and provide for scope of development of relationships beyond hierarchies, b) Second, technology provides opportunities for interpersonal interaction through various media, i.e., video conferencing, e-mails etc and c) It eliminates the number of hierarchies while increasing the scope of control.

It will place greater emphasis on employee contribution, by effectively measuring the performance. In the process it strengthens, employee's need for recognition to his value-contribution. The pay-for-performance can be effectively administered. The competency and skills of the employees can be recorded and in the process, their learning requirements can be planned for, as a part of overall organizational learning efforts.

In short, it allows empowerment of employees at ground level and facilitates better performance of organization through these front-line at the point-of-interface with customer, which would lead to increased customer satisfaction and improved resultant business performance.

Technology and Customer*:* At the customer level, technology has provided customers with more knowledge about the options and standards of services and products that are available to them, but also the quality consciousness. Their demand for customized products and solutions based on the best in terms of a) Cost: What is least expensive and most economical b) Quality: with zero defects and thereby meet and rather exceed the expectations of the customer c) Time: Providing of products/services in the shortest possible time d) Service: Efficient and hassle frees service through empowered employees e) Innovation: Envisioning and creating/producing beyond customer expectations, and f) Customization: Products/services tailored to specific needs of customer

In precise, technology is the effective way for organizational transformation in what most aspire for i.e., customer centric organization. It facilitates for total reorientation of companies around meeting customer needs and expectations.

The organizational breathing cycles can be understood through unfreezing, change and re-freezing process. The organization's response of "Uncovering or Unfreezing", of current reality can be termed as "breathing in" while the process of implementing changed consciousness into practices can be termed as "Breathing Out". Thus, the Lewin-Schein model of unfreezing-change-refreezing can be perceived as one sequence with an ongoing process of organizational breathing.

The next issue regarding what it takes to compete in new economy. Brian Arthur (2000) emphasized that in order to do well in new economy managers have to understand their ways of knowledge creation and knowing. Arthur (1996) adds, "If knowledge-companies are competing in winner-take-most markets, then managing becomes a series of quests for the next technological winner". The cognitive and knowing process is isomorphic top in the levels of change described above and can be understood among four levels of cognition 1) *Level 1 Cognition: Downloading Mental Models* 2) *Level 2 Cognition: Reflection and Reinterpretation* 3) *Level 3 Cognition: Imagination and* 4) *Level 4 Cognition: Primary Knowing (Presencing):* At level 4 cognition, the quality of attention is the highest and most subtle level allows it to become one with the intention of the emerging whole. This level of cognition is what Rosch (forthcoming) refers to as *primary knowing of wisdom awareness.*

The learning organization is "an organization skilled at creating acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge, and at modifying behavior to reflect new knowledge and insights" (Garvin 1993, p.80) Information Technology (IT) is often used by learning organizations to rapidly disseminate knowledge and overcome "the learning curve" when introducing employees to new procedures or products (Quinn et al., 1996). "Knowledge management technologies" such as intranets, data warehouses, and groupware products, provide organizations with mechanisms to accomplish these activities.

Tornatzky and Fleisher (1990) provided a broad theoretical framework consisting of three components that influence the information systems adoption process: (1) the organizational context, (2) the technological context, and (3) external environmental context. For example, Grover and Goslar (1992) found a significant relationship between adoption uncertainty, whereas Chau and Tam (1997) found no such relationship when adoption of open systems. Sherry D. Ryan, Gulillerno Rodriguez, John C.Windsor (2000), in their paper on "Factors Affecting the Adoption of Knowledge Technologies: An International Perspective, proposed a Research Model, taking into consideration the following aspects:

Organizational Context: It describes the attributes of an organization such as organizational culture, the degree of centralization and formalization. It depicts the processes and structure of an organization and their impact on adoption of technological innovations. Several studies have found significant relationship between these attributes and innovation adoption (Tornatzky and Fleisher 1990; Chau and Tam 1997). Lipshitz, Popper and Oz (1996) suggested that Learning Organization consists of two aspects: Structural and Cultural. The structural aspects refer to established structures and procedures by which organization collects, analyses, stores, disseminates and uses information that is pertinent to organizational effectiveness. Knowledge Management Technologies such as intranets have been identified as supporting these activities. The cultural aspects are result of shared values and experiences, which aggregate individual experiences into a corporate awareness.

Technological Context: It refers to how the characteristics of existing technologies in an organization influence the adoption process. (Tornatzky and Fleisher 1990). Brown (1981) and Rogers (1983) summarized innovation characteristic variables that were commonly found to influence the adoption decision. Lai and Guynes (1994) applied three of characteristics - compatibility relative advantage and complexity to technological adoption process. Compatibility has been defined as "the degree to which a new innovation is perceived as being consistent with potential adopter's current task environment" (Lai and Guynes 1994, p.76)

Relative advantage can be described as a perception held by the potential adopting firm as top degree to which innovation is superior to the practice(s) it will supercede and other solution that might be possible (Lai and Guynes 1994). Complexity is

defined as the degree to which an innovation is perceived as difficult to understand (Lai and Guynes, 1994, p.77). When technology is difficult to understand, it is hard to obtain management commitment to proceed.

Environmental Context: It refers to the various factors in the environment in which the organization is subsisting. These factors vary from culture, values, development etc. Since, the organization is a subsystem of the external environment, it is logical that the environmental factors significantly influences various internal factors for the organization such as culture, values, ethics etc.

Training, which is one of the important aspect of organizational learning process has become user-friendly, both from the both the involved segments i.e., Facilitators/Trainers as well as learners perspectives. Training, with advent of technology, can now be provided anywhere, anytime and for anyone. The entire gamut of involved processes can be managed through centralized location or even distributed locations networked with the central location. The training involves various stages as detailed below:

In the pre-training, the processes such as Training Needs Identification & Assessment (TNI & TNA), can be effectively performed with help of e-Performance Measurement Systems (PMS). The skills and competencies, which are captured during PMS, by the Managers, are surely one of the better ways of capturing the data. The other aspects such as relating of organizational core competencies with the individual competencies in the process of developing competency index, is one of the important aspects in the pre-training stage. The various aspects involved in the training are: a) Identifying the range and extent of training needs from the business needs b) Specifying those training needs precisely and c) Analyzing how best the training needs might be met.

The business needs of the organization can be assessed with the help of five main tools, namely viz., human resource planning, succession planning, critical incidents, management information systems and performance appraisal systems. Traditionally, many authors on TNA (Stewart & Stewart, 1978; Goldstein, 1986; Kubr & Pokopenk, 1989) have studied the different levels at which the training needs can be assessed. The most common structure of levels i.e., *a) Organizational Level:* It involves identification of training needs, which affects the whole organization, for instance, training aimed at introducing cultural change across the organization or induction training b) *Occupation/Group Level:* Identify the training needs affect particular occupations or groups, e.g. training in Asset Liability Measurement (ALM) to the Credit and Treasury Staff and *c) Individual Level:* Identifying the training needs of the employees, for instance, training on marketing strategies to target high net-worth Individuals to the retail marketing staff in the banks.

Another aspect focused upon (Boydell, 1990; Kubr & Prokopenko, 1989) whether the training is for the present of future needs. The present needs are seen relative to the current objectives. For instance, training to branch staff on the networking aspects, keeping in view the bank's objectives of total branch networking. Future needs relate to long(er) term objectives. For instance, training of core IT specialists of a bank in areas such as mobile banking etc., then the bank has drawn up aggressive plans for providing into high-tech banking services to its customers. In fact, there is no best approach towards identifying the training needs. The imperative need is for continuous scanning of environment and tries to understand, what performance changes are needed to meet the business needs? Further, the most importantly, can those performance changes be met by a training intervention?

IT plays a facilitative role in the entire process. The performance measurement as well as the maintenance of the skills and competence database can be interlinked and can be maintained as a common database. This can further correlated with the process of training needs identification and assessment.

In the training stage, The Training delivery comprises of design/development and implementation stages. Training per se, has been defined as a process to change employee's behavior at work through the application of learning principles. The behavioral change usually has a focus on knowledge or information, skills or activities, and attitudes of belief and value system. A succinct definition of the scope of the subject is "the systematic development of the attitude, knowledge and skill behavior pattern required by an individual in order to perform adequately a given task or job (department of employment, *Glossary of Training Terms*)". The traditional view is that learning, or behavior change modification, should continue until "experienced worker standard (EWS) is reached. The UK IPM has the wider vision of development and attempts to treat it as a form of continuous learning. Continuous Development (CD) is not a body of theory, nor a collection of techniques; it is an approach to the management of learning. Continuous development means a) Learning from real experiences at work, b) Learning throughout working life, not confined to useful but occasional injections of "training".

For the individual employee, continuous development means lifelong learning, with a strong element of self-direction and self-management. For the organization, continuous development means the management of learning on continuing basis through the promotion of learning as an integral part of work itself (IPM Statement, Continuous development people and work).

To meet the IPM's aspirations, short-term task based learning would need to be broadened and the focus would have to be on how the individual 'learned to learn' between various tasks, so that principles of learning can be moved into new contexts to solve new problems. This 'portable learning' seems a long way off to most of the employees. However, such 'portable learning' is more a function of education. The inherent limitations in jobs of most of the employees make CD a great aspiration rather than a reality. The developmental perspective with an over-specialized task approach proves more beneficial to the organization rather than the employees. Enhanced productivity and profitability would be the motivation and spin-off, which can be expected by the

organization. The other benefits to an organization from training the employees are: a) Reduction of learning time b) Reduction of turnover and Retention of employees c) Increasing scope for flexibility in job, c) Attitudes towards ethos of organization can be altered and d) Management Training can enhance the internal capacity for decision-making and planning etc., which can impact on the very growth if not the survival of the organization.

Training knowledge and skills without organizational commitment would be futile and can be dissipated. The training skills need to be spread out in the organization and danger of concentration needs to be guarded against. If, we consider the learner, the self-development perspective is geared to self-help philosophies and is based on the following premises a) Institutionalized training is expensive and often not relevant to learner needs b) It fits everyone and individual takes responsibility for his her own learning c) Self-Actualization seems to be the real goal d) 'Anti-expert' slant. In addition, e) The student participation in the programme is critical.

Again, methods/techniques revolving around the learner, and almost ignoring the other influences in the system, can give a distortion on reality. To over-emphasize the learner is to neglect, if not to negate the learning or training system. The comprehensive model of Anderson Associates, Personnel and Management Advisors, regarding the training system is as under:

Chart-6
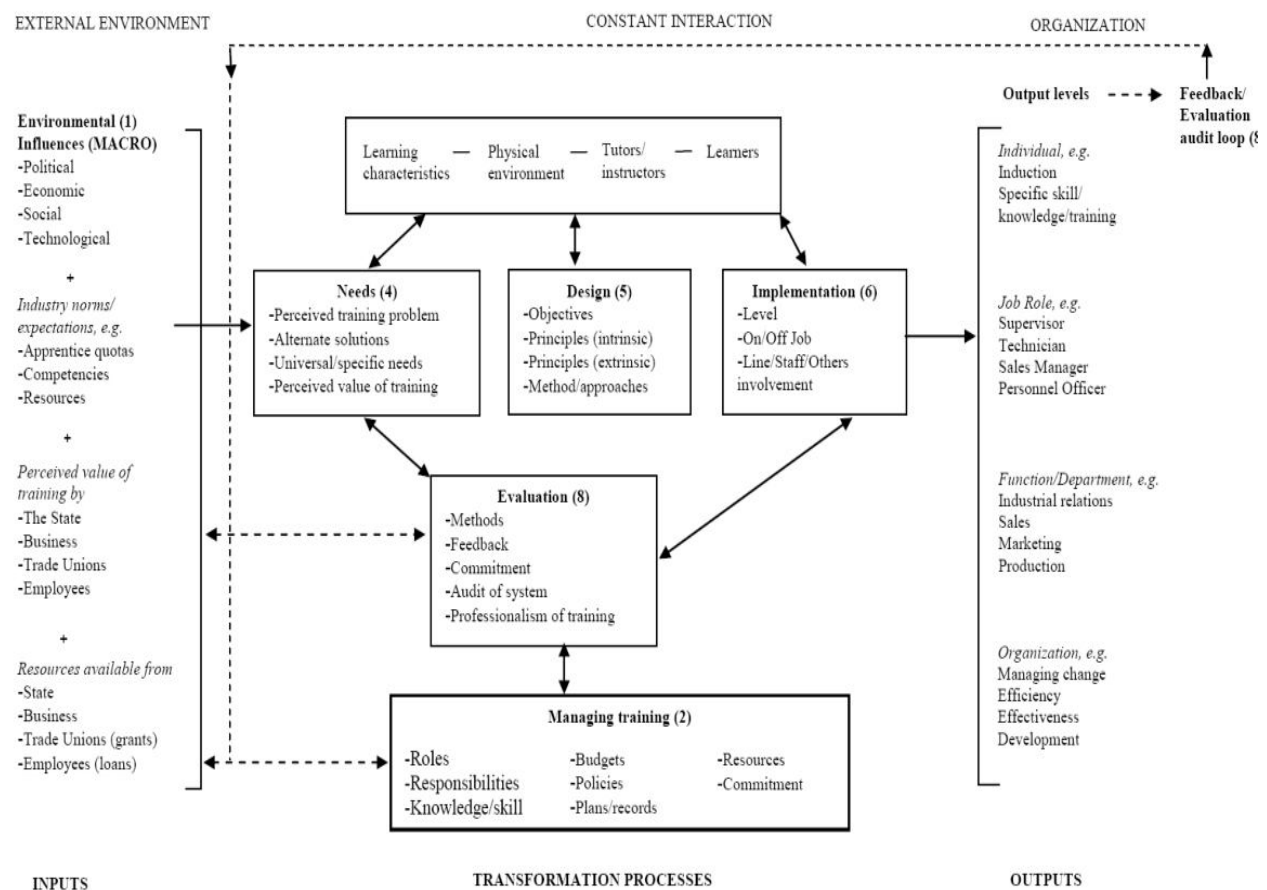
Sources: Anderson Associates, Personnel and Management Advisors

A traditional vision of management can be seen as 'effective planning and regulation of operations'. People were prominent in the analysis of management gurus with a three-fold analysis of managing the 'business', managing managers and managing workers all under the important constraint of time. Others took a wider environmental view and looked at management as some form of 'agency of community'. Therefore, irrespective of the organizational or managerial frame of reference adopted by managers, there are implications for training. Examining the mainstream 'functional approach' and role type of analysis can further illustrate indeed this, which is a serious rival to the functionalists. The functional approach emphasizes the activities of management the military vision of 'commanding' has been liberalized through time to become 'directing and leading'; while coordinating has been absorbed into the organizing/planning function and staffing has now been added. The reality of what managers actually do in effect is seen by others to differ from the functions of management. A role analysis is used as being more consistent with reality. This role, or pattern of behavior associated with a position, involves the manager's view of the behavior as well as the perceived expectation of others.

The *Managerial thought and Training Implications*, as explained by A. H. Anderson are indicated in the following table:

Chart-7

School	Themes	Training implications
Interpersonal behavior	Human Interaction at work is the focus.	Skill development / people management important.
Group Behavior	Workshop attitudes and motivation to act important.	Leadership Training Group Dynamics etc.,
Cooperative social system	Cohesion encouraged; conflict ironed out.	'Core value' systems and building up a unitary culture part of the brief for attitudinal change via training.
Socio-technical	Constant interaction between social (people) aspects of the organization and technology (equipment work methods etc.)	Again people part of eth equation, so groups/individuals affected by interaction, e.g., new technology/machines etc., hence skill implications.
Decision Theory	Organization seen as a 'complex web of interlocking structures'. Analyze decision – processes.	In many ways, management in decision making, shrewd training people 'switch into' the power structures to gain resources etc.
Contingency	A horse for courses approach. No one solution as it depends on the circumstances.	The uniqueness of the culture and organization must be understood and used by the trainer (staff or line).
Classical/ Scientific Management	'Scientific' selection and training of workers. Scientific analysis of time. Market division of labour (Planners and workers) Differing responsibilities.	Training with its skill divisions seen to be a main premise of this school.
Behavioral	Groups and individuals important to counter the pure 'task' mentality. 'Contented cows give the best milk.	People to the fore hence training and development important to this school.

Sources: Authors Compilation

In classical managerial philosophy, a clear division is made between the line and staff managers. There may be hierarchy in training system as well, where roles may even be assigned to the line authorities. In practice, the responsibility of training is shared in training between the staff and line manager/trainer. The various roles as adopted by A. H. Anderson from the work of Henry Mintzberg, *The nature of Managerial Work* are as below:

Chart-8

Role	Theme	Training Implication
Interpersonal Roles		
1. Figure Head	Legal and ceremonial.	Training? (Social Graces).
2. Liaison	Network of external contacts.	Important information source.
3. Leader	Hires, train, promote and dismisses.	Clear training role.
Informational		
4. Monitor	Receiving information (external/internal).	'Control' aspect for policies etc.
5. Disseminator	Gives information to groups (external).	Training is dissemination of information.
6. Spokesman	Giving information to groups (external).	Possible liaison type of role but usually internal activity.
Decisional		
7. Entrepreneur	Initiates and designs much of the controlled organizational change.	Clear Trainer's Role.
8. Disturbance Handler	Removing obstacles to change.	Perhaps more of an industrial relations role but 'disturbances' may be indicative of a training need.
9. Resource Allocator	Schedules own time, authorizes actions etc.,	Training competes here for the resources of the manager/organization.
10. Negotiator	Bargaining Role.	Very important in getting resources plus convincing subordinates of value etc. of training.

Sources: Authors Compilation

A.M. Pettigrew and Reason had departed from the 'job functions' approach and examined the 'best fit' between job role, person and organizational culture. They identified five trainer types (indicated below) and went to great lengths to pint out the need for 'congruence of role, person and culture, to from any vision of trainer effectiveness.

Chart-9

Trainer Types and Effectiveness	
Provider	Maintenance not changes; performance-oriented. Likes the concrete and the practical. Nitty -gritty training carried out. Divided into three sub-categories. *Cultural operator* Identifies with mores of organization. Credible but power-based legitimacy given to role by organization. May find difficulty in dealing with sub-cultures. *Individual contributor* Good knowledge base, unique personal contribution. Almost charismatic figure. Organizational and bureaucratic constraints may impinge on this individuals 'freedom to operate'. *Role Performer* Identified with 'system'. More bureaucratic in approach. Likes paperwork / routine work.
Training Mangers	Less of a practitioner and more of an overseer. Geared to power and influence. Uses policies / procedures to 'advance training'. 'Co-coordinators' – often based at HQ, subordinates may have 'dotted line' relationship. Manipulative skills to the fore in this potentially 'no win situation'.
Change Agent	Aspire to altering the 'personality' of the organization. Often seen as 'neutral' outside of the structure of the organization.
Passive Providers	Low influence. Many trainers in this category. Waits for 'clients'. Involved in endless details/routine work.
Role in transition	'New Vision' of the organization but lacks clear role marginalization and legitimacy problems abound. Potential for role conflict.
Evaluation	Joint Initiative. Shorter time-scale tends to be line while organizational view and longer time-scale tends to be staff.

Sources: Authors Compilation

Learning technology is "the use of electronic technologies to deliver information and facilitate the development of skills and knowledge". It includes both presentation (how information is presented to learners) and distribution (how information is delivered to learners) elements. The various presentation and distribution learning technologies as categorized by American Society for Training and Development (ASTD) are: a) Presentation Technologies: Electronic Text or Publishing, CBT, Multimedia, Television, Tele Conferencing, Virtual Reality, Electronic performance support system – EPSS (an integrated computer application using expert systems, hypertext, embedded animation, and/or hyper media to help and guide users to perform tasks) b) Distribution Technologies (Cable TV, CD-ROM, E-mail, Internet, Intranet, Local Area Network, Wide Area Network).

The use of information technology by organization for imparting of learning is due to host of factors such as speed of learning, quality, relevance etc. Some of the advantages are explained in brief are a) Available as needed and Just in Time, b) Learner Controlled, c) Cost Effective, d) Self-Paced and User Friendly, e) Accessibility over a wide Geographic Area via Distance Learning, f) Hands-on Instructiveness, g) Uniformity of Content and Delivery, h) Adjustment to Individual Learning style, i) Adjustment to Motivation level of Learners, j) Safety and Flexibility, and k) Ability to continuously update.

Role of Technology - Transformation from Training to Learning: Research Evidence shows that in traditional training programs, less than 15% of the material covered in the corporate training room ever are applied in job. The reasons for this are:
- ❖ The training is provided to a group of people with varying degrees of interest and expertise in the subject matter at the time they are receiving training.
- ❖ Most of the content is being provided on a just-in-case basis, many participants are not sure if or when they will apply the learning and hence put in little effort to learn.
- ❖ Some material may be too advanced to too easy and thereby leading to frustration of boring.
- ❖ Since the instructors are reaching 5-30 participants, they do not take effort to deliver a top- quality program.

Learning Management and Technological support: Beckman suggested four sequential but overlapping stages in assuring that the knowledge is collected, stored and shared and they are a) Stage 1: Establish an installed IT infrastructure for all employees, b) Stage 2: Create enterprise-wide Data, object and Knowledge Repositories, c) Stage 3: Automate and Enable Operations, Management, and Support Activities, and d) Stage 4: Develop Integrated Performance Support Systems and Knowledge Discovery and Data Mining Applications.

Technology and Learning Integration / Implementation Principles: The dimensions of technology vis-à-vis learning can be organized at two levels i.e., Learning Context Level (Class Room) and Organizational Level.

Classroom principles expand upon the premise that effective technology integration requires the time and attention of instruction designers. Value is integrated into educational technology to facilitate teaching and learning processes. There are basically three e-tips to prompt an instructor/designer as to what they are teaching, what added value does technology contribute to the learning environment and how technology help the student to assess his learning. These three principles are a) *Learning outcomes drive selection of technology:* As a first step teacher must be clear about the learning outcomes of the learners. This helps in deciding

whether a given technology can support teaching as well as learning. The teachers can also focus upon learner's acquisition of higher level thinking in specific curricular area. A variety of educational technology i.e., software tools, web sites and peripherals are correlated with the types of outcomes they support., b) *Technology use provides added value to teaching and learning:* The term "added value" in learning context implies individualizing instruction or making it more responsive to the learner's questions and interests or providing additional sources of information. In the sense, educational technology provides "scaffolds" to learners in moving from what they know and can do to what they are learning. It also means that it supports the accessing of data, processing of information, or communicating of knowledge by making these processes more feasible as cited below:

Chart-10

Task	Added Value
Accessing data	➢ Multi-sensory, ➢ Greater amounts of data, ➢ Searching and "mining " capabilities, ➢ Timeliness of the information, ➢ Relevance of the information.
Processing Information	➢ Self-Paced, ➢ Individual attention, ➢ Remediation, ➢ Practice to the point of fluency, ➢ Visualizing information, ➢ Develop process or skill capabilities, ➢ Organize and Categorize information.
Communicating Knowledge	➢ Publish information, ➢ Communicate in authentic format, style. ➢ Communicate findings and understanding to others.

Sources: Authors Compilation

Planning for the outcomes of the learning is an important *aspect* of designing instruction. Some software or hardware actually collects formative data during its use, and some technologies provide help in the analysis of information. It can also to summative assessment, especially when learners are to produce products that allow them to show what they know and can do.

These three principles focus upon technology support features that are present in high quality technology support programs, which are correlated with increased use of educational technology.

At the Organizational Level the applicable principles are a) Providing Ready Access to Supported Technology: The organization has to ensure convenient and flexible access to and technical support to the instructors/designers facilitate learning environment in the organization. It implies technology must be close to the instructors and learners where they can use it flexibly. Dockterman (1991) describes several possibilities for use of technology in learning environment.

Chart-11

Resource Type	Technical Domain
Facilities	Network and Internet Access, hardware, software
Staff assistance and necessary services	Technical support, help desk, network services
One-to-one personal guidance, help	Computer experts from trouble shooting
Professional development	Operating equipment, general software
Incentives	Release time; free hardware, software and network access; anticipation of expert status
Resource Type	**Instructional Domain**
Facilities	Content-area specific software, communications access to pedagogical expertise
Staff Assistance and necessary services	Instructional expertise and back ground of people providing support
One-to-one personal guidance, help	Pedagogy, models implementation strategies
Professional Development	Pedagogy, models implementation strategies
Incentives	Release time, support focusing on instructional content

Sources: Authors Compilation

Technology professional development is the key to employees' learning into the wok environment. The learning needs can be thought of as, one, about learning to operate the software, and two, about learning to use software as an integrated, instructional tool. The trainers and learners must have frequent opportunity to operate educational pedagogy. Possible sources for learning include access top shares resources, training modules, mentoring, facet-to-face or online, asynchronous professional development courses or net-seminars, Intranets.

Employees need to have a forum for discussing/feedback on supportive role of educational pedagogy: This principle describes a professional collaborative environment for integrating and implementing technology. In such an environment, technology use would be more effective because the organization would recognize individuals make to the collective knowledge.

Facilitative Role of Online Discussions for Sharing and Learning: Discussion   teaching is "teaching/learning strategy that emphasizes participation, dialogue, and multi-way communication. It involves the teacher and a group of learners addressing a topic, issue, case study or problem and exchanging information, experiences, ideas, opinions, reactions and conclusions (Heming, 1996)". As an instructional or facilitative strategy, to allow employees / learners to interact with peers, articulate and reach a more critical and informed understanding about the topic under discussion, elaborate on and challenge ideas, hear and incorporate multiple perspectives, while motivating learners through active learning environments (Brookefiled & Preskil, 1999; Heming, 196; Powers & Dutt, 1995).

The purpose of an instructional analysis for online discussion is to determine the primary instructional goals and objectives (Schreiber, 1998). The possible learning activities and the style or mode of presentation need to be considered. *The Instructional Design of Online Discussion (ID-OD),* as proposed by Rogers (2002) is as below:

Chart-12

Phase	Analyze	Tech Reality	High –Level Design	Interactivity Design	Develop	Implement	Evaluate
Activities	Instructional Analysis	Institutional Inventory	Modularize Content, objectives Assignments	Vary Learning Activities And discussion Formats To maximize Interactivity	Instructional Materials and Discussion Questions	Moderate Discussion	Formative Evaluation: Revision on the fly
	Learner Analysis	Student Technology Inventory	Select Evaluation methods		Evaluation Materials		Summative Evaluation
	Does online discussion Make sense	Technology Support Availability	Plan for tech training		Tech training Materials		Was the discussion effective?
Outputs	Content scope and sequence, Instructional Objectives	Organizational tasks. Timeliness, Responsibilities	Module plan, Evaluation Plan, Tech training Plan	Interactivity Plan for each module	Completed course materials	Course delivery	Revise plans and materials as needed

Sources: Authors Compilation

Douglas Weidner addressed the issue through a three architectural layers of a potential solution – namely, the knowledge itself, the functionality or structure of knowledge (base) that serves as a repository and the knowledge delivery or access mechanism. A brief outline of implications of just a few axioms and corollaries of the "to-be" design hypothesis on the three architectural levels, knowledgebase functionality and delivery mechanism are:

Chart-13

Knowledge Axioms and Corollaries on Three Architectural Layers			
Hypothesis	*Architectural* Layers		
	Knowledge	**Knowledge Base Functionality**	**Delivery / Access Mechanisms**
Axiom 1 *Corollaries* Relevant Knowledge only threshold of amount Sound knowledge / Instructional Design	Process/task oriented Beneficial even if partial knowledge	Process-oriented Search	Access to software tools economical at every level
Axiom 2: Right Person Corollaries Knowledge Worker User Compatibility	Need for multiple perspectives / viewpoints Diversity of user learning needs	Accommodates multiple view points Accommodates user diversity	Universal Access Multimedia Capable
Axiom 3 Corollaries Existing Knowledge Age of Knowledge	Explicit vs. Tacit Updated frequently	Previously structured knowledge Easy to author/enrich	Universal and easy accessibility –User Update speed, accessibility to author

Sources: Authors Compilation

Similar to the chef metaphor – having all the ingredients beforehand, we have an insight or appropriate metaphor for knowledge – "the best knowledge to the right person just in time"; the reverse process of combining the requirement or architectural components can result in the needed knowledge management systems design. Each of the facets in the new paradigm can be understood i.e.

a) *Best Knowledge*: In the old paradigm, the burden of search was on the knowledge seeker. In the new paradigm, the appropriate ingredients are arranged before the chef in an organized manner at the moment of need. In organizational context, the relevant knowledge is associated with the performance of specific activity or task within a known process. The process then becomes a more powerful organizing scheme, than the most robust search algorithm applied to general knowledge. The other aspects include; the threshold amount of knowledge needed and whether the provided knowledge needs to abide by sound instructional design principles

b) *Right Person:* In the old paradigm, a search algorithm applied to a database might yield textual material written from the perspective of technical analyst, when learner might need management perspective/approach. This need for multiple viewpoints and perspectives, as well as the necessary attention to diverse learning needs, is critical to system design if the system is to be truly effective.

c) *Right Time:* in the old paradigm, knowledge was sought when it was needed. This required conversion of unstructured tacit knowledge, in the heads of subject matter experts, into explicit usable knowledge. This has proven to be difficult, if not impossible, just-in-time exercise. In the new paradigm, the ingredients or necessary knowledge must be amassed beforehand, knowing the need associated with common purposes. However, even with knowledge gathered beforehand, ease of use is not guaranteed. Apart from ease of use, it is essential to maintain and enrich the knowledge from user's perspective. A knowledge base consists of two types of synchronized information a *Work Breakdown Structure (WBS) and References*. It is template of activities and tasks to be performed in order to complete the process or project, the "who", "what" and "when" for each task. Technically WBS is process decomposition model, which is fully documented activity node tree of activities and tasks. It is the backbone or skeleton of the knowledgebase or the organizing scheme for the process knowledge, which is included in References. *References:* They provide the knowledge of process - lessons, guidelines, tools and techniques. The more synchronized references provide the process details and JIT training to support each task, the 'why' and 'how' for each task.

Knowledg**e** engineering has defined two different primary uses for knowledge bases and knowledge base tool functionality. They can be used effectively for 1) for designing entirely new processes, the 'to-be', and 2) for the ongoing optimization of an existing process. In both cases, the knowledge engineering principles as demonstrated through the knowledge base tool functionality fosters the learning organization.

FINDINGS

The findings of the study are:

- Organizational learning has transformed from a standalone mode to business-solution centric approach.
- Organizations are ensuring integration of both macro (analysis and alignment to environmental and business needs) and micro approaches (training needs identified from individual employees and their managers, based on on-the-job performance.
- The higher is the technology adaptation by an organization, the level of adaptation for business needs is higher.
- Organizations are leveraging on technology infrastructure built for their business needs to nurture organizational learning
- Technology based learning is being deployed by organizations for achieving twin advantages of learner convenience and learning effectiveness.

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"THE NEXT BIG THING IS REALLY SMALL" NANOTECHNOLOGY: A CONCEPTUAL STUDY

Hardeep Singh[7] Bikram Pal Singh[8]

ABSTRACT

The term "nanotechnology" has evolved over the years via terminology drift to mean "anything smaller than microtechnology," such as nano powders, and other things that are nanoscale in size, but not referring to mechanisms that have been purposefully built from nanoscale components. Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering. Nanotechnology is not just a new field of science and engineering, but also a new way of looking at and studying. Nanotechnology is affecting every aspect of our lives, from the medicines, we use, to the power of our computers, the energy supplies we require, the food we eat, the cars we drive, the buildings we live in, and the clothes we wear. To keep our natural environment safe and that is the biggest need of the time Green Nanotechnology is coming in demand. That is the need of future and present hour.

This paper mainly focuses on the importance of nanotechnology. Empirical studies and examples have been used to make the points more clear. Research methodology to make this paper reliable and of better use is the research based on the secondary data as well as primary data. Secondary data has been collected using various sources like websites; journals; magazines; newspapers; research papers; and even books. A very few primary data has also been used that has been collected with the use of personal interactions or telephonic conversations with the learned people.

KEYWORDS

Engineering, Nanotechnology, Nanoscience, Science, Smaller Size, Technology etc.

"Just wait—the 21st century is going to be incredible. We are about to be able to build things that work on the smallest possible length scales, atom by atom. These nano things will revolutionize industries and our lives"

--- Richard Smalley, 1999

"Nanoscience and technology will change the nature of almost every human-made object in the 21st century"

--- M.C. Roco, R.S. Williams, P. Alivisatos, 1999

INTRODUCTION

When K. Eric Drexler (right) popularized the word 'nanotechnology' in the 1980's, he was talking about building machines on the scale of molecules, a few nanometers wide—motors, robot arms, and even whole computers, far smaller than a cell. Drexler spent the next ten years describing and analyzing these incredible devices, and responding to accusations of science fiction. Meanwhile, mundane technology was developing the ability to build simple structures on a molecular scale. As nanotechnology became an accepted concept, the meaning of the word shifted to encompass the simpler kinds of nanometer-scale technology. The U.S. National Nanotechnology Initiative was created to fund this kind of nanotech: their definition includes anything smaller than 100 nanometers with novel properties. Much of the work being done today that carries the name 'nanotechnology' is not nanotechnology in the original meaning of the word. Nanotechnology, in its traditional sense, means building things from the bottom up, with atomic precision. This theoretical capability was envisioned as early as 1959 by the renowned physicist Richard Feynman.

Based on Feynman's vision of miniature factories using nanomachines to build complex products, advanced nanotechnology (sometimes referred to as molecular manufacturing) will make use of positionally controlled mechanochemistry guided by molecular machine systems. Formulating a roadmap for development of this kind of nanotechnology is now an objective of a broadly based technology roadmap project led by Battelle (the manager of several U.S. National Laboratories) and the Foresight Nanotech Institute. Shortly after this envisioned molecular machinery is created, it will result in a manufacturing revolution, probably causing severe disruption. It also has serious economic, social, environmental, and military implications.

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What is Nanotechnology?

Nanotechnology (sometimes shortened to "**nanotech**") is manipulation of matter on an atomic and molecular scale. Generally, nanotechnology works with materials, devices, and other structures with at least one dimension sized from 1 to 100 nanometres. Quantum mechanical effects are important at this quantum-realm scale. With a variety of potential applications, nanotechnology is a key technology for the future and governments have invested billions of dollars in its research. Through its National Nanotechnology Initiative, the USA has invested 3.7 billion dollars. The European Union has invested 1.2 billion and Japan 750 million dollars. Nanotechnology is very diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to direct control of matter on the atomic scale. Nanotechnology entails the application of fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, microfabrication, etc. Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering. Nanotechnology is not just a new field of science and engineering, but a new way of looking at and studying. The ideas and concepts behind nanoscience and nanotechnology started with a talk entitled "There's Plenty of Room at the Bottom" by physicist Richard Feynman at an American Physical Society meeting at the California Institute of Technology (CalTech) on December 29, 1959, long before the term nanotechnology was used. In his talk, Feynman described a process in which scientists would be able to manipulate and control individual atoms and molecules. Over a decade later, in his explorations of ultra precision machining, Professor Norio Taniguchi coined the term nanotechnology. It was not until 1981, with the development of the scanning tunneling microscope that could "see" individual atoms that modern nanotechnology began.

Definition of Nanotechnology

Nanotechnology is defined as the engineering of functional systems at the molecular scale. This covers both current work and concepts that are more advanced. In its original sense, 'nanotechnology' refers to the projected ability to construct items *from the bottom up*, using techniques and tools being developed today to make complete, high performance products.

HISTORY OF NANOTECHNOLOGY / LITERATURE REVIEW

Although nanotechnology is a relatively recent development in scientific research, the development of its central concepts happened over a longer period. The emergence of nanotechnology in the 1980s was caused by the convergence of experimental advances such as the invention of the scanning tunneling microscope in 1981 and the discovery of fullerenes in 1985, with the elucidation and popularization of a conceptual framework for the goals of nanotechnology beginning with the 1986 publication of the book Engines of Creation. The scanning tunneling microscope, an instrument for imaging surfaces at the atomic level, was developed in 1981 by Gerd Binnig and Heinrich Rohrer at IBM Zurich Research Laboratory, for which they received the Nobel Prize in Physics in 1986. Fullerenes were discovered in 1985 by Harry Kroto, Richard Smalley, and Robert Curl, who together won the 1996 Nobel Prize in Chemistry. Around the same time, K. Eric Drexler developed and popularized the concept of nanotechnology and founded the field of molecular nanotechnology. In 1979, Drexler encountered Richard Feynman's 1959 talk there's Plenty of Room at the Bottom.

The term "nanotechnology", originally coined by Norio Taniguchi in 1974, was unknowingly appropriated by Drexler in his 1986 book Engines of Creation: The Coming Era of Nanotechnology, which proposed the idea of a nanoscale "assembler" which would be able to build a copy of itself and of other items of arbitrary complexity. He also first published the term "grey goo" to describe what might happen if a hypothetical self-replicating molecular nanotechnology went out of control. Drexler's vision of nanotechnology is often called "Molecular Nanotechnology" (MNT) or "molecular manufacturing," and Drexler at one point proposed the term "zettatech" which never became popular. In the early 2000s, the field was subject to growing public awareness and controversy, with prominent debates about both its potential implications, exemplified by the Royal Society's report on nanotechnology, as well as the feasibility of the applications envisioned by advocates of molecular nanotechnology, which culminated in the public debate between Eric Drexler and Richard Smalley in 2001 and 2003. Governments moved to promote and fund research into nanotechnology with programs such as the National Nanotechnology Initiative. The early 2000s also saw the beginnings of commercial applications of nanotechnology, although these were limited to bulk applications of nanomaterials, such as Silver Nanoplatform for using silver nanoparticles as an antibacterial agent, nanoparticle-based transparent sunscreens, and carbon nanotubes for stain-resistant textiles.

OBJECTIVES OF STUDY

Main objectives of this study include:

- To study the concept of Nanotechnology and the make the readers aware about the Nanotechnology;
- To create awareness about need and importance of Nanotechnology;
- How nanotechnology affects our lives and to study the future requirements in the field of nanotechnology.

RESEARCH METHODOLOGY

Research methodology to make this paper reliable and of better use is the research based on the secondary data as well as primary data. Secondary data has been collected using various sources like websites; journals; magazines; newspapers; research papers; and even books. A very few primary data has also been used that has been collected with the use of personal interactions or telephonic conversations with the learned people. Empirical study and examples have been discussed to make the paper more reliable.

IMPORTANCE OF NANOTECHNOLOGY

Nanotechnology is significant because of its pre- eminence upon the comprehension, use, and control of matter at magnitudes of a minute scale, akin to approaching atomic levels, with which to manufacture new substances, instruments, and frameworks. Also known as 'Molecular Manufacturing', it is an emergent diversity of technologies in which medicine and engineering come together with physics and chemical science, which are opening up many brand new possibilities especially within the medical arena in terms of implantable transmission methods, which are often favored to the application of injectable medicines.

One, if not the most important, aspects of the applications of Nanotechnology is the incorporation of this science into medical programs embracing the present research into vaccine formation, wound regeneration, skin care, narcotic countermeasures and chemical and biologic detectors. The biological in addition to medicinal study areas, have utilized the unequalled properties of nonmaterial's for various programs not least due to their aspiring enhanced delivery methods, such as pulmonic or epidermic systems to prevent having to pass throughout the abdomen, encapsulation for both delivery and deferred release, and ultimately the combination of detection with transmission, to ensure that medicines are delivered precisely where they are required, consequently reducing the side effects on sound tissue and cells.

The future may well include huge task forces of medical nanorobots tinier than a cell drifting through our bodies removing bacteria, cleaning blocked arteries, and undoing the damage of old age. This type of emerging important science would permit medical personnel to analyze if someone has suffered a heart attack quicker than is currently possible with existing checks on blood proteins. Contemplate a medical device that journeys through the body to search for and eliminate small groups of cancerous cells in advance of their spread. The leading light of nanotechnology, Dr K Eric Drexler, even asserts that nanorobots will be produced that are capable of self replicating in much the same method as cells currently do in our bodies.

Nanotechnology pulls theories and conceptions from disciplines not only comprising engineering and physics but also chemistry, biology, mathematics and computer science. Moreover, it is being proclaimed as the next big technological revolution. As discussed earlier, its use is very varied, ranging from novel additions of traditional device physics, to entirely new approaches founded upon molecular self-assembly, to improving new substances with dimensions on the nanoscale, even to supposition around whether we can directly manipulate matter on the atomic scale. While the evolvement of nanotechnology has the potential to take several decades, and the early developers are likely to be sizeable institutions with great wealth that can produce considerable advancement efforts, in the long term nanotechnology is going to be attainable to a larger variety of people. At this moment in time, now that the feasibleness of nanotechnology is extensively acknowledged, we enter the latest stage of the national debate regarding what programs should we take up to best deal with it. Raised energy proficiency, cleaner surroundings, further productive medical treatment and enhanced fabrication construction are only some of the possible advantages of nanotechnology.

Specialty manufacturers produce powders based on small designer molecules. These so-called "nanopowders" pack a large surface area into a small volume, allowing highly efficient chemical reactions. In addition, electronic components such as batteries and capacitors using these materials can hold more energy than devices made with traditional parts. In the future, scientists are likely to design molecule-sized computers using nanotechnology. As even simple appliances now have microcomputers, eventually "smart materials" will contain millions of tiny computers, putting properties such as flexibility, texture and color of physical materials under the control of software. Living things are examples of the power of nanotechnology, as biology consists of billions of sophisticated molecular machines.

Research scientists are using nanotechnology to explore its effects on diseases such as cancer. For example, tiny gold particles attached to molecular markers can be injected into a patient's blood stream, target, and accumulate only in tumor cells. Infrared light heats the gold particles, affecting the tumor around them and killing it. You may also eventually see doctors treat patients by injecting them with nanorobots. Smaller than a red blood cell and working under computer control, these tiny robots can scavenge the circulatory system, seeking out and destroying viruses, bacteria and other infectious microorganisms. Currently, bulk processes combine various chemicals under conditions of heat and pressure, producing gasoline, plastics, fertilizers and many other products. Nanotechnology offers ways of making manufacturing processes more efficient. Self-assembly, for example, combines two large molecules by "snapping" them together automatically. The surfaces of the molecules fit like a lock and key, connecting accurately and precisely. Several steps of molecular self-assembly may yield machine and electronic products without traditional welding, cutting or drilling.

How Nanotechnology Impacts Our Lives Now: Empirical Study

Nanotubes: Examples

- **Nanoledge** makes carbon nanotubes for commercial uses, of which one mundane (marketing tactic) use is in a tennis racket, made by Babolat. The yoke of the racket bends less during ball impact, improving the player's performance. Once companies like Nanoledge can scale-up their production from grams, to pounds, to tons, and can do so while controlling the type of nanotube they produce, the world becomes their oyster: everywhere strength and weight are a factor - such as in the aerospace, automobile, and airplane industries - they will make a major (disruptive) impact.
- **Applied Nanotech** recently demonstrated a 14" monochrome display based on electron emission from. carbon nanotubes. Once the process is perfected, costs will go down, and the high-end market will start being filled. Shortly thereafter, and hand-in-hand with the predictable drop in price of CNTs, production economies-of-scale will enable the costs to drop further still, at which time we will see nanotube-based screens in use everywhere CRTs and view screens are used today**.**

Nanocatalysts: Examples

- **China's largest coal company (Shenhua Group)** has licensed technology from Hydrocarbon Technologies that will enable it to liquify coal and turn it into gas. The process uses a gel-based nanoscale catalyst, which improves the efficiency and reduces the cost. "If the technology lives up to its promise and can economically transform coal into diesel fuel and gasoline, coal-rich countries such as the U.S., China and Germany could depend far less on imported oil. At the same time, acid-rain pollution would be reduced because the liquefaction strips coal of harmful sulfur." One of the characteristic properties of all nanoparticles has been used from the outset in the manufacture of automotive catalytic converters: The surface area of the particles increases dramatically as the particle size decreases and the weight remains the same. A variety of chemical reactions take place on the surface of the catalyst, and the larger the surface area, the more active the catalyst. Nanoscale catalysts thus open the way for numerous process innovations to make many chemical processes more efficient and resource-saving – in other words more competitive.

Nanofilters: Examples

- **Argonide Nanomaterials,** an Orlando based manufacturer of nanoparticles and nanofiltration products, makes a filter that is capable of filtering the smallest of particles. The performance is due to its nano size alumina fiber, which attracts and retains sub-micron and nanosize particles. This disposable filter retains 99.9999+% of viruses at water flow rates several hundred times greater than virus-rated ultra porous membranes. It is useful for sterilization of biological, pharmaceutical and medical serums, protein separation, collector/concentrator for biological warfare detectors, and several other applications. In the future, for one application, sterilizing drinking water, this product may have an impact on so-called Third World peoples, who only have access to dubious sources of water.

Nanocomposite Coatings: Examples

- **Wilson Double Core tennis balls** have a nanocomposite coating that keeps it bouncing twice as long as an old-style ball. Made by InMat LLC, this nanocomposite is a mix of butyl rubber, intermingled with nanoclay particles, giving the ball substantially longer shelf life. Tires are the next logical extension of this technology: it would make them lighter (better millage) and last longer (better cost performance).

Nanoclays and Nanocomposites: Examples

- Used in packaging, like beer bottles, as a barrier, allowing for thinner material, with a subsequently lighter weight, and greater shelf-life. $480B packaging and $300B plastics industries. Reduced weight means transportation costs decline. Changing from glass and aluminum - think beer and soda bottles - to plastic reduces production costs. Nanoclays help to hold the pressure and carbonation inside the bottle, increasing shelf life. It is estimated that beer in these containers will gain an extra 60 days (from 120 to 180) of shelf life, reducing spoilage, and decreasing overall costs to the end user. Nanocor is one company producing nanoclays and nanocomposites, for a variety of uses, including flame retardants, barrier film (as in juice containers), and bottle barrier (as shown above). "They are not only used to improve existing products, but also are extending their reach into areas formerly dominated by metal, glass and wood."

Nanostructured Materials: Examples

- **Nanodyne** makes a tungsten-carbide-cobalt composite powder (grain size less than 15nm) that is used to make a sintered alloy as hard as diamond, which is in turn used to make cutting tools, drill bits, armor plate, and jet engine parts. Every industry that makes parts or components whose properties must include hardness and durability.

- Kodak is producing OLED color screens (made of nanostructured polymer films) for use in car stereos and cell phones. OLEDs (organic light emitting diodes) may enable thinner, lighter, more flexible, less power consuming displays, and other consumer products such as cameras, PDAs, laptops, televisions, and other as yet undreamt of applications. All current makers of CRTs, liquid crystal displays (LCDs), and other display types.

Nanocomposites: Examples

- Researchers at **Pacific Northwest National Laboratory** have developed a coating process to make sponge-like silica latch onto toxic metals in water. Self-Assembled Monolayers on Mesoporous Supports easily captures such metals as lead and mercury, which are then recovered for reuse or contained in-place forever. PNNL One example of a SAMMS nanocomposite (**S**elf-**A**ssembled **M**onolayers on **M**esoporous **S**upports). A hexagonally close-packed cluster of tubular pores (end view) is shown in the foreground. A single pore, in this case coated with a mercaptopropylsiloxy monolayer, is shown in the background.

- A plastic nanocomposite is being used for "step assists" in the **GM Safari and Astro Vans**. It is scratch-resistant, lightweight, and rustproof, and generates improvements in strength and reductions in weight, which lead to fuel savings and increased longevity. In addition, in 2001, Toyota started using nanocomposites in a bumper that makes it 60% lighter and twice as resistant to denting and scratching. Will likely be used on other GM and Toyota models soon, and in other areas of their vehicles, as well as the other auto manufactures, lowering weight, increasing milage, and creating longer-lasting autos. Likely to affect repair shops (fewer repairs needed) and auto insurance companies (fewer claims). Will also likely soon be seen everywhere weight, weatherproofing, durability, and strength are important factors. Expect NASA, the ESA, and other space-faring organizations to take a serious look, soon, which will eventually result in lower lift costs, which will result in more material being lifted into space.

Nanocrystals: Examples

- "Nanocrystals are an ideal light harvester in photovoltaic devices. (They) absorb sunlight more strongly than dye molecules or bulk semiconductor material; therefore, high optical densities can be achieved while maintaining the requirement of thin films. Crystalline CdSe nanocrystals are also an artificial reaction center, separating the electron hole pair on a femtosecond timescale. Fluorescent nanocrystals have several advantages over organic dye molecules as fluorescent markers in biology. They are incredibly bright and do not photodegrade. Drug-conjugated nanocrystals attach to the protein in an extracellular fashion, enabling movies of protein trafficking. (They) also form the basis of a high-throughput fluorescence assay for drug discovery." Nanocrystals absorb then re-emit the light in a different color -- the size of the nanocrystal (in the Angstrom scale) determines the color.

- Six different quantum dot solutions are shown, excited with a long-wave UV lamp. Quantum dots are molecular-scale optical beacons. Qdot™ nanocrystals behave like molecular LEDs (light emitting diodes) by "lighting up" biological binding events with a broad palette of applied colors. "Metal nanocrystals might be incorporated into car bumpers, making the parts stronger, or into aluminum, making it more wear resistant. Metal nanocrystals might be used to produce bearings that last longer than their conventional counterparts, new types of sensors and components for computers and electronic hardware. Nanocrystals of various metals have been shown to be 100 percent, 200 percent and even as much as 300 percent harder than the same materials in bulk form. Because wear resistance often is dictated by the hardness of a metal, parts made from nanocrystals might last significantly longer than conventional parts." **Smith & Nephew** markets an antimicrobial dressing covered with nanocrystalline silver (**A patented Technology of NUCRYST Pharmaceuticals).** The nanocrystalline coating of silver rapidly kills a broad spectrum of bacteria in as little as 30 minutes.

Nanoparticles: Examples

- **Stain-repellent Eddie Bauer Nano-Care™** khakis, with surface fibers of 10 to 100 nanometers, uses a process that coats each fiber of fabric with "nano-whiskers." Developed by Nano-Tex, a Burlington Industries subsidiary. Dockers also make khakis, a dress shirt and even a tie treated with what they call "Stain Defender", another example of the same nanoscale cloth treatment.

- **BASF's** annual sales of aqueous polymer dispersion products amount to around \$1.65 billion. All of them contain polymer particles ranging from ten to several hundred nanometers in size. Polymer dispersions are found in exterior paints, coatings and adhesives, or are used in the finishing of paper, textiles and leather. Nanotechnology also has applications in the food sector. Many vitamins and their precursors, such as carotinoids, are insoluble in water. However, when skillfully produced and formulated as nanoparticles, these substances can easily be mixed with cold water, and their bioavailability in the human body increases. Many lemonades and fruit juices contain these specially formulated additives, which often also provide an attractive color. In the cosmetics sector, BASF has for several years been among the leading suppliers of UV absorbers based on nanoparticulate zinc oxide. Incorporated in sun creams, the

small particles filter the high-energy radiation out of sunlight. Because of their tiny size, they remain invisible to the naked eye and so the cream is transparent on the skin.

- **Sunscreens** are utilizing nanoparticles that are extremely effective at absorbing light, especially in the ultra-violet (UV) range. Due to the particle size, they spread more easily, cover better, and save money since you use less. In addition, they are transparent, unlike traditional screens, which are white. These sunscreens are so successful that by 2001 they had captured 60% of the Australian sunscreen market. Makers of sunscreen have to convert to using nanoparticles. Moreover, other product manufactures, like packaging makers, will find ways to incorporate them into packages to reduce UV exposure and subsequent spoilage. The $480B packaging and $300B plastics industries will be directly affected.

- Using aluminum nanoparticles, **Argonide** has created rocket propellants that burn at double the rate. They also produce copper nanoparticles that are incorporated into automotive lubricant to reduce engine wear.

- **AngstroMedica** has produced a nanoparticulate-based synthetic bone. "Human bone is made of a calcium and phosphate composite called Hydroxyapatite. By manipulation calcium and phosphate at the molecular level, we have created a patented material that is identical in structure and composition to natural bone. This novel synthetic bone can be used in areas where natural bone is damaged or removed, such as in the in the treatment of fractures and soft tissue injuries."

FUTURE REQUIREMENTS IN FILED OF NANOTECHNOLOGY

In the modern era of globalization, it has become a challenge to keep our natural environment safe and that is the biggest need of the time. As the society is becoming more and more aware and concerned with natural resources and environment, business organizations have begun to modify their working in attempt to increase the greenery to the maximum possible and to attain sustainability in business that becomes a deciding factor for tomorrow's business. Keeping in mind all the points related to green environment protection, the role of green nanotechnology is also required to be observed at all levels of management (may be Human Resource Management / Marketing Management / Finance Management / Operations Management / Production Management / IT Management) in this modern world of globalization and innovative hi-tech advancements. Green Nanotechnology refers to the use of nanotechnology to enhance the environmental-sustainability of processes currently producing negative externalities. It also refers to the use of the products of nanotechnology to enhance sustainability. It is about doing things right in the first place - about making green nano-products and using nano-products in support of sustainability.

Green nanotechnology is the development of clean technologies, "to minimize potential environmental and human health risks associated with the manufacture and use of nanotechnology products, and to encourage replacement of existing products with new nano-products that are more environmentally friendly throughout their lifecycle." Green Nanotechnology has two goals: producing nonmaterial's and products without harming the environment or human health, and producing nano-products that provide solutions to environmental problems. It uses existing principles of Green Chemistry and Green Engineering to make nonmaterial's and nano-products without toxic ingredients, at low temperatures using less energy and renewable inputs wherever possible, and using lifecycle thinking in all design and engineering stages. In addition to making nonmaterial's and products with less impact to the environment, Green Nanotechnology also means using nanotechnology to make current manufacturing processes for non-nano materials and products more environmentally friendly. For example, nanoscale membranes can help separate desired chemical reaction products from waste materials. Nanoscale catalysts can make chemical reactions more efficient and less wasteful. Sensors at the nanoscale can form a part of process control systems, working with nano-enabled information systems. Using alternative energy systems, made possible by nanotechnology, are another way to "green" manufacturing processes.

The second goal of Green Nanotechnology involves developing products that benefit the environment either directly or indirectly. Nanomaterials or products directly can clean hazardous waste sites, desalinate water, treat pollutants, or sense and monitor environmental pollutants. Indirectly, lightweight nanocomposites for automobiles and other means of transportation could save fuel and reduce materials used for production; nanotechnology-enabled fuel cells and light-emitting diodes (LEDs) could reduce pollution from energy generation and help conserve fossil fuels; self-cleaning nanoscale surface coatings could reduce or eliminate many cleaning chemicals used in regular maintenance routines; and enhanced battery life could lead to less material use and less waste. Green Nanotechnology takes a broad systems view of nonmaterial's and products, ensuring that unforeseen consequences are minimized and that impacts are anticipated throughout the full life cycle. Green Nanotechnology may benefit the environment by drastically reducing waste in manufacturing.

CONCLUSIONS

"This is not to say that nanotechnology is a far-off, fuzzy, futuristic technology. It is not. It has already established a beachhead in the economy. Nanotechnology is the study of atomic and molecular structures at the nanometer level. One nanometer is one billionth of a meter, or about the size of three oxygen atoms. The trend to ever-smaller technologies in technology such as the microscopic transistors in computer chips is leading to mechanical and electronic systems made of custom-designed molecules.

Some futurists predict nanotechnology will revolutionize the materials and manufacturing methods that produce the goods we use in everyday life.

Nanotechnology is affecting every aspect of our lives, from the medicines, we use, to the power of our computers, the energy supplies we require, the food we eat, the cars we drive, the buildings we live in, and the clothes we wear. In addition, it will happen sooner than most people think. By 2020 you won't be able to count the number of businesses affected by nanotechnology."

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THE ROLE OF DATA MINING IN KNOWLEDGE DISCOVERY DATABASES

Sherly Prakash[9]

ABSTRACT

Knowledge discovery and data mining (KDD) is an interdisciplinary area focusing upon methodologies for extracting useful knowledge from data. The ongoing rapid growth of online data due to the internet and the widespread use of databases have created an immense need for KDD methodologies. In this paper, it provides an overview of common knowledge discovery tasks and approaches to solve these tasks. The challenge of extracting knowledge from data draws upon research in statistics, databases, pattern recognition, machine learning, data visualization, optimization, and high-performance computing, to deliver advanced business intelligence and web discovery solutions. Finally, it specify features that we consider important for knowledge discovery software to possess in order to accommodate its users effectively, as well as issues that are either not addressed or insufficiently solved yet.

KEYWORDS

Knowledge Discovery, Data Mining, Data Cleaning, Data Access, Data Preparation etc.

INTRODUCTION

Historically, the notion of finding useful patterns in data has been given a variety of names, including data mining, knowledge extraction, information discovery, information harvesting, data archaeology, and data pattern processing.

The rapid emergence of electronic data management methods has led some to call recent times as the "Information Age." Powerful database systems for collecting and managing are in use in virtually all large and mid-range companies - there is hardly a transaction that does not generate a computer record somewhere. Each year more operations are being computerized, all accumulate data on operations, activities and performance. All these data hold valuable information, e.g., trends and patterns, which could be used to improve business decisions and optimize success. However, today's databases contain so much data that it becomes almost impossible to manually analyze them for valuable decision-making information. In many cases, hundreds of independent attributes need to be simultaneously considered in order to accurately model system behaviour.

The term *data mining* has mostly been used by statisticians, data analysts, and the management information systems (MIS) communities. It has also gained popularity in the database field. The phrase *knowledge discovery in databases* was coined at the first KDD workshop in 1989 [1] (Piatetsky-Shapiro 1991) to emphasize that knowledge is the end product of a data-driven discovery. It has been popularized in the AI and machine-learning fields. In our view, KDD refers to the overall process of discovering useful knowledge from data, and data mining refers to a particular step in this process. *Data mining* is the application of specific algorithms for extracting patterns from data. The distinction between the KDD process and the data-mining step (within the process) is a central point of this article. The additional steps in the KDD process, such as data preparation, data selection, data cleaning, incorporation of appropriate prior knowledge, and proper interpretation of the results of mining, are essential to ensure that useful knowledge is derived from the data. Blind application of data-mining methods (rightly criticized as data dredging in statistical literature) can be a dangerous activity, easily leading to discovery of meaningless and invalid patterns.

THE INTERDISCIPLINARY NATURE OF KDD

KDD has evolved, and continues to evolve, from the intersection of research fields such as machine learning, pattern recognition, databases, statistics, AI, knowledge acquisition for expert systems, data visualization, and high-performance computing. The unifying goal is extracting high-level knowledge from low-level data in the context of large data sets. The data-mining component of KDD currently relies heavily on known techniques from machine learning, pattern recognition, and statistics to find patterns from data in the data-mining step of the KDD process.

A natural question is how is KDD different from pattern recognition or machine learning (and related fields)? The answer is that these fields provide some of the data-mining methods that are used in the data-mining step of the KDD process. KDD focuses on the overall process of knowledge discovery from data, including how the data are stored and accessed, how algorithms can be scaled to massive data sets still run efficiently, how results can be interpreted and visualized.

Thus, for example, neural networks, although a powerful modeling tool, are relatively difficult to understand compared to decision trees. KDD also emphasizes scaling and robustness properties of modeling algorithms for large noisy data sets. Related AI research fields include machine discovery, which targets the discovery of empirical laws from observation and experimentation [10] (Shrager and Langley 1990) and causal modeling for the inference of causal models from data [11] (Spirtes,

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Glymour, and Scheines 1993). Statistics in particular has much in common with KDD. Knowledge discovery from data is fundamentally a statistical endeavor. Statistics provides a language and framework for quantifying the uncertainty that results when one tries to infer general patterns from a particular sample of an overall population. As mentioned earlier, the term *data mining* has had negative connotations in statistics since the 1960s when computer-based data analysis techniques were first introduced.

The concern arose because if one searches long enough in any data set (even randomly generated data), one can find patterns that appear to be statistically significant but, in fact, are not. Clearly, this issue is of fundamental importance to KDD. Substantial progress has been made in recent years in understanding such issues in statistics. Much of this work is of direct relevance to KDD. KDD can also be viewed as encompassing a broader view of modeling than statistics. KDD aims to provide tools to automate (to the degree possible) the entire process of data analysis and the statistician's "art" of hypothesis selection.

A driving force behind KDD is the database field (the second D in KDD). Indeed, the problem of effective data manipulation when data cannot fit in the main memory is of fundamental importance to KDD. Database techniques for gaining efficient data access, grouping and ordering operations when accessing data, and optimizing queries constitute the basics for scaling algorithms to larger data sets. Most data-mining algorithms from statistics, pattern recognition, and machine learning assume data are in the main memory and pay no attention to how the algorithm breaks down if only limited views of the data are possible. A related field evolving from databases is *data warehousing,* which refers to the popular business trend of collecting and cleaning transactional data to make them available for online analysis and decision support. Data warehousing helps set the stage for KDD in two important ways:

Data Cleaning

As organizations are forced to think about a unified logical view of the wide variety of data and databases they possess, they have to address the issues of mapping data to a single naming convention, uniformly representing and handling missing data, and handling noise and errors when possible.

Data Access

Uniform and well-defined methods must be created for accessing the data and providing access paths to data that were historically difficult to get to (for example, stored offline). Once organizations and individuals have solved the problem of how to store and access their data, the natural next step is the question, what else do we do with all the data? This is where opportunities for KDD naturally arise.

A popular approach for analysis of data warehouses is called *online analytical processing* (OLAP), named for a set of principles proposed by [12] Codd (1993). OLAP tools focus on providing multidimensional data analysis, which is superior to SQL in computing summaries and breakdowns along many dimensions. OLAP tools are targeted toward simplifying and supporting interactive data analysis, but the goal of KDD tools is to automate as much of the process as possible. Thus, KDD is a step beyond what is currently supported by most standard database systems.

DATA MINING AND KNOWLEDGE DISCOVERY IN THE REAL WORLD

A large degree of the current interest in KDD is the result of the media interest surrounding successful KDD applications, for example, the focus articles within the last two years in *Business Week*, *Newsweek*, *Byte*, *PC Week*, and other large-circulation periodicals. Unfortunately, it is not always easy to separate fact from media hype. Nonetheless, several well-documented examples of successful systems can rightly be referred to as KDD applications and have been deployed in operational use on large-scale real-world problems in science and in business.

In Science, one of the primary application areas is astronomy. Here, a notable success was achieved by SKICAT, a system used by astronomers to perform image analysis, classification, and cataloging of sky objects from sky-survey images [2] (Fayyad, Djorgovski, and Weir 1996). In its first application, the system was used to process the 3 terabytes (1012 bytes) of image data resulting from the Second Palomar Observatory Sky Survey, where it is estimated that about 109 sky objects are detectable. SKICAT can outperform humans and traditional computational techniques in classifying faint sky objects. See [3] Fayyad, Haussler, and Stolorz (1996) for a survey of scientific applications.

In Business, main KDD application areas includes marketing, finance (especially investment), fraud detection, manufacturing, telecommunications, and Internet agents.

In Marketing, the primary application is database-marketing systems, which analyze customer databases to identify different customer groups and forecast their behavior. Business Week [4] (Berry 1994) estimated that over half of all retailers are using or planning to use database marketing, and those who do use it have good results; for example, American Express reports a 10- to 15- percent increase in credit-card use. Another notable marketing application is market-basket analysis [5] (Agrawal et al. 1996) systems, which find patterns such as, "If customer bought X, he/she is also likely to buy Y and Z." Such patterns are valuable to retailers.

Investment

Numerous companies use data mining for investment, but most do not describe their systems. One exception is LBS Capital Management. Its system uses expert systems, neural nets, and genetic algorithms to manage portfolios totaling $600 million; since its start in 1993, the system has outperformed the broad stock market [6] (Hall, Mani, and Barr 1996).

Fraud detection

HNC Falcon and Nestor PRISM systems are used for monitoring credit card fraud, watching over millions of accounts. The FAIS system [7] (Senator et al. 1995), from the U.S. Treasury Financial Crimes Enforcement Network, is used to identify financial transactions that might indicate money laundering activity.

Telecommunications

The telecommunications alarm-sequence analyzer (TASA) was built in cooperation with a manufacturer of telecommunications equipment and three telephone networks [8] (Mannila, Toivonen, and Verkamo 1995). The system uses a novel framework for locating frequently occurring alarm episodes from the alarm stream and presenting them as rules. Large sets of discovered rules can be explored with flexible information-retrieval tools supporting interactivity and iteration. In this way, TASA offers pruning, grouping, and ordering tools to refine the results of a basic brute-force search for rules.

DATA CLEANING

The Merge-Purge system was applied to the identification of duplicate welfare claims [9] (Hernandez and Stolfo 1995). It was used successfully on data from the Welfare Department of the State of Washington. In other areas, a well-publicized system is IBM's Advanced Scout, a specialized data-mining system that helps National Basketball Association (NBA) coaches organize and interpret data from NBA games (U.S. News 1995). Advanced Scout was used by several of the NBA teams in 1996, including the Seattle Supersonics, which reached the NBA finals. Finally, a novel and increasingly important type of discovery is one based on the use of intelligent agents to navigate through an information-rich environment. Although the idea of active triggers has long been analyzed in the database field, successful applications of this idea appeared only with the advent of the Internet. These systems ask the user to specify a profile of interest and search for related information among a wide variety of public domain and proprietary sources. For example, Firefly is a personal music-recommendation agent: It asks a user his/her opinion of several music pieces and then suggests other music that the user might like.

KNOWLEDGE DISCOVERY AND DATA MINING

This section provides an introduction into the area of knowledge discovery and data mining tasks:

The Knowledge Discovery Process

There is still some confusion about the terms *Knowledge Discovery in Databases (KDD)* and *data mining*. Often these two terms are used interchangeably. We use the term *KDD* to denote the overall process of turning low-level data into high-level knowledge. A simple definition of KDD is as follows: *Knowledge discovery in databases is the nontrivial process of identifying valid, novel, potentially useful, and ultimately understandable patterns in data*. We also adopt the commonly used definition of data mining as the extraction of patterns or models from observed data. Although at the core of the knowledge discovery process, this step usually takes only a small part (estimated at 15% to 25 %) of the overall effort. Hence, data mining is just one-step in the overall KDD process. Other steps for example involve: Developing an understanding of the application domain and the goals of the data mining process Acquiring or selecting a target data set Integrating and checking the data set Data cleaning, preprocessing, and transformation Model development and hypothesis building Choosing suitable data mining algorithms Result interpretation and visualization Result testing and verification Using and maintaining the discovered knowledge.

Data Mining Tasks

At the core of the KDD process are the data mining methods for extracting patterns from data. These methods can have different goals, dependent on the intended outcome of the overall KDD process. It should also be noted that several methods with different goals might be applied successively to achieve a desired result. For example, to determine which customers are likely to buy a new product, a business analyst might need to first use clustering to segment the customer database, and then apply regression to predict buying behavior for each cluster. Most data mining goals fall under the following categories:

Data Processing

Depending on the goals and requirements of the KDD process, analysts may select, filter, aggregate, sample, clean and/or transform data. Automating some of the most typical data processing tasks and integrating them seamlessly into the overall process may eliminate or at least greatly reduce the need for programming specialized routines and for data export/import, thus improving the analyst's productivity.

Prediction

Given a data item and a predictive model, predict the value for a specific attribute of the data item. For example, given a predictive model of credit card transactions, predict the likelihood that a specific transaction is fraudulent.

Regression

Given a set of data items, regression is the analysis of the dependency of some attribute values upon the values of other attributes in the same item, and the automatic production of a model that can predict these attribute values for new records. For example, given a data set of credit card transactions, build a model that can predict the likelihood of fraudulence for new transactions.

Classification

Given a set of predefined categorical classes, determine to which of these classes a specific data item belongs. For example, given classes of patients that corresponds to medical treatment responses; identify the form of treatment to which a new patient is most likely to respond.

Clustering

Given a set of data items, partition this set into a set of classes such that items with similar characteristics are grouped together. Clustering is best used for finding groups of items that are similar. For example, given a data set of customers, identify subgroups of customers that have a similar buying behavior.

Link Analysis (Associations)

Given a set of data items, identify relationships between attributes and items such as the presence of one pattern implies the presence of another pattern. These relations may be associations between attributes within the same data item. The investigation of relationships between items over a period is also often referred to as 'sequential pattern analyses.

Model Visualization

Visualization plays an important role in making the discovered knowledge understandable and interpretable by humans. Besides, the human eye-brain system itself remains the best pattern-recognition device known. Visualization techniques may range from simple scatter plots and histogram plots over parallel coordinates to 3D movies.

THE DATA-MINING STEP OF KDD PROCESS

The data-mining component of the KDD process often involves repeated iterative application of particular data-mining methods. This section presents an overview of the primary goals of data mining, a description of the methods used to address these goals, and a brief description of the data-mining algorithms that incorporate these methods. The knowledge discovery goals are defined by the intended use of the system. We can distinguish two types of goals:

> With *verification,* the system is limited to verifying the user's hypothesis. With *discovery,* the system autonomously finds new patterns. We further subdivide the discovery goal into *prediction,* where the system finds patterns for predicting the future behavior of some entities, and *description,* where the system finds patterns for presentation to a user in a human-understandable form.

In this article, we are primarily concerned with discovery-oriented data mining. Data mining involves fitting models to, or determining patterns from, observed data. The fitted models play the role of inferred knowledge: Whether the models reflect useful or interesting knowledge is part of the over all, interactive KDD process where subjective human judgment is typically required.

Two primary mathematical formalisms are used in model fitting:

> The *statistical approach* allows for nondeterministic effects in the model, whereas a *logical model* is purely deterministic. We focus primarily on the statistical approach to data mining, which tends to be the most widely used basis for practical data-mining applications given the typical presence of uncertainty in real-world data-generating processes.

Most data-mining methods are based on tried and tested techniques from machine learning, pattern recognition, and statistics: classification, clustering, regression, and so on. The array of different algorithms under each of these headings can often be bewildering to both the novice and the experienced data analyst. It should be emphasized that of the many data-mining methods advertised in the literature, there are really only a few fundamental techniques.

RESEARCH AND APPLICATION CHALLENGES

This paper outlines some of the current primary research and application challenges for KDD. This list is by no means exhaustive and is intended to give the reader a feel for the types of problem that KDD practitioners wrestle with:

Larger Databases

Databases with hundreds of fields and tables and millions of records and of a multi gigabyte size are commonplace, and terabyte (1012 bytes) databases are beginning to appear. Methods for dealing with large data volumes include more efficient algorithms sampling, approximation, and massively parallel processing.

High Dimensionality

Not only is there often a large number of records in the database, but there can also be a large number of fields (attributes, variables); so, the dimensionality of the problem is high. A high-dimensional data set creates problems in terms of increasing the size of the search space for model induction in a combinatorial explosive manner. In addition, it increases the chances that a data-mining algorithm will find spurious patterns that are not valid in general. Approaches to this problem include methods to reduce the effective dimensionality of the problem and the use of prior knowledge to identify irrelevant variables.

Over Fitting

When the algorithm searches for the best parameters for one particular model using a limited set of data, it can model not only the general patterns in the data but also any noise specific to the data set, resulting in poor performance of the model on test data. Possible solutions include cross-validation, regularization, and other sophisticated statistical strategies.

Assessing of Statistical Significance

A problem (related to over fitting) occurs when the system is searching over many possible models. For example, if a system tests models at the 0.001 significance level, then on average, with purely random data, $N/1000$ of these models will be accepted as significant edge is important in all the steps of the KDD process. Bayesian approaches [13] (for example, Cheeseman [1990]) use prior probabilities over data and distributions as one form of encoding prior knowledge. Others employ deductive database capabilities to discover knowledge that is then used to guide the data-mining search [14] (for example, Simoudis, Livezey, and Kerber [1995]).

Integration with other Systems

A standalone discovery system might not be very useful. Typical integration issues include integration with database management system (for example, through a query interface), integration with spreadsheets and visualization tools, and accommodating of real-time sensor readings. Examples of integrated KDD systems are described by [14] Simoudis, Livezey, and Kerber (1995).

CONCLUSIONS

The KDD process can be viewed as a multidisciplinary activity that encompasses techniques beyond the scope of any one particular discipline such as machine learning. In this context, there are clear opportunities for other fields of AI (besides machine learning) to contribute to KDD. KDD places a special emphasis on finding understandable patterns that can be interpreted as useful or interesting knowledge.

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NEURAL NETWORK APPROACH FOR SOFTWARE EFFORT ESTIMATION USING COCOMO-II MODEL

Usha Gupta[10] Manoj Kumar Aren[11]

ABSTRACT

Now a day's software companies develop different software in parallel, which is a very complex task. It is the task of the project managers to manage different software development processes based on constraints like, time, cost, and number of staff required sequentially. Now to estimate time, cost, and number of staff are a very tedious job for the project managers of the software companies. Total estimation of these parameters or constraints at an early stage of software project planning is one of the challenging issues in software project management. COCOMO model was one of the best models to estimate the cost and time in person month of a software project. Software cost and time estimation supports the project planning and tracking, as well as also controls the expenses of software development process. Software effort estimation refers to the estimates of the likely amount of cost, schedule, and manpower required to develop software. The accurate effort estimation at an early stage will lead to improve the project success rate. This review paper presents a novel artificial neural network (ANN) prediction model and Radial Basis Function Neural Network (RBFN) incorporating Constructive Cost Model (COCOMO), ANN-COCOMO II, to provide more accurate software estimates at the early phase of software development. This model uses the advantages of artificial neural networks such as learning ability and good interpretability, as well as radial basis clustering techniques while maintaining the merits of the COCOMO model. The ANN is utilized to calibrate the software attributes using past project data, in order to produce accurate software estimates.

KEYWORDS

ANN, APC-III, Clustering, COCOMO-2, K-means, Neural network, RBFN, Radial Basis Function Neural Network, Constructive Cost Model etc.

INTRODUCTION

The Constructive Cost Model (COCOMO) is the well-known software effort estimation [1], [3] model based on regression techniques. The COCOMO model is used to calculate the amount of effort then based on the effort calculated, the time, cost and number of staff required for software project are estimated. The Post-Architecture Level of COCOMO II consists of 17 cost drivers represented in the form of project attributes, programmer abilities, developments tools etc. These cost drivers and scale factors for COCOMO II are then rated on a scale from Very Low to Extra High in the same way as in COCOMO 81 dataset. The effort calculation formulas for COCOMO II post architecture level are calculated as given below [4]:

$$Effort = A * [size]^B * \prod_{i=1}^{17} Effort\ Multipliers_i$$

Where,

$$B = 1.01 + 0.01 * \sum_{j=1}^{5} Scale\ Factor_j$$

A: Multiplicative Constant,
Size: Size of the software measures in terms of KSLOC (kilo source line of code).
Scale factors (SF) are based on significant source of exponential variation on a project's effort or productivity variation.

RBFN architecture [7], [8] configured for software development effort is a three-layer feed forward network consisting of one input layer, one middle layer and an output layer. The RBFN generates output (effort) by propagating the initial inputs (cost drivers) through the middle-layer to the final output layer. The activation functions of each middle layer neurons are usually the Gaussian function. The output layer consists of one output neuron that computes the software development effort as a linear weighted sum of the outputs of the middle layer.

Neural networks [3], [4], [5] consist of layers of interconnected nodes, where each node in turn produces a non-linear function of its input. The nodes in the network are divided into the ones from the input layer going through the network to the ones at the output layer through some nodes in a hidden layer. The NN process starts by developing the structure of the network and establishing the technique used to train the network with using an existing data set. Therefore, there are three main entities: a) the neurons (nodes), b) the interconnection structure, and c) the learning algorithm.

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COCOMO MODEL

Constructive Cost Model is the most commonly used model because of its simplicity for estimating the effort [9] in person-month for a project at different stages. In general, expert judgment does not require any historical data. The advantages of using expert judgment are that the estimation is customized to the specific organizational culture, which contributes to the accuracy of estimation compare to a general algorithmic approach.

The learning algorithm used to train the network is Perceptron learning rule [2]. COCOMO- Post Architecture model determines the efforts (in Person-Months) required for a project based on software project's size in KSLOC (Kilo Source Line Of Code) as well as other cost factors known as scale factors and effort multipliers. The estimated effort in person-month is given below [4]:

$$PM = A * (Size)^{1.01 + \sum_{i=1}^{5} SF_i} * \prod_{i=1}^{17} EM_i$$

Where A is a multiplicative constant, and the set of SF (Scale Factor) and EM (Effort Multiplier) are defined in table given below [9]:

Table-1: Cost drivers of COCOMO-II Dataset

Symbol	Abbreviation	Name
SF1	PREC	Precedentedness
SF2	FLEX	Development Flexibility
SF3	RESL	Architecture and Risk Resolution
SF4	TEAM	Team Cohesion
SF5	PMAT	Process Maturity
EM1	RELY	Required Software
EM2	DATA	Database Size
EM3	CPLX	Product Complexity
EM4	RUSE	Required Reusability
EM5	DOCU	Documentation match to life- cycle needs
EM6	TIME	Time Constraints
EM7	STOR	Storage Constraints
EM8	PVOL	Platform Volatility
EM9	ACAP	Analyst Capability
EM10	PCAP	Programmer Capability
EM11	AEXP	Application experience
EM12	PEXP	Platform Experience
EM13	LTEX	Language and Tool Experience
EM14	PCON	Personnel Continuity
EM15	TOOL	Use of Software tools
EM16	SITE	Multi-site Development
EM17	SCED	Required Development Schedule

Sources: Authors Compilation

NEURAL NETWORK APPROACH

The given algorithm implements perceptron learning rule. This algorithm is executed using COCOMO data set for various projects and the COCOMO II post architecture scale factors and effort multipliers are taken as input to the network. The figure [2] below shows the layered architecture of neural network along with COCOMO II dataset functions.

**Figure-1: Neural Network Layered Architecture with Scale Functions
and Effort Multipliers along with Bias Function Values**
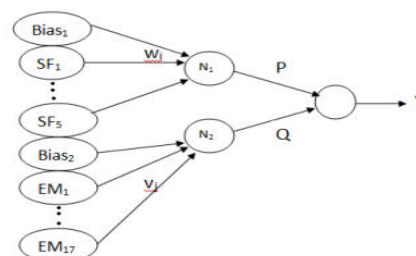
Sources: Authors Compilation

Algorithm for Perceptron Learning

This is one of the most efficient approaches for evaluating the calculated effort for any software project. It is a form of supervised learning, as it trains the neural network [2], [3], [6] by updating the weights at hidden layer for estimation. In this, the output generated at the output layer will be in the form of either true of false. We can take these values in the form of binary (0/1) as well, where '0' indicates false and '1' indicates true.

Algorithm: Perceptron Algorithm

Step 1: Initialize the weights, bias and learning rate α.

Step 2: Perform steps 3-8 until stopping condition is false.

Step 3: Perform steps 4-7 for each training pair.

Step 4: The input layer receives input signal and sends it to the hidden layer by applying identity activation functions on all the input units from i=1 to 17, j=1 to 5.

Step 5: Each hidden unit j= 1 to 2 sums its weighted input signals to calculate net input given by [4]:

$$Y_{inj} = b_j + \sum_{i=1}^{n} x_i w_{ij}$$

The activation function is applied over the above net input to calculate the output response.

Step 6: Calculate the output i.e. effort at the output layer using the same procedure as in step 5 and considering all the weights for j=1 to 2 as 1.

Step 7: If the output is false, the weights are updated as follow:
         wi(new) = wi(old) + α × input(i)

Step 8: Check for the stopping condition i.e. if there is no change in weights then stop the training process.

Step 9: else start again from Step 3.

Step 10: exit.

RBFN Network clustering Approaches

As in general, clustering is a method of finding the most similar groups of given data, which means that the data belonging to one cluster are the most similar, and data belonging to the different clusters are the most dissimilar ones. Clustering techniques have been used in many applications like medicine, biology, pattern recognition etc. There are two types of clustering techniques used along with RBFN briefly explained in this paper are as below:

- K-means
- APC-III.

K-means clustering algorithm has many successful applications such as pattern recognition and data compression. It is a multi-pass and time-consuming clustering algorithm.

K-Means algorithm

This algorithm helps in determining the receptive fields at hidden layer of a Radial Basis Neural Network [7] for estimating the cost of any software. In this algorithm, total vectors or datasets (say 'N') of COCOMO-2 model are partitioned in to clusters (say 'c').The objective of this algorithm is to find out the centers of the clusters known as centroids by minimizing the distance (or dissimilarity) between clusters. As per the calculations, this approach is very time consuming and multi pass process. This approach starts with defining the total number of clusters in advance before estimating the cost of software.

Algorithm: RBFN_K-means:

Step 1: start the K-means procedure for radial basis function for neural network with J function value.

Step 2: define the total number of clusters desired, say 'c'.

Step 3: initialize the centers of clusters to 1, say c_i, where 'c' is the total number of clusters. In addition 'i' is used for iteration and for i=1 to c.

Step 4: now compute the Euclidean distance between x_j and c_i, for j=1 to N, and i=1 to c. here x_j represents a dataset from dataset collection of COCOMO-2 model, j indicates iteration for each dataset.

Step 5: now according to the Euclidean distance values, assign the x_j to the closer cluster C_i based on less distance value (compare the distance values for x_j to each cluster c_i).

Step 6: now again recalculate the centers of each cluster say 'c_i'.

Step 7: now calculate the distance or dissimilarity function say 'J' as given below [8]:

$$J = \sum_{i=1}^{c} \sum_{xj \in Ci} d(xj, ci)$$

Here d (xj, ci) is the measure of distance value between i^{th} center (ci) and the kth data point of dataset of COCOMO-2 model.

All for the sake of simplicity, this d value can be taken as Euclidean distance value and hence the J function value can be represented as given below [8]:

$$J = \sum_{i=1}^{c} \sum_{xj \in Ci} \|xj - ci\|^2$$

Step 8: check if the improvement is below a certain threshold value, and then stop the iteration.

Step 9: else go to step 3.

Step 10: exit.

APC-III Algorithm

This algorithm helps in determining the receptive fields at hidden layer of a Radial Basis Neural Network [8] for estimating the cost of any software. It is a one pass clustering algorithm. This approach works by calculating the constant radius of cluster through the following formula [8]:

$$R_0 = \alpha * \frac{1}{N} * \sum_{i=1}^{N} min_{i \neq j} \left(\|P_i - P_j\| \right)$$

Where.

        N=number of historical software projects
        α=predetermined constant
        R_0=radius of each cluster which in turn controls the number of clusters provided.

APC-III approach works by generating clusters for each dataset. As the classification generated by the APC-III algorithm depends on the number of α that defines the radius R_0. The number of clusters generated is inversely proportional to the radius.

$$Number\ of\ clusters \propto \frac{1}{R_0}$$

Algorithm: RBFN_APC-III

Step 1: start the APC-III procedure for radial basis function for neural network.

Step 2: set the total number of clusters initially to 1, i.e. c=1.

Step 3: now set P_1 as the center of this cluster C_1, here P_1 represents the first software project in the datasets.

Step 4: now for i=2 to N (N=total number of historical software projects), repeat the following steps.

Step 4(a): for j=1 to c (c=number of clusters)

    i.   Calculate the d_{ij} (d_{ij} is the Euclidean distance of P_i and c_j, c_j is the center of the cluster C_j).

ii.   now check if $d_{ij} < R_0$ then,

     i.   Add the P_i dataset into C_j and correspondingly adjust the center of C_j.
     ii.   Exit from the loop.

Step 4(b): else, if P_i is not included in to any of the clusters then,

     i.   Create a new cluster that contains P_i as a center.

Step 5: stop the criteria.

CONCLUSIONS

This paper presents two neural network techniques for estimating the efforts for any software project. As explained above, all three approaches work based on COCOMO-II dataset model. Perceptron algorithm is quite a good approach, as it comprises of learning ability but on the other hand radial basis function neural network along with APC-III procedure is much better as it estimates the effort based on clustering approach and also consumes less time. On the other hand, k-means is quite lengthy and complex. This paper concludes that APC-III approach for estimating the efforts of COCOMO-II dataset model is the best among others in terms of time and performance.

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TRANSFORM AN OPTIMIZATION PROBLEM INTO A DECISION PROBLEM BY GENETIC ALGORITHM

Preeti P. Bhatt[12]

ABSTRACT

This paper describes different technique of genetic algorithm, which attracts maximum centre of attention. It is a concept of natural evaluation where each population has their own feasible solution to problem. Each individual are characterized by Fitness function. After analysis if we get higher fitness means best solution, then based on fitness function, parents are selected to reproduce offspring for new generation, where fitter individual have more chance to reproduce. It increase probability of new generation has same size as old generation. Offspring has combination of properties of two parents, if well designed; population will converge to optimal solution.

KEYWORDS

Genetic Algorithm, Fitness Function, Reproduction Operators, Offspring, Generation etc.

INTRODUCTION

Firstly many individual solutions are occur to form an initial population based upon which nature of the problem depends on the size of population, but hardly they contains several hundreds or thousands of possible solutions. Previously, the population is occurred randomly, allowing the overall limits of possible solutions. During each successive generation, a proportion of the existing population is selected to breed a new generation. a *fitness-based* process is one from which Individual solutions are selected, where fitter solutions are typically more likely to be selected. By such certain selection methods rate we select the best solutions.

The next way is to generate a second-generation population of solutions from those selected through genetic operators: A pair of "parent" solutions is selected for each new solution to be produced from the group selected previously. By using methods of crossover and mutation, we producing a "child" solution using the above a new solution is created which typically included many of his parent's characteristics and the process continues until a new population of solutions of appropriate size is generated. These processes ultimately result in the next generation population of chromosomes that is different from the initial generation.

Generally, the average fitness will have increased by this procedure for the population, since only the best organisms from the first generation are selected for breeding, along with a small proportion of less fit solutions, for reasons already mentioned above. Moreover, the main genetic operators are Crossover and Mutation. This generational process is repeated until a termination condition has been reached.

COMMON ALGORITHM

```
BEGIN
    Generate initial population;
    Compute fitness of each individual;
    REPEAT /* New generation /*
        FOR population size / 2 DO
            Select two parents from old generation;
                /* biased to the fitter ones */
            Recombine parents for two offspring;
            Compute fitness of offspring;
            Insert offspring in new generation
        END FOR
    UNTIL population has converged
END
```

As we absorbed that Reproduction mechanisms have, no knowledge of the problem to be solved so we get that there is Link between genetic algorithm and problem. They are:
  • Coding
  • Fitness function

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BASICS PRINCIPLES

It work under following principles in which first is Coding or Representation where String with all parameters is taking consideration , then Fitness function where Parent selection plays a vital roles after that Reproduction come with Crossover & Mutation process and finally come to end mean Convergence (When to stop).

Commonly they started to form chain, which is as this sequence an individual is characterized by a set of parameters: **Genes.** The genes are joined into a string**: Chromosome**, The chromosome forms the **genotype.** The genotype contains all information to construct an organism: **the phenotype**, Reproduction is a "dumb" process on the chromosome of the genotype and Fitness is measured in the real world ("struggle for life") of the phenotype.

CODING

Here different Parameters of the solution (genes) are concatenated to form a string (chromosome) and All kind of alphabets can be used for a chromosome (numbers, characters), but generally a binary alphabet is used .Always remember about the Order of genes on chromosome which plays a important roles then Generally many different codings for the parameters of a solution are possible where Good coding is probably the most important factor for the performance of a GA but In many cases many possible chromosomes do not code for feasible solutions.

For Example:

Problem: Schedule *n* jobs on *m* processors such that the maximum span is minimized:

- **Design alternative:** job i (i=1,2,…n) is assigned to processor j (j=1,2,…,m)
- **Individual:** A n-vector **x** such that *xi = 1, ...,or m*
- **Design objective:** minimize the maximal span
- **Fitness:** the maximal span for each processor

REPRODUCTION

It included two processes (Crossover, Mutation) where as in crossover two parents produce two offspring and there is a chance that the chromosomes of the two parents are copied unmodified as offspring. There is a chance that the chromosomes of the two parents are randomly recombined (crossover) to form offspring and if we talking about mutation we found that there is a chance that a gene of a child is changed randomly and generally the chance of mutation is low.

Here while talking about Crossover where Generating offspring from two selected parents are comes from three types:

  x Single point crossover,
  x Two point crossover (Multi point crossover),
  x Uniform crossover.

Single Point Crossover: In this, randomly one position in the chromosomes is chosen where Child 1 is head of chromosome of parent 1 with tail of chromosome of parent 2 and Child 2 is head of 2 with tail of 1

Chart-1
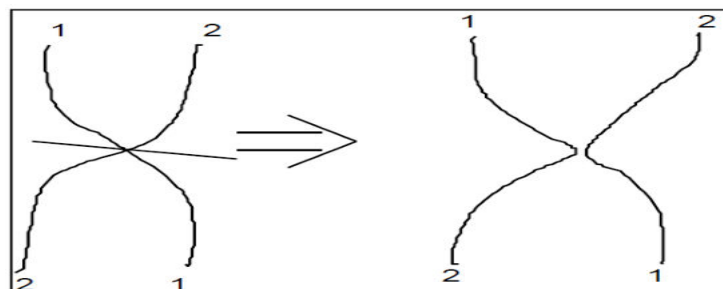
Sources: Authors Compilation

Whereas in **Two point crossover,** randomly two positions in the chromosomes are chosen, avoid that genes at the head and genes at the tail of a chromosome are always split when recombined; and while talking about '**Uniform Crossover'**, we get a random mask is generated, the mask determines which bits are copied from one parent and which from the other parent, Bit density in mask determines how much material is taken from the other parent.

Table-1

Mask:	0110011000	(Randomly generated)
Parents:	1010001110	0011010010
Offspring:	0011001010	1010010110

Sources: Authors Compilation

As we see above, parent's selection plays important roles so let talks about the methods. Chance to be selected as parent proportionals to fitness are given below:

     a. Roulette wheel to which we use to avoid problems with fitness function,
     b. Tournament, which is not a very important parameter.

Parent selection having uniform randomly selection, probability selection: proportional to their fitness tournament selection (Multiple Objectives), now focus on Roulette wheel in which firstly Sum the fitness of all chromosomes, call it 'T' then generate a random number 'N' between '1' and 'T' after that Return chromosome whose fitness added to the running total is equal to or larger than 'N' here Chance to be selected is exactly proportional to fitness.

Table-2

Chromosome :	1	2	3	4	5	6
Fitness:	8	2	17	7	4	11
Running total:	8	10	27	34	38	49
N $(1 \leq N \leq 49)$:	23					
Selected:	3					

Sources: Authors Compilation

However, applying this we are facing with the problems of Fitness Ranges. These are:

1. Premature convergence: its includes ΔFitness too large, Relatively super fit individuals dominate population ,Population converges to a local maximum ,Too much exploitation; too few exploration
2. Slow finishing: its having ΔFitness too small, No selection pressure, After many generations, average fitness has converged, but no global maximum is found; not sufficient difference between best and average fitness, Too few exploitation; too much exploration

Nevertheless, we have solutions for these problems, which are Use tournament selection includes implicit fitness remapping, Adjust fitness function for roulette wheel and explicit fitness remapping with Fitness scaling, Fitness windowing & Fitness ranking. Start the explanatory mode of all one by one:

Fitness Scaling: Subtraction and division scale Fitness values so that worst value is close to 0 and the best value is close to a certain value, typically 2 where Chance for the fit individual is 2 times the average and Chance for the least fit individual is close to 0. It is used in the Problems when the original maximum is very extreme (super-fit) or when the original minimum is very extreme (super-unfit). A good thing about this is it can be solved by defining a minimum and/or a maximum value for the fitness.

Chart-2
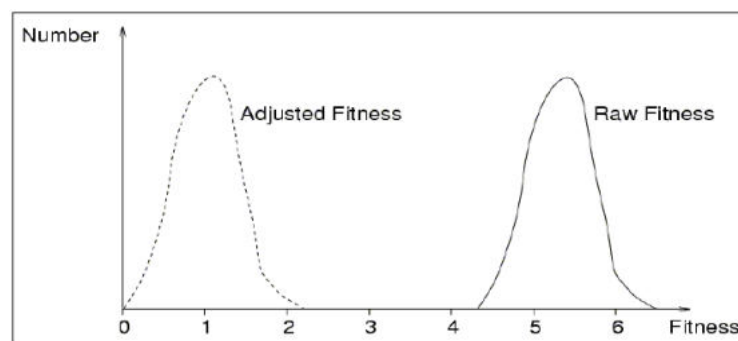
Sources: Authors Compilation

Build a small comparison set,
Randomly select a pair with the higher rank one beats the lower one,
Non-dominated one beat the dominated one.

Niche Count: The number of points in the population within certain distance, higher the niche count, lowers the rank. Whereas in **Fitness Ranking** Individuals are numbered in order of increasing fitness and The rank in this order is the adjusted fitness good point about this is that Starting number and increment can be chosen in several ways and influence the results , here No problems with super-fit or super-unfit and Often superior to scaling and windowing

CONCLUSIONS

On focusing on above matters, we comes on point that transform an optimization problem into a decision problem and prefers genetic algorithm with tabu search that surely gives good results, also prefer tab search for efficient local search and go with meaningful crossover with followed by certain implementation that are parent selection that should be random and prefer crossover operator with Unify Independent Set (UIS).

Crossover and Independent set and always try to increase the size of the independent set to improve the performance of the solutions common terminating conditions are: A solution is found that satisfies minimum criteria, fixed number of generations reached, allocated budget (computation time/money) reached, the highest ranking solution's fitness is reaching or has reached a plateau such that successive iterations no longer produce better results, Manual inspection, combinations of the above and for simple generational genetic algorithm procedure: a) Choose the initial population of individuals, b) Evaluate the fitness of each individual in that population, c) Repeat on this generation until termination (time limit, sufficient fitness achieved, etc.), d) Select the best-fit individuals for reproduction Breed new individuals through crossover and mutation operations to give birth to offspring, and e) Evaluate the individual fitness of new individuals and replace least-fit population with new individuals.

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A PRAGMATIC ANALYSIS OF SELECTED ALGORITHMIC ACTIVITIES

Pramod Kadam[13] Dr. Sachin Kadam[14]

ABSTRACT

In the Computer science context, algorithm is known as "Problem solving tool technique" for well-specified computational problem. The proposed research considers the algorithms categorically according to their functionalities. Each of these categories is identified as individual activities. A survey is conducted to identify the algorithmic activities prevalent in software development industry. The resulting data is then further analyzed by various discrete statistical tools to identify reasons responsible for their respective prevalence status and finally ranking is provided amongst them based on dependency and usability in programming.

KEYWORDS

Computer Algorithms, Algorithmic Activities, Software Development etc.

INTRODUCTION

An algorithm provides effective solutions for a computing problem, which can be realized in finite number of steps. Numerous algorithms are available in computing domain to solve a variety of different problems. To solve any problem efficiently, there is a need of careful planning, logical precision, persistence and attention in details. At the same time, solution thought not that of simple, it can be challenging, which requires creative and innovative ideas and only these spirit can amplify chances of success greatly. Outside an algorithm is "problem solving tool or technique" for well specified computational problem. To solve any single problem there multiple solutions are possible. In addition, algorithms are categories according to those problem-solving approaches (E.g. Brute force, Greedy approach, Divide and Conquer, Decrease and Conquer etc.). It is important to understand all of these types of algorithms and their approaches so that one can use them properly. If you are working on an important piece of software, you will be able to estimate how fast it is going to run based on their efficiencies and it is possible only because of analytical study of algorithms.

Proper input, flawless processing, desired output these are three integral parts of any algorithms. Algorithms are always associated with time and space complexity. Actually, complexity of an algorithm is a measure of the amount of time and/or space required by an algorithm for an input of a given size (n). Out of these two-complexity space complexities about to nil because of technological up gradation, which has taken place during last decade in storage capacities of devices? However, until date time complexity is a burning issue for algorithms. However, the execution time of many complex algorithms can varies due to factors other than the size of the input. As a result algorithms are further divided in the categories like worst-case runtime, average-case runtime, best –case runtime. The worst-case runtime is how long it would take the algorithm to run if it were given the most insidious of all possible inputs. The average-case runtime is the average of how long it would take the algorithm to run if it were given all possible inputs. Following table shows approximate completion time for algorithms, if input (n) = 100.

Table-1

$O(Log(N))$	10^{-7} seconds
$O(N)$	10^{-6} seconds
$O(N*Log(N))$	10^{-5} seconds
$O(N^2)$	10^{-4} seconds
$O(N^6)$	3 minutes
$O(2^N)$	10^{14} years.
$O(N!)$	10^{142} years.

Sources: http://community.topcoder.com "The importance of algorithm" by Iback Storm, Cornell University, US

ALGORITHMIC ACTIVITIES

All available algorithms can be further categories according to their functionality provided. Each of these categories is identified as individual activity.

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Sorting Activity

The sorting activity is known as one of the major activities involved in many computer applications. Sorting alone accounts for more than 30% of all computer time spend. Sorting provides us with a means of organizing information to facilitate the retrieval of specific data. Efficient sorting is important for optimizing the use of other algorithms (such as search and merge algorithms) that require sorted lists to work correctly. For example, the searching methods are designed to take advantage of the organization of information and thereby reduce the amount of effort either to locate a particular item or to establish that it is not present in a data set. There are numerous algorithms available for sorting information. Sorting algorithms usually fall into one of two classes:

- The simpler and less sophisticated algorithms are characterized by the fact that they require of the order of n^2 comparisons (i.e. $O(n^2)$) to sort 'n' items.
- The advanced sorting algorithms take of the order of $nlog_2n$ (i.e. $O(nlog_2n)$) comparisons to sort 'n' items of data. Algorithms within this set come close to the optimum performance for sorting random data.

No one sorting algorithm is best for all applications. Performances of various algorithms depend on parameters like the size of the data set, the degree of relative order already present in the data, the distribution of values of the items, and the amount of information associated with each item.

Merging Activity

A merging activity is supportive activity of sorting and both are depends on each other for effective solution. A merging (or collaborate) is the combination of two or more sequences resulting in to well defined and ordered single sequence. Merge activity is a family of algorithms that run sequentially over multiple sorted lists, typically producing sorted lists as output. Merge algorithms generally run in time proportional to the sum of the lengths of the lists; When merging of two lists of length m, there is a lower bound of $2m-1$ comparisons required in the worst case. The classic merge outputs the data item with the lowest key at each step; given some sorted lists, it produces a sorted list containing all the elements in any of the input lists, and it does so in time proportional to the sum of the lengths of the input lists. In general merging activity is further divided in to type given below according to their design pattern:

1) Minimum comparison merging Algorithms,
2) Two way Merging Algorithms,
    a. Balanced two way comparison Merging Algorithms,
    b. Natural two way comparison Merging Algorithms,
3) Three way Merging Algorithms,
4) Poly phase Merging Algorithms,
5) Cascade Merge Algorithms.

Searching Activity

Searching is the most time consuming activity of many piece of programs and replacement of good search method over bad one results in increase in efficiency. Searching and sorting are closely related with each other. Searching is a problem of locating appropriate one in the set of 'n' records. To identify each record individually there is need of unique identification number, which is known as key (Each of these key represents distinct record).

Algorithms for searching are presented with a key (K) and the problem to find record has key 'K'. After completion of searching activity, only two possibilities can arise. Either search was successful (if record having key 'K' found) or unsuccessful (if record having key 'K' nowhere in table). Searching algorithms can be divided in to two major types static searching and dynamic searching.

Matching Activity

In computer science, the technique of finding strings that matches a pattern approximately or exactly known as Matching. This matching activity is typically divided into two sub-types: a) finding substring matches inside a given set, and b) finding dictionary that match the pattern approximately.

Traversing Activity

There are numerous set of algorithms are available in the family of traversing activity. Traversing means visiting each node of a pattern (E.g. tree, network etc) exactly once. A full traversal produces a linear order for the information. This further supports searching and matching activities at the most.

Below table, depict some of the activities and representative algorithms of each activity:

Table-2

Activities	List of representative Algorithms
Sorting	Insertion Sort, Selection sort, Merge Sort, Quick Sort, Heap Sort, shell Sort, Radix Sort, Median Sort, Bucket Sort, Counting Sort, Hash Sort etc.
Merging	Parallel Merge etc.
Searching	Sequential Searching, Binary Search, Hash-Based Search, Digital Search, Multiway Search, Depth-First Search, Breadth-First Search, etc.
Matching	Augmenting Paths Algorithm, Hop croft-Karp Algorithm, Edmonds Algorithm etc.
Traversing	Depth-first , Breadth-first, Sequential polling, Tarry's, Algorithm, Awerbuch's, Depth-first search, Kruskal's, Prims, Jarnik, Bouruvak's etc.

Sources: Survey Study

RESEARCH METHODOLOGY

Overview

There are six research strategies available for research in information systems and computing; Survey, Design and Creation, Experiment, Case Study, Action Research and Ethnography. Out of these six, present study follows survey research methodology as to obtain same kind of data from the group of respondent.

Data Required

The data means manifested record of observations, experience, and stimuli's .The required data for this study exclusively fetched from the software development personnel and for data generation, questionnaire is used. Other than questionnaire, Interviews, documents and actual observations these 3 more data generation methods are mentioned by Briony Oates in his book Researching information system and computing

Data Sources

There are two major types of data sources mentioned in research methodology:

Primary Data Source

Primary data source is defined as a source, which gives data through observation, or direct communication with the person associated with subject of research or a data, which collected for the first time. There are several methods present in research methodology to collect primary data. Observation Method, Interview Method, Questionnaire methods etc. are some of them. Present study uses Questionnaire method for collection of primary data.

Questionnaire

Questionnaire is the one the important tool and is commonly used in research. Respondents for considered questionnaire are selected randomly (Sampling Technique used: Random Sampling of Probabilistic Sample type) and all respondents are exclusively from software development industry having sample size 20 at preliminary level (Further study will possible with increased sample size).

Measuring instrument or techniques used in research matters a lot. Scaling is the techniques used for measuring of responses. There are several scaling techniques are available in research domain. During Construction of questionnaire for present study, all parameters of good questionnaire have been well studied and implemented with content, wording, sequence, and layout wise. To make questionnaire easy and more convenient, less time consuming and to gain maximum responses from the respondent; rating scale (Q.1), ranking scale (Q.9) and selection of multiple options from available set of answers, these scaling techniques are used.

This questionnaire has been sent 20 software developers out of 19-showed willingness to fill.

Secondary Data Source

Secondary data sources are defines as sources, which have been created for the purpose of first time use and further use. Books, reports, previous study, Magazines, Newspapers etc. are examples of secondary data source. The secondary data regarding the algorithmic activities have been collected from various books, journals, and websites. This data results to the activity identification and for other conceptual framework.

DATA ANALYSIS

Data analysis is computation of certain measures or indices along with searching for pattern of relationships that exists between the collected data and data group. Data analysis is one of the important steps in any research process. It works like bridge between collected data and conclusion. For present study, we seek Descriptive data analysis:

Descriptive Data Analysis

This is largely used type of data analysis, which followed by major descriptive statistical tools and techniques.

Importance of algorithmic activities

Following table shows stimuli of respondents. These responses are categorized as algorithmic activities against to their frequencies received based on rating scale.

Table-3: Activities Rating According to their Importance (n=9)

Activity Name	Frequencies Received based on Rating Scale Low --------> High					No Response	Rank
	1	2	3	4	5		
Sorting	0	1	3	9	6	0	2
Merging	1	8	5	4	1	0	4
Searching	1	0	2	4	12	0	1
Matching	0	1	9	6	3	0	3
Traversing	1	4	6	5	3	0	5

Sources: Data Received from Questionnaire

Table shows the responses received from software developers based on their responses ranking of each activity are decided.

Table-4: Ranking of the Algorithmic Activity according to their Importance

Rank(High-to-Low)	Activity
1	Searching
2	Sorting
3	Matching
4	Merging
5	Traversing

Sources: Result after Data Analysis

From table, it is concluded that searching is the most important and traversing is the least important algorithmic activity amongst all of them.

Analysis of Algorithmic Activities Based on their Usability in Software Development

After perusal of the collected data, it is found that some algorithmic activities are quit important while framing software or in the process of software development but these activities are less in use. Whereas, some algorithmic activities have not that much of importance in software development process. Perhaps these activities are in use most. Table3 shows importance of activities and their usability in software development domain.

Table-5: Algorithmic Activities and their Ranks According to Usability in Software (n=15)

Activities	Frequency (f1)	Rank (R1)	Frequency (f2)	Rank (R2)
Searching	4	3	1	5
Merging	7	1	5	2
Sorting	4	3	3	4
Matching	4	3	4	3
Traversing	3	5	6	1
No Response	1	6	0	6
Total	23		19	

Sources: Data Received from Questionnaire.

Here, f1: Frequencies for activities, which are important but less used,
   R1: Rank for activities which are important but less in use,
   f1: Frequencies for activities, which are not important, but in use,
   R1: Ranks for activities, which are not important but are in use.

Table 5 depicts that some algorithmic activities are important but these activities are less in use and vice versa. Concluded, merging activity is one the most important but less in use. Whereas Traversing is more in use but this activity is not that much of importance in computer algorithmic domain.

Probable Reasons for Efficient and Inefficient use of Activities

Usually there are many reasons are possible to decide efficient algorithmic solution for any computing problem. Some of these major and representative reasons are considered in proposed study to show efficient and inefficient use of algorithmic activities.

Graph-1 and Graph-2 depict, contributions of each of these reasons towards efficient and inefficient use of activity,

Graph-1
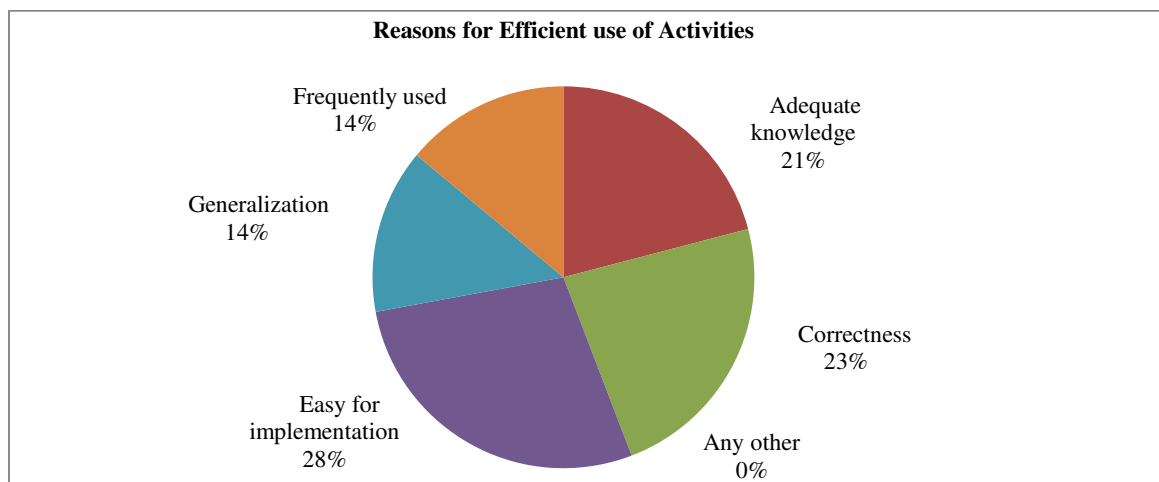
Sources: Data Received from Questionnaire

Graph-2
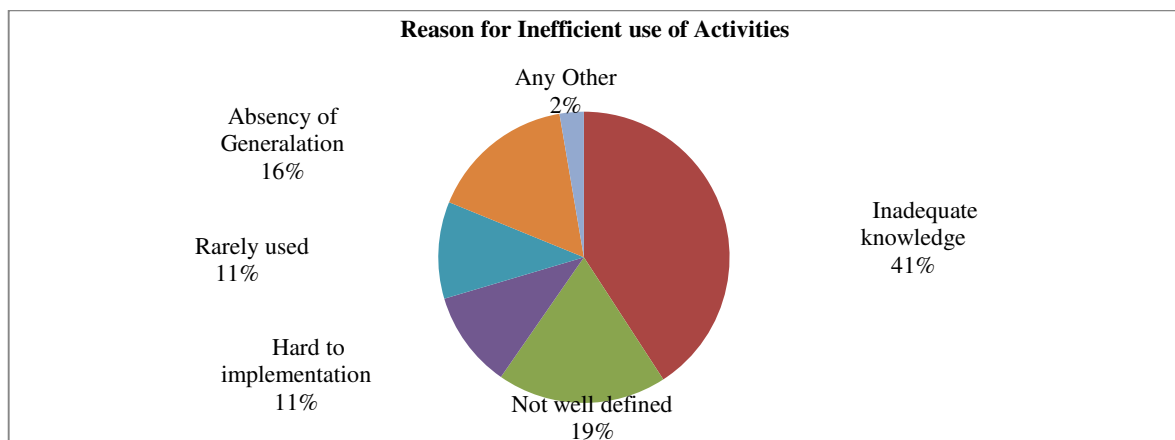
Sources: Data Received from Questionnaire

Graph-1 & 2, shows that contribution (in percentage) of each of reasons for efficient or inefficient use of activities e.g. Inadequate knowledge about algorithmic activities is most probable reason for inefficient use of activities whereas if algorithms are easy for implementation then there is an increase in efficient use of algorithmic activities.

Rank of Algorithmic Activities according to their Dependency and Usability in Programming

When question framed for the rank of algorithmic activities according to their dependency and usability in programming, following ranks for each of the activities received by software development professionals.

Table-6: Rank of Algorithmic activities (n=19)

Activity Name	Frequencies for Ranking of Activities according to their Dependency and Usability in Program					No Response	Total Responses Received	Rank
	R1	R2	R3	R4	R5			
Sorting	3	5	3	3	3	2	19	**2**
Merging	2	4	4	7		2	19	**4**
Searching	7	2	0	1	7	2	19	**1**
Matching	1	2	4	6	4	2	19	**3**
Traversing	2	3	2	2	8	2	19	**5**
Total	15	16	13	19	22	10	n=19	

Sources: Data Received from Questionnaire

CONCLUSIONS

Comparison and analysis amongst selected algorithmic activities, it is concluded that searching is the most important and traversing is the least important algorithmic activity. However, it is found that merging activity is one the most important but less in use and Traversing is more in use but this activity is not that much of importance in computer algorithmic domain. After the reasoning analysis. It is found that Inadequate knowledge about algorithmic activities is the most probable reason for inefficient use of algorithmic activities and if algorithms are easy for implementation then there is an increase in the efficiency of algorithmic activities. Among the selected algorithmic activities, ranks given by the respondent based on their dependency and usability in programming ranks are same for each of the activities it is intended that importance of algorithmic activities rely on their usability. In addition, with the easy implementation one can increase usability of the algorithmic activities. Therefore, easy implementation of algorithmic activity is directly proportionate with its importance in programming.

Table-7

Rank	Activity
1	Searching
2	Sorting
3	Matching
4	Merging
5	Traversing

Sources: Data Analysis

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PARALLEL K MEANS CLUSTERING USING GPU: IMPLEMENTATION USING CUDA

Kusum Mittal[15]

ABSTRACT

In this paper, we are presenting implementation of parallel k-means clustering on the graphics-processing unit (GPU). We are implementing this through CUDA, available from the G80 GPU family onwards, is used as the programming environment. Our system relies on the massively multi-threaded SIMD (Single Instruction, Multiple-Data) architecture provided by GPUs [3]. We expect many fold speed up of this algorithm as compared to CPU only implementation. Emphasis is placed on optimizations directly targeted at this architecture to best exploit the computational capabilities available. Additionally drawbacks and limitations of previous related work, e.g. maximum instance, dimension and centroid count is addressed. Our implementation of k-means clustering on an Nvidia 5900 graphics processor is 4 to 12 times faster than the CPU and 7 to 22 times faster on the Nvidia 8500 graphics processor for various data sizes.

KEYWORDS

Centroid, CUDA, Cluster, GPU, OpenCL, SIMD etc.

INTRODUCTION

Cluster analysis plays a critical role in a wide variety of applications, but it is now facing the computational challenge due to the continuously increasing data volume [4]. For the past decade, various data mining techniques have been developed to discover patterns, clusters, and classifications from various kinds of data. Parallel computing is one of the most promising solutions to overcoming the computational challenge. In this paper, we target at parallelizing k-Means, which is one of the most popular clustering algorithms, by using the widely available Graphics Processing Units (GPUs). Different from existing GPU-based k-Means algorithms, we observe that data dimension is an important factor that should be taken into consideration when parallelizing k-Means on GPUs.

GPUs can be regarded as massively multi-threaded many-core processors. Recent multi-core CPUs, e.g., Sun's Niagra, are following a similar trend of exploiting parallelism in time and space. Different from multi-core CPUs, the cores on the GPU are virtualized, and GPU threads are managed by the hardware. Such a design simplifies GPU programs and improves program scalability and portability, since programs are oblivious about physical cores and rely on hardware for thread creation and management. At present, the GPU possesses an order of magnitude higher computation capability as well as memory bandwidth than a multi-core CPU.

GPUs (Graphics Processing Units that comes with a Graphics card) have hundreds of processing cores, and have parallel architecture. Because of the parallel architecture of GPUs (Graphics Processing Units that comes with a Graphics card) suits very well for implementation of a number of algorithms having parallel components. Thanks to the inception of CUDA and OpenCL developers are now able to utilize the computing resources; namely cores, of GPUs by programming these devices. The level of abstractions provided by these APIs is making the complexity of programming these devices. Thus utilizing these 100s of processing cores, one can get many fold speed up in the applications, especially time critical applications.

Further recent advancements in GPU computing have made it easier to utilize the resources of a GPU. Specifically the programming model has been made much simpler. NVIDIA CUDA and OpenCL for example can be extremely helpful in accelerating algorithms on GPUs. Thus CUDA/OpenCL accelerated algorithms can be used in many real-time applications, including Image processing, object classifications, voice recognition and in a number of systems which require intelligence and auto control.

RELATED WORK

D T Pham, S. S. Dimov, and C. D. Nguyen proposed a method based on information obtained during the K-means clustering operation itself to select the number of clusters, K[10]. However, its limitation was of computationally expensive method if used with large data sets because it requires several applications of the K-means algorithm before it can suggest a guide value for K.

Next Jing Wang, [11] Jing dong Wang proposed o efficiently identify those active points by pre-assembling the data into groups of neighboring points using multiple random spatial partition trees, and to use the neighborhood information to construct a closure for each cluster, in such a way only a small number of cluster candidates need to be considered when assigning a data point to its nearest cluster.

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You Li, Kaiyong Zhao, Xiaowen Chu [12] used two different strategies for low-dimensional data sets and high-dimensional data sets respectively, in order to make the best use of GPU computing horsepower. However, results showed that GPU-based k-Means algorithms are three to eight times faster than the best reported GPU-based algorithms.

IMPLEMENTING PARALLEL K MEANS CLUSTERING USING GPU

Parallel K-Means Clustering

The set of data points X is split up equally among p processors, each calculating the labels of all data points of their subset of X. In a reduction step the centroids are then updated accordingly [13].

It has been shown that the relative speedup compared to a sequential implementation of k-means increases nearly linearly with the number of processors. Performance penalties introduced by communication cost between the processors in the reduction step can be neglected for large n.

The Algorithm

K-means [7] is one of the simplest unsupervised learning algorithms that solve the well-known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priori. The main idea is to define k centroids, one for each cluster. These centroids should be placed in a cunning way because of different location causes different result. Therefore, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early groupage is done. At this point, we need to re-calculate k new centroids as barycenters of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. Because of this loop, we may notice that the k centroids change their location step by step until no more changes are done. In other words, centroids do not move any more.

Finally, this algorithm aims at minimizing an objective function, in this case a squared error function. The objective function:

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2 \quad \ldots\ldots(1)$$

Where $\left\| x_i^{(j)} - c_j \right\|^2$ is a chosen distance measure between a data point and the cluster centre is an indicator of the distance of the n data points from their respective cluster centres.

K Centroids Recalculation

The new centroid is the arithmetic means of all data objects. The positions of the k centroids are also parallel recalculated by GPU and every thread is responsible for a new centroid [14].

After data objects assignment, we get the cluster label of every data point. A straight forward idea for recalculating the position of one centroid is to read all data objects and determine whether the data point belongs to this centroid or not. Unfortunately, massive condition statements are not suitable to the stream processor model of GPUs. We add another procedure that the cluster labels are downloaded from the device (GPU) to the host (CPU) and the host rearranges all data objects and counts the number of data objects maintained by each cluster. Then, both structures are uploaded to the global memory of the device. In this way, every thread of CUDA kernel can complete its task by reading its own data objects continuously.

NVIDIA's CUDA (Compute Unified Device Architecture)

The graphics card that we use in our PC for gaming and visual enhancement has a Graphics Processing Unit (GPU) and some dedicated off-chip DRAM. GPUs in general have a parallel architecture and in particular, some of NVIDIA's GPUs have 240 cores per processor (compare this with modern CPUs: 2, 4 or 8 cores). With such a parallel architecture, GPUs provide excellent computational platform, not only for graphical applications but any application where we have significant data parallelism. For example, one can accelerate virus scanning by off loading the virus-matching task on the GPU. The GPUs thus are not limited to its use as a graphics engine but as parallel computing architecture capable of performing floating-point operations at the rate of Tera bytes/s. People have realized the potential of GPUs for highly computational tasks, and have been working in general-purpose computation on GPUs (GPGPU) for a long time. However, life before NVIDIA's Compute Unified Device Architecture (CUDA) was extremely difficult for the programmer, since the programmers need to call graphics API (Open GL, Open MP, Open CV etc.). This also has a very slow learning rate. CUDA[6] solved all these problems by providing a hardware abstraction, hiding the inner details of the GPUs, and the programmer is freed from the burden of learning graphics programming.

CUDA is C language with some extensions for processing on GPUs. The user writes a C code; while, the compiler bifurcates the code into two portions. One portion is delivered to CPU (because CPU is best for such tasks); while, the other portion, involving extensive calculations, is delivered to the GPU(s) that executes the code in parallel. Because C is a familiar programming language, CUDA results in very steep learning curve and hence it is becoming a favorite tool for accelerating various applications. NVIDIA's CUDA SDK is being employed in a plethora of fields' right from the computational finance to Neural network and fuzzy logic to simulations for Nanotechnology.

The following graph shows the rapid increase in the processing speed of GPUs as compared to CPUs in GFLOPS (Giga Floating Point Operations per Second).

- Copy data from main memory to GPU memory,
- CPU instructs the process to GPU,
- GPU execute parallel in each core,
- Copy the result from GPU memory to main memory.

Chart-1: Processing Flow on CUDA
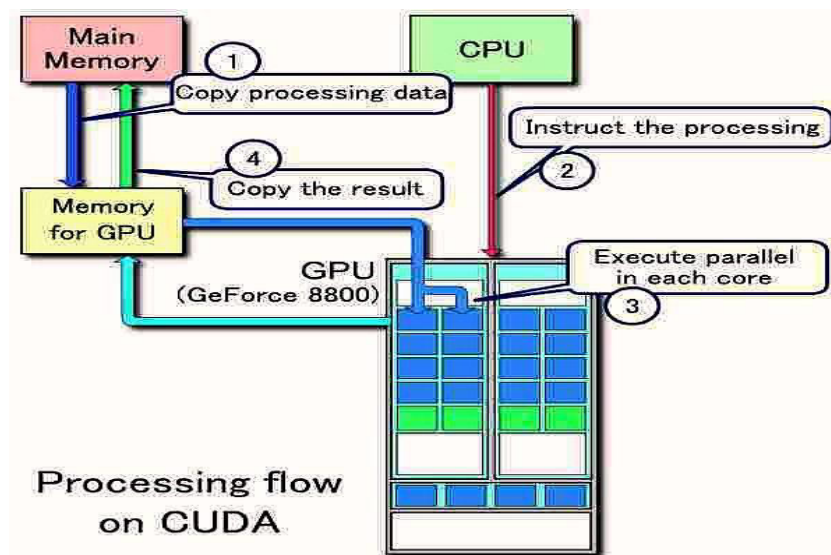
Sources: Authors Compilation

RESULTS AND DISCUSSIONS

The CPU and the GPU computational execution time were measured to compare the speed. Tremendous gain in performance (time per iteration) is noticed while using the GPU over the CPU. It is quite evident that the CPU performance is affected by the data size whereas GPU shows little or no drop in performance with increased data size. The implementation in the 5900 GPU gains about 4 to 12 times in speed than its CPU counterpart. This is at least 3 times faster than the previous implementation. The performance of this implementation has surpassed the CPU implementations by few tens to about a hundred. The results [Annexure1] are encouraging and have made the k-means clustering algorithm much more efficient.

CONCLUSION AND FUTURE WORK

Exploiting the GPU for the labeling stage of k-means proved to be beneficial especially for large data sets and high cluster counts. The presented implementation is only limited in the available memory on the GPU and therefore scales well. However, some drawbacks are still present. Many real-life data sets like document collections operate in very high dimensional spaces where document vectors are sparse. The implementation of linear algebra operations on sparse data on the GPU has yet to be solved optimally.

Necessary access patterns such as memory coalescing make this a very hard undertaking. In addition, the implementation presented is memory bound meaning that not all of the GPUs computational power is harvested. Finally, due to rounding errors the results might not equal the results obtained by a pure CPU implementation. However, our experimental experience showed that the error is negligible.

Future work will involve experimenting with other kmeans variations such as spherical or kernel k-means that promise to increase the computational load and therefore better suit the GPU paradigm. In addition, an efficient implementation of the centroid update stage on the GPU will be investigated. Another research direction is to employ GPU to other data mining algorithms.

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ARCHITECTURE OF E-GOVERNANCE CITIZEN CHARTER USING CLOUD

Naveen Tewari[16] Dr. M. K. Sharma[17]

ABSTRACT

The focus of this paper is to develop an architecture using cloud for the Citizen Charter application i.e. implementation level detail for the Citizen charter application through Cloud described in our previous paper [1]. Cloud computing offers an easy means of achieving the application model of e-Governance with multi-tenancy. We can use Internet as a type of communication medium and provide a better citizen charter, which can be used by every citizen in spite of his or her diversity & location.

KEYWORDS

Citizen Charter, Cloud Computing, E-Citizen Charter, E-Governance, Government to Citizen, ICT Issues in Citizen Charter etc.

INTRODUCTION

In this paper, we have discussed the cloud implementation of e-Citizen Charter. We also discuss how cloud works and what are the benefits of using cloud in such e-governance applications. Cloud is used as an umbrella term to describe a category of sophisticated on-demand computing services offered by some commercial providers [6]. Through cloud on-demand, A-Z computing experience can be given to citizens (customers). This gives numerous benefits to the user and provides various facilities under one roof. Cloud can also be integrated in ongoing e-governance projects and, enlarge them by incorporating various cloud services. This, feature makes cloud best choice for all professionals.

CITIZEN CHARTER [1]

Citizen's Charter is a document, which represents a systematic effort to focus on the commitment of the Organization towards its Citizens in respects of Standard of Services, Information, Choice and Consultation, Non-discrimination and Accessibility, Grievance Redress, Courtesy and Value for Money. This also includes expectations of the Organization from the Citizen for fulfilling the commitment of the Organization [1].

A good Citizen's Charter should have the following components [1]:

- Vision and Mission Statement of the Organization,
- Details of Business transacted by the Organization,
- Details of 'Citizens' or 'Clients',
- Statement of services including standards, quality, time frame etc. provided to each Citizen/ Client group separately and how/ where to get the services,
- Details of Grievance Redress Mechanism and how to access it,
- Expectations from the 'Citizens' or 'Clients',
- Additional commitments such as compensation in the event of failure of service delivery.

E-GOVERNANCE CITIZEN CHARTER

The Government services can be provided with the help of internet and the related projects have been developed in India and many other countries. This is what we call e-Governance today.

E-Governance covers various relationships as follows [1]:

1. Government to Citizen (G2C),
2. Citizen to Government (C2G),
3. Government to Government (G2G),
4. Government to Business (G2B).

The object of E-Governance is to provide a SMARRT Government. SMARRT means Simple, Moral, Accountable, Responsive, Responsible and Transparent Government [1].

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The focus of this paper is on Citizen Charter; therefore, we also limit the scope of e-Governance up to this only. Most of the above-mentioned issues of CC's could be solved if we develop citizen charter in the form of web-based services.

Some of the Benefits of e-Citizen Charter are:

- Internet as a citizen's choice of medium,
- Transparent services to public,
- Personalized, up-to-date and consistent Information can be stored and used accordingly,
- Convenient for Citizen as well as for Government,
- Trustworthy and Reliable,
- Involvement of Citizen can rise significantly,
- Citizens easily get to know how Government works and monitor progress,
- Government compensates for mistakes and uses feedback information to improve its products, services and procedures.

CLOUD COMPUTING: AN OVERVIEW

It denotes a model on which a computing infrastructure is viewed as a "cloud," from which businesses and individuals access applications from anywhere in the world on demand [7]. This model offers computing, storage, and software "as a service."

Cloud is divided into three delivery models:

- *Software as a Service (SaaS):* The consumer uses an application, but does not control the operating system, hardware or network infrastructure on which it is running.

- *Platform as a Service (PaaS):* The consumer uses a hosting environment for their applications. The consumer controls the applications that run in the environment (and possibly has some control over the hosting environment), but does not control the operating system, hardware or network infrastructure on which they are running. The platform is typically an application framework.

- *Infrastructure as a Service (IaaS):* The consumer uses "fundamental computing resources" such as processing power, storage, networking components or middleware. The consumer can control the operating system, storage, deployed applications and possibly networking components such as firewalls and load balancers, but not the cloud infrastructure beneath them.

Figure-1: The Cloud Computing Stack [7]
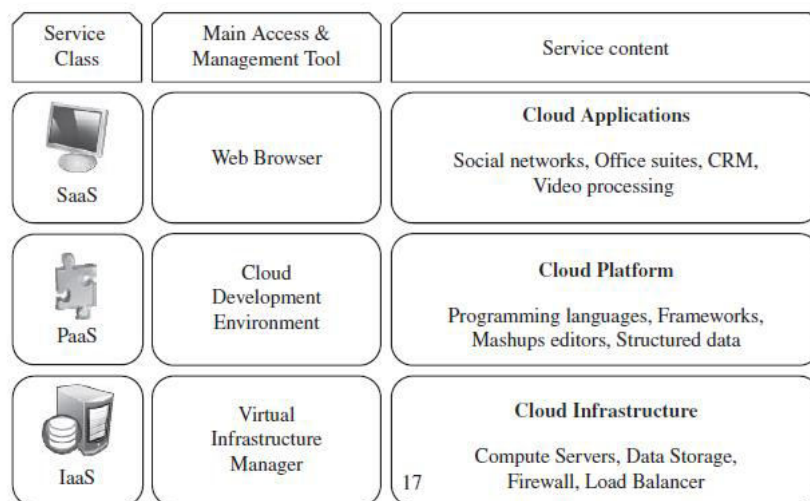
Sources: Authors Compilation

CLOUD COMPUTING AND CHALLENGES OF E-GOVERNANCE [1]

Data Scaling

As we know the e-Governance projects deals with the huge amount of data (of citizens), so, for scaling of databases, data is required. Cloud databases support high-end scalability and distributed scalability. These databases can be used for on-demand scalability of e-Governance applications.

Auditing and Logging

In e-Governance, services tracing is required at periodic interval. Information Technology Services can be used for controlling corruption in Government Departments. Regular Audits (process as well as security audits) must be done to ensure high security of the system. Cloud can make audit process easier by analyzing huge amount of data and detecting any fraud. With the help of cloud, a defense mechanism can be developed to enhance the security.

Rolling out new Instances, Replication and Migration

Government works at different levels to provide services to its citizens. Therefore, e-Governance applications should be present at different levels of Government (departments, states, cities, districts etc). A project in a district can be applied for other district also by creating its replication. Therefore, all e-Governance application should have this option available.
Cloud offers excellent architecture to support the feature of Replication, new Instances and Migration.

Disaster Recovery

Natural disasters like floods, earthquakes, wars and internal disturbances could cause the E-Governance applications not only loose data, but also make services unavailable. Cloud virtualization technologies give the facilities of backups and restoring. It also gives such application and facilities by which migration and disaster recovery becomes possible.

Performance and Scalability

Commonly e-Governance technologies are required to meet the growing numbers and demand of citizens. If implemented, the E-Governance portals could become the biggest users and beneficiaries of Information Technology. Scalability is inbuilt in Cloud Architecture. E-Governance applications can be scaled to larger extent with the help of Cloud.

Reporting and Intelligence (Better Governance)

Various factors like data center usage; peak load hours, consumption level, power usage etc. are to be monitored for the better utilization of resources. Different services provided by the Government can become better and citizen friendly if they can be visualized properly. Different frameworks like MapReduce (Apache Hadoop) can process large dataset available on clusters of computers. Cloud computing offers easy integration with these types of frameworks.

Policy Management

Government has certain policies in terms of dealing with citizens. E-Governance also adheres to these policies. Along with the infrastructure and data center, policies have to be enforced for day-to-day operations. Cloud helps in implementing these policies in data centers. Policies like securities, application deployment etc. are too applied on data centers seamlessly.

Systems Integration and Legacy Software

The main advantage of e-Governance can be the data sharing between different applications. This shared data can be used for different purposes in the Government. The information technology empowers e-Governance in co-relating data across application and share messages across different systems for the betterment of the end user (citizen). Service Oriented Architecture (SOA) of Cloud provides awesome solution for integration of various applications. In addition, the applications, which are already built, can be easily moved onto cloud.

Obsolete Technologies and Migration to New Technologies

Software and platforms becomes obsolete on the arrival of their newer versions. Moving to newer version of software is never an easy task, lots of security patches exist in between the shifting, which must be dealt with great care. Cloud deal with this requirement very effectively. The different versions of software exist in parallel at the same time. Firstly, the versions are tested and then the application can be migrated into the newer one.

Going Green

E-Governance provides facilities to the citizen to the root level. Therefore, large data centers and massive hardware support are to be provided by the Government to fulfill the need of large number of citizens. The power usage, air-conditioning and electronic waste could create bio-hazard.

An AT&T-sponsored report from research firm Verdantix announced that cloud computing could allow companies to save an estimated $12.3 billion off their energy bills, annually. This energy savings would directly translate into carbon emission savings of 85.7 million metric tons per year by 2020 [4].

GOVERNMENTS TO CITIZEN (G2C) MODEL AND ITS SERVICES [1]

As the Government is for the people, by the people and to the people, serving citizens is the motto leading to the nation's development [5].Governments provide numerous services to its citizen.G2C is the communication link between Government and Citizen in E-Governance model.

The different services provided by the G2C model are:

- Information about all Government Departments,
- Different Welfare Schemes,
- Various forms (one way /two way) used by the citizens.

E-CITIZEN CHARTER: THE ADVANTAGE

Applications in E-Governance are varied as small to very complex. This particular application of Citizen Charter is proposed for the Tehsil level, where all the certificates are issued for the citizens [1].

Citizen Charter helps the citizen in the following ways [1]:

- They are able to know the required information about the particular certificate.
- Apply for the particular certificate online.
- Submit their data for the required certificate easily.
- Get the knowledge about the time taken and requirement for the particular certificate.
- Can use their data for applying multiple certificates.
- Can track the status of their applied certificate.
- Can participate in Government working at tehsil level.

Citizen Charter (Application) helps the Government in the following ways [1]:

- Government can take corrective decision based on the data collected through this application.
- Redundancy of data is not present, if citizen's data is collected through this Cloud Application.
- Government can track the working at Tehsil level.
- Corruption can be reduced at lower level of Government department i.e. Tehsil.
- Can track the Certificate issued.

CITIZEN CHARTER APPLICATIONS: THE WORKING CONCEPT (ALGORITHM) [1]

1. Start
2. Citizen login to the System
3. Authentication Check (verify login details)
   a. If success then go to step 4
   b. Else
      i. Register new user and go to step 2
      ii. Password retrieval if forgotten and go to step 2
4. Various modules available to user/citizen are:
   a. CRUD his/her detail (profile).
   b. Retrieve, update, and delete his /her academics/professional certificates.
   c. Can check rules and regulations of the department (tehsil) and various certificates issued at the tehsil level.
   d. Can apply online for various certificates.
   e. Can check the status of applied certificates.
   f. Participate (Grievances/feedback) for the better working of the Tehsil level Government.
5. Logout
6. Stop

CLOUD ARCHITECTURE FOR E-CITIZEN CHARTER

In the Cloud Architecture, our Application resides at SAAS level. Citizen can use different browsers (Firefox, IE, and Chrome etc) to login at SAAS level by using its UID provided by government. After that, he/she can use various modules like:

- CRUD his/her details.
- Apply for certificate.
- Upload his/her data if needed for a particular certificate.
- Track his/her certificate status.

- Can participate in government working by giving feedback /grievances.
- View various certificate and their governing rules updated at Tehsil (part of a district) level.

All data will be uploaded at different data center govern by centralized e-government agencies. This level is provided by IAAS delivery model of CLOUD. Various web applications, platform and other resources needed for successful   run of SAAS level application is maintained by PAAS delivery model of CLOUD. Citizen can use this application in any device, which runs internet like Smart phones, Laptops, Desktops PDAs etc.

Figure-2: Cloud Based Architecture of Citizen Charter
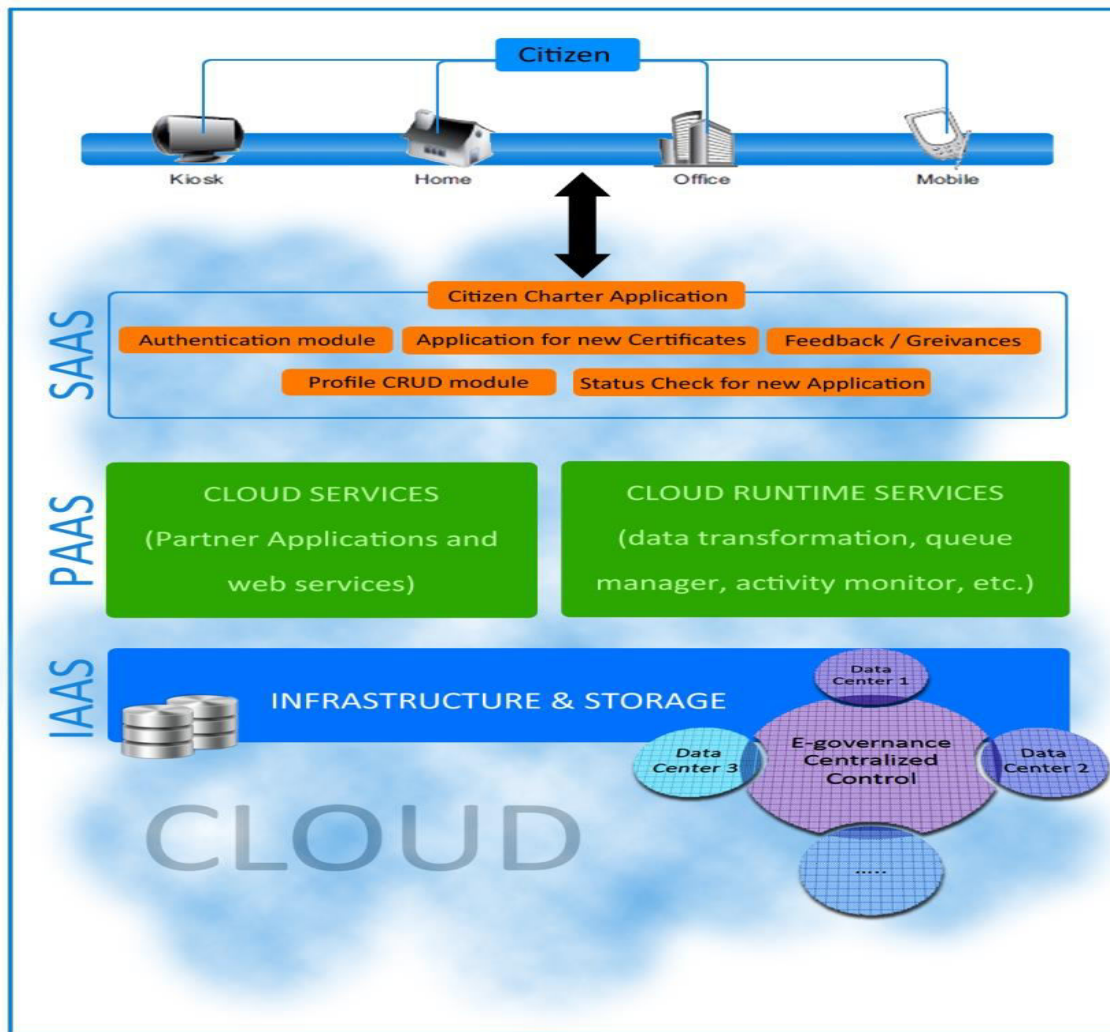
Sources: Authors Compilation

CONCLUSIONS

Study in this paper concludes that the Cloud provides an effective solution to almost every problem faced today in E-Governance. The Cloud offers seamless integration with all the technologies present today. E-Governance Citizen Charter can be heavily benefited with the introduction of Cloud Framework. Lots of research has to be conducted before implementing Cloud in E-Governance. Before, moving to the cloud computing, one should have the security issues in mind. Security of any cloud-based services must be closely reviewed to understand the protection of information.

FUTURE SCOPE

This is only the theoretical model of citizen charter at Tehsil level Governance. The practical possibilities of this model include the various security issues. These issues must be kept in mind if this is to be implemented. Also as of now, cloud is in its infancy, so, many new things will be included in near future. After that, the proposed model can be practically implemented.

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A STUDY FOR ICT ENABLE E-HEALTH SERVICES IN UTTARAKHAND

Mukesh Joshi[18] Dr. Durgesh Pant[19]

ABSTRACT

All the application comes under eHealth will focus on the individual to provide greater access and increased knowledge in eHealth. Its application empowers an individual to manage his/her own personal eHealth records. It integrates all the information related with an individual's health, which allows the smooth functioning of services and products associated with the health care system. ICT based health applications can benefit peoples of hilly and remote areas where access to specialized care is very difficult or near to impossible. In terms of attaining better health care in remote and hilly areas of Uttarakhand.

KEYWORDS

Computerized Physician Order Entry (CPOE), EHR, Decision Support System, SWAN, ICT, e-Health, Adverse Event System and Alert System, Incident Reporting System etc.

INTRODUCTION

Many ICT applications are available in health care; here we review some applications w.r.t to available health care facilities in Uttarakhand. These applications enable future pursuit of user friendly, patient safety enabling and risk-management ICT system.

While implementing the ICT based eHealth application one needs to take into account the technical feasibility, it must also maintain awareness of all those issues that are related to culture, organization, legal and regulatory conditions, ethical issues and quality assurance. Moreover, the coordination between existing technologies also seems to be a promising field of research for the area of patient safety and risk management.

ABOUT UTTARAKHAND

The state of Uttarakhand is bounded by Nepal in the east, the Tibet Autonomous Region of China in the north, Himachal Pradesh in the west and Uttar Pradesh in the south. The total geographical area of the state is about 53,483 sq. km. According to the Census, the State's population was 1.01 Crores (10 million) in 2011 [1]. Uttarakhand was carved out of Uttar Pradesh and given an independent status as the tenth Himalayan state and the twenty-seventh state of the Indian Union on 9th November, 2000. Formation of this state was a long-standing aspiration of the people of Garhwal and Kumaun, as this would accelerate the pace of socio-economic and human development. The state has been created with the inclusion of 13 districts of undivided Uttar Pradesh. It is further divided into 49 sub-divisions and 95 development blocks in order to ensure rapid human development through effective administration. There are 15,638 inhabited villages and 86 urban settlements in the state. However, it is very tough to create policies based on health care conditions due to every constrained hilly regions of this state as well as due to various physical, geographical and environmental problems in Uttarakhand.

IMPORTANCE OF ICT BASED APPLICATIONS FOR UTTARAKHAND

E-health is important for remote and hilly areas of Uttarakhand because it provides us a way of using the electronic communication technologies to provide clinical care. ICT enabled applications allowed a physician or specialist at one site to deliver e-health, diagnose patients as well as provide intra-operative assistance with another physician or paramedical personnel at a remote site. In remote and hilly areas of Uttarakhand it is not possible, due to geographical condition, to have a face to face interaction between a doctor and a patient on regular basis so the ICT enabled applications like Teleradiology, Telepathology, Teleconsultation, Teleconferencing and Telepsychiatry are very helpful as sometime they acts as a lifesaving technologies [2].

Now a day's Video conferencing is also available, which acts as a boon in success of e-health. Under this facility, the patients and doctors can interact through videoconference to another doctors sitting at another side. Increasingly the use of information technology and its applications will allow much of the work currently being carried out in hospital, to be carried out in people's homes, this process can enhance the efficiency and standards of clinical care and at the same time, it reduces the cost drastically. Thus, the videoconferencing plays a vital role in increasing the health facilities among remote and hilly areas of Uttarakhand.

All the application comes under eHealth will focus on the individual to provide greater access and increased knowledge in eHealth. Its application empowers an individual to manage his/her own personal eHealth records. It integrates all the information related with an individual's health, which allows the smooth functioning of services and products associated with the health care system.

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ICT based health applications can benefit peoples of hilly and remote areas where access to specialized care is very difficult or near to impossible. In terms of attaining better health care in remote and hilly areas, therefore ICT applications are helpful in several ways:

- The referral patient can be reduced by as much as by connecting primary health care centers physicians to specialists of higher centers to provide better health care.
- The ICT applications also improve access to specialty care in some areas, especially in rural and hilly areas.
- Through this, one can improve the quality of care to patients through more timely delivery of medical services to the point of care.

Some ICT based eHealth applications with respect to Uttarakhand are as follows:

EHR Implementation

Through ICT, EHR can be an important facilitator of patient safety. Using of EHR will ensures that patient records are not lost and this may help us getting better control over existing health facilities and help us in prescribing medicines.

Development of EHR [3] may also help us in developing State Health Data center. While using of EHR in Uttarakhand would be the single step that would most improve patient safety. Development of State Health Information infrastructure was required to overcome the ICT deficit in Health care. The State health information infrastructure should be secure, reliable and adaptable state level Infrastructure. It must be capable of connecting and supporting highly distributed, varied and independently – managed, multi tired, intra-institutional, clinical information or communications technology systems and applications. The key benefits of using EHR are that they can be used to detect the frequency of adverse events and to develop methods to reduce the number of such events.

Decision Support System

DSS incorporates a variety of eHealth applications. In particular, DSS and CPOE are highly complementary to each other, and should be incorporate to a single solution. DSS can be described as 'Computer based support for management decision makers who are dealing with semi-structured problems. In general, we have two types of DSS systems: a) Business, and b) Clinical.

The above-mentioned system differs significantly in intent and content but at the same time, they share many common elements. According to Liu [4], a decision tool is an active knowledge resource that uses EHR (patient data) to generate case-specific advice, which supports decision making about an individual health-by-health professionals. Under decision, support system for eHealth simple algorithms generates reminders, alerts or other information while protocol that incorporates more complex rules that reduce the clinical decision error rate.

CPOE (**Computerized Physician Order Entry**)

CPOE can be described as process whereby the instruction of physicians regarding the treatment of patients under their care are entered electronically and communicated directly to responsible individuals or services.

In the past these orders were either hand-written or communicated verbally, which led to medical errors [5]. Clinical decision support systems are built to varying degrees into almost all CPOE systems. The system is very helpful in disaster prone areas of state like Uttarakhand. The CPOE system will provide basic computerized advice regarding drugs, doses, frequencies, drug allergies and various others guidelines. CPOE can be applied in a variety of physical and technical environment that use currently available vendor software. CPOE helps us in reducing in transcription errors, which in turn helps us in improvement in patient safety. CPOE reduces prescribing errors significantly in the situation of drug interaction or allergies. It helps in improving the quality of care by increasing clinicians' compliance with standard guidelines of care.

Figure-1: COPE System
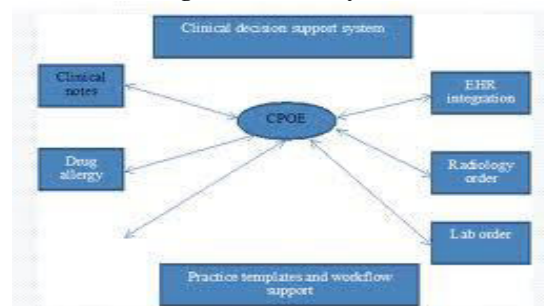
Sources: www.google.co.in

In most part of the world, ICT supported medication- handling pathways reduced drastically errors in the prescription of specific high-risk drugs. Moreover, the interaction of a dispensing system reduces the risk of medication errors, while electronic prescription mechanism helps us in improving the legibility and completeness of prescriptions. Moreover, "the use of ICT applications supporting work processes freed staff for clinical activities and patients besides."

The California health care foundation and first consulting group also sponsored a research study to provide information about CPOE implementation in a community hospital setting. The research focuses [6] that how community health centers can implement a CPOE system. Finally author concluded by saying that careful planning should also include good technology management.

According to sitting and steal [7], key ingredients must be present for a system to work. This may include fast and easy to use interface. At last, CPOE should be viewed as supportive technology for implementing health informatics in Uttarakhand.

Adverse Event System and Alert System

Automize adverse event system aims to monitor the occurrence of Instances, which could be adverse events, and to alert clinicians when certain indicators are present. As system based on ICT have been tested in the areas of adverse drug events. The system of automatic alerts can improve the treatment time for patients as most of the time is wasted while prevailing from one place to another as in Uttarakhand. The system is very helpful in getting laboratory results in time [10].

In their review, article Gandhi and Betes [11] report on one study that demonstrates significant decreases in adverse clinician out come with alert systems provided by them mainly deals with allergic reactions.

The alert system is based on defined set of rules. Concerning Uttarakhand the development of alert system is very effective due to its distant barriers. In Uttarakhand, the system can be developed by integrating government pathologies data with the database of drugs supplied by government to its hospitals. The alert system can be more effective if it uses the existing network of SWAN in Uttarakhand for integrating the database of different sectors. In the later phase, EHR can be integrated with alert system for receiving patient information.

However, the computerized alert can only be effective if they are relevant. The over alerted system may have a disadvantage of "alert blindness".

Incident Reporting System

For Uttarakhand the need of incident reporting is requiring too much extent because of its uncertain climatic change and disaster.

Figure-2: Telemedicine System

Sources: www.google.co.in

The system of incident reporting can be done by connecting all the referral hospitals providing 24x7 emergency facilities to the patients. Such systems after their development can be used for bio-surveillance and fast alert and pattern tracking in case of bio-terrorism attack or an epidemic outbreak.

CONCLUSIONS

Use of ICT based applications for Uttarakhand is a necessity for improving health care services in geographically bared areas. Development of EHR is the first step for Using ICT in health care. Decision-making can be done based on patient health record. Government can also use collected records for making policies for people resided in those areas. ICT applications are also helpful in getting assistance during disaster, which is very prominent in the state like Uttarakhand.

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INTEGRATED GOVERNANCE (I-GOVERNMENT): THE NEED OF FUTURE E-GOVERNANCE IN INDIA

Ashish B. Khare[20] Dr. M. K. Sharma[21]

ABSTRACT

Despite being the largest democracy in the world map with an essential need to deliver effective and transparent public governance, India still stands at the bottom of the UN E-Government Survey 2012 rankings. With an increasing percentage of internet users in recent years it stills lacks in population penetration and reaching out to common person. However, India is making efforts to move forward to use technology for delivering social benefits to its poor by launching different schemes and enhancing its e-governance strategies.

In this paper, the author has focused on strengthening the core of E-governance and its reach to end users by shifting the trend of e-governance (e-gov) towards integrated governance (i-gov) for India. Initially the conceptual framework has been suggested for India and its governance architecture. In future, the government can frame the technical and implementation issues of the same.

KEYWORDS

E-governance (e-gov), Integrated Governance (i-gov), Internet, Models etc.

INTRODUCTION

E-governance is not a new terminology in India anymore. With the increasing demand of 'citizen centric' government around the globe, India too has put forward its step to deliver a transparent and approachable government to its citizens. E-government is one of the strategic innovations that many governments have considered adopting to deliver better services to citizens, to improve the democratic processes, and to support the modernization of their business process. However, deploying the government processes online and providing information as well as communication with the use of ICT is not just the demand of future. The need is to provide a user friendly, seamless, efficient and citizen centric public services, which would help to increase the population penetration of these services in India. A user-focused approach would certainly help to decrease the complex structure and relationships of the government agencies, which would lead to better interaction between agencies and user [1].

The integrated government (i-gov) structure can help achieve this goal, by enabling governments to appear as a single integrated organization and provide seamless and efficient one stop online service. This services integration structure will integrate people, processes, information, and technology in the aim to achieve government as well as users' objectives. In this paper author has put focus on the importance and benefits of integrated governance (i-gov) to the users and provided a conceptual framework for the integration of e-governance services which will lead to 'citizen centric' governance.

E-GOVERNMENT MODELS

The table below shows some e-governance models proposed by different authors. Looking at this table, there are relationships that have been broadly represented in the different studies. These relationships are:

- "Government to citizen - G2C," - manages the relationship between citizens and their government.

- "Government to business - G2B"- manages the relationship between the public and the private sector.

- "Government to government - G2G"- concerns the relationship within government agencies and departments who collaborate the work for a single government.

- "Government to employee- G2E"- manages the relationship between the government and employees.

However, Lam (2005) proposed a new model of e-government based on above relationships, namely:

- "Government agency to government agency - GA2GA"- cooperation and integration of different government agencies. Government agencies are responsible for the production and the distribution of integrated services. The collaboration is based on components reuse and information sharing

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- "Central government to government agency - CG2GA" – electronic liaising between central government and different state and other government agencies. The central government is responsible of the coordination and control of integrated projects and their progress. It includes coordination, control, funding and monitoring of e-government projects between central government and other state agencies

- "Government agency to government users - GA2GU"- it concerns with government interaction and participation with "government user. The GA2GU represents the relationship between agencies and all the stakeholders of government, which are citizens, businesses and employees [9].

Table-1: E-Governance Models

Author	Definition
Gonzalez and al. (2007) [4]	G2C : government to citizen G2B : government to business G2G : government to government G2E : government to employee
Beyon-Davies (2007) [5]	Internal Government: G2C : government to citizen G2B : government to business G2G : government to government C2C : citizen to citizen
Siau and Long (2009) [6]	G2C : government to citizen G2B : government to business G2G : government to government G2E : government to employee
Lam (2005) [7]	GA2GA : government agency to government agency CG2GA : central government to government agency GA2GU : government agency to government user
Yildiz (2007) [8]	G2G : government to government G2C : government to citizen G2B : government to business G2CS : government to civil society C2C : citizen to citizen

Sources: Authors Compilation

The distinction and literature in point 5, 6 and 7 describes the integration of e governance in a fully functional single unit, which would lead to better efficiency, and success of e-governance projects.

INTEGRATED GOVERNANCE (I-GOV): HORIZONTAL INTEGRATION OF E-GOV

Most of the e governance services offered by the state or central governments are not integrated. This can mainly be attributed to lack of communication between different departments. Therefore, the information that resides with one department has no or little meaning to some other department of government. Connected governance or integrated governance is built upon the concept of interoperability that is the ability of public agencies to share and integrate information using common standards [2]. The key features of connected governance are successful service innovation and multi-channel service delivery. Service integration depends on strategies, policies and architectures that allow data, IT systems, business processes and delivery channels to interoperate. If delivery channels and back-office processes are integrated, different service delivery channels can complement each other, improving the quality of both services and the delivery to government and citizens simultaneously [3]. Integrated e-gov will in turn help foster sustainable development because national and local government is citizen-centric and economic, social and environmental aspects of government. This horizontal integration of e-governance services will act as a 'one stop shopping' for the citizens. In simple case if a citizen has to moves from his/her home, the basic address can be propagated to all functional agencies such as election commission or vehicle registration department from a single portal and updated to the central database. The citizen does not have to fill personal record form and submit to each individual department or agency.

ISSUES AND BARRIERS IN INTEGRATION OF E- GOVERNANCE

Integrated service delivery (ISD) for integrated governance has three main characteristics: it is integrated; it has services to provide and with mission of delivery to users [10]. The different government agencies at state level have to be connected and finally have to be integrated with the central government agency. The second component of i-gov is 'service', defined as being a set of activities and exchanges that meet the expressed need of a person or group, i.e. a customer or a citizen. The final component

is 'delivery', the mechanism by which a particular service is connected to a particular customer to meet a particular need. A mechanism for delivering a service is referred to as a channel.

Barriers in integrating e-governance are:

- Political and administrative issues: while the political and administrative structure of Indian government seems to be same as a whole, but somehow the legal issues of different states vary in implementation. Integrating different departments which different protocols and way of working seems tedious to merge.

- Varied working Flowchart of individual government agencies: The structure and work process of different departments within or outside the state are quite different. They are set to a standard, which is best suited to them for an easy outcome. Implementation of a standard, which is unique and common, will certainly be a hard work and resistance to change by them.

- Operation and management: The most technical and realistic issue for integration lies with the concept of interoperability. To implement a single integrated e-governance module we require a high-end feasible interoperable environment. With different services required by the users and different channels to help them out, it becomes technically a big challenge to find a solution. Managing this structure will also require a great financial aid and expertise manpower.

- Access and privacy issues: Internet has been a threat to privacy of an individual from the day of its evolution until date. Privacy of data and information will be a major concern for the users: citizens, businesspersons or government agency. The state of Uttarakhand has a very low rate of internet users as well as of people who are not equipped with internet-enabled devices. This would decrease the accessibility of the integrated e- governance to the common person.

- Financial concern: It is a major issue as lot has been invested in setting up ICT structure throughout the country and at state levels. Uttarakhand, being a young state and learning to stand up on its feet has to take a hard financial aid to liaison of such structure with the central government.

BASIC FRAMEWORK FOR I-GOV IN INDIA

The following model shows the basic integration of government agencies within a state for integration of e-governance structure:

Figure-1: Basic Integration Model for State 'i-gov'
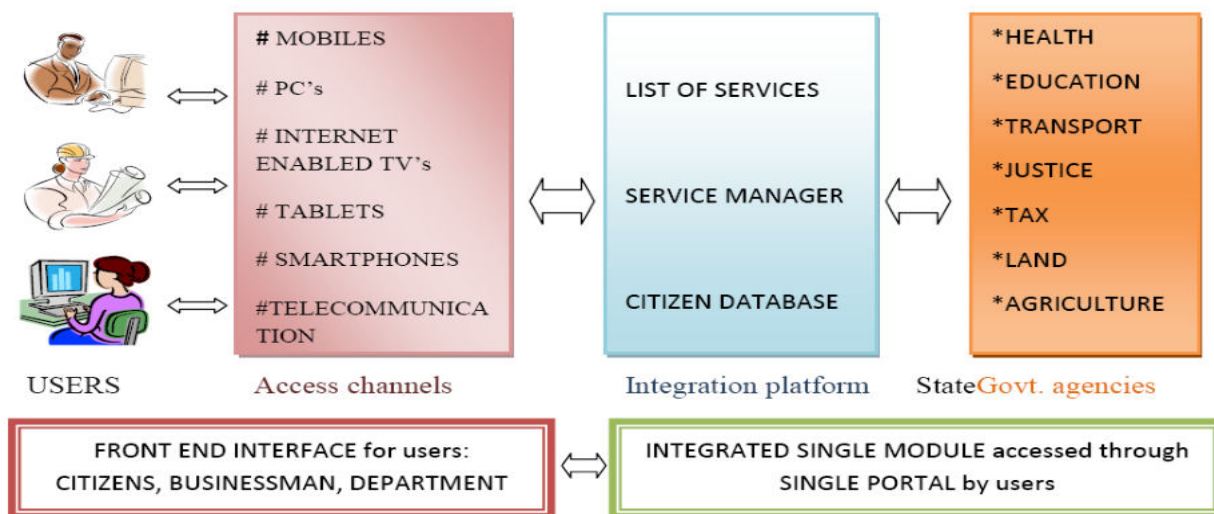
Sources: Authors Compilation

The figure depicts the use of integrated services by the users through a single web based portal through internet accessible devices. The state agencies are linked and interconnected via integration platform, which will hold a list of services that can be used, service manager to manage the services being provided and a central database to all the departments as a whole. The integration should be interoperable and will certainly require a study of technical capabilities of tools and experts. The structure of central database should be capable to accept all the terminologies of all individual departments as without any discrepancies.

Figure-2: Basic Framework of Integrated Nationwide 'i-gov'
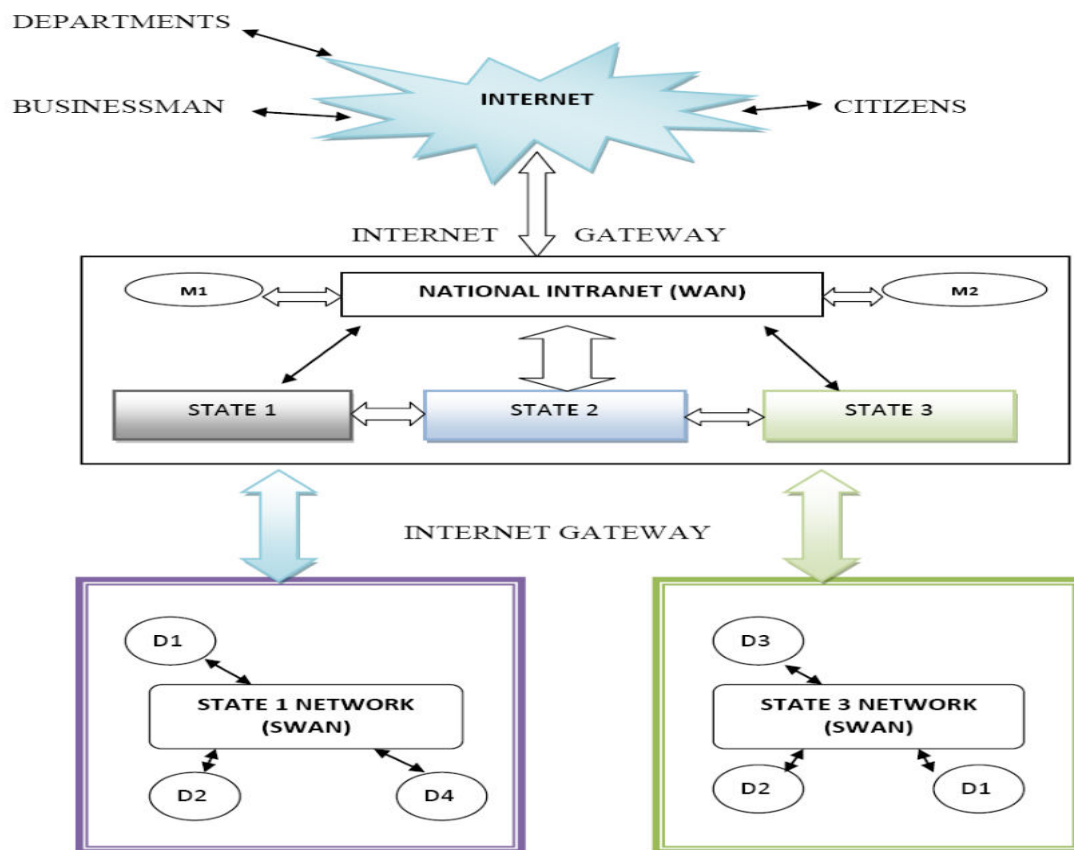
Sources: Authors Compilation

The model above depicts the connection of state level departments with the help of state networks (SWAN) to provide seamless information sharing through a web based state portal. The D1, D2.... DN depicts the various state departments connected to the state network. The state network can be further integrated with central government agencies with the help of internet gateways forming a national level intranet (WAN). The M1, M2.... MN depicts the different ministries under the central government. The national portal can consist of a provision to integrate the state level web portals and providing a direct interface between the users and the information at any level of governance. The interoperable architecture will help a single gateway through which users does not have to move to different locations for different information related to different departments. This will eventually help to increase the efficiency and effectiveness of e- government services in India.

CONCLUSIONS

The researcher has tried to point out the importance of integrated governance in today's scenario of effective governance. The future of e-governance and its efficiency can only be sustained through the implementation of 'i-gov'. Citizen centric governance is the demand of future, which will in turn decrease the gap between a good government and its citizens. However, implementation of 'i-gov' is a crucial factor, which will take time, and a lot of money with mature technical tools and expertise of technocrats, its success cannot be overlooked. The researcher has proposed a conceptual model and in future, the study of interoperability and design of technical model can be done to facilitate the beginning of new change in e-governance.

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DESIGNING ISSUES FOR E-LEARNING MODULES IN CLOUD PLATFORM

Preeti Bansal[22] Dr. M. K. Sharma[23]

ABSTRACT

E-Learning is the topic related to the virtualized distance learning by means of electronic communication mechanisms, specifically the Internet. The need for education is increasing constantly. The development and improvement of the e-learning solutions is necessary. In addition, the e-learning systems need to keep the pace with the technology, so the new direction is to use cloud computing. Cloud computing is highly scalable and creates virtualized resources that can be made available to users. Cloud computing will have a significant impact on the educational environment in the future. In this paper, we give an overview of the current state of Cloud Computing. We provide details of the most common infrastructures for e learning, and finally we present some challenges of e-learning approaches for Cloud Computing.

KEYWORDS

Cloud Computing, E-learning, ICT, SaaS, PaaS, IaaS etc.

INTRODUCTION

The Electronic Learning, better known as E-Learning, is defined as an Internet enabled learning. Components of e-Learning can include content of multiple formats, management of the learning experience, and an online community of learners, content developers and experts. The study summarized the main advantages, which include flexibility, convenience, easy accessibility, consistency and its repeatability. Cloud Computing is a new paradigm that provides an appropriate pool of computing resources with its dynamic scalability and usage of virtualized resources as a service through the Internet. The resources can be network servers, applications, platforms, infrastructure segments and services. Cloud computing deliver services autonomously based on demand and provides sufficient network access, data resource environment and effectual flexibility. This technology is used for more efficient and cost effective computing by centralizing storage, memory, computing capacity of PC's and servers. With the tremendous advantages of cloud computing, we expect this technology to revolutionize the field of e-learning education. Cloud computing applications provide flexibility for all educational universities, schools and institutions. The cloud platform in institutions' campuses provides effective infrastructure and deployment model for their dynamic demands. Cloud computing is becoming an attractive technology due to its dynamic scalability and effective usage of the resources; it can be utilized under circumstances where the availability of resources is limited. This paper presents the impact of using cloud computing upon e-learning solutions development.
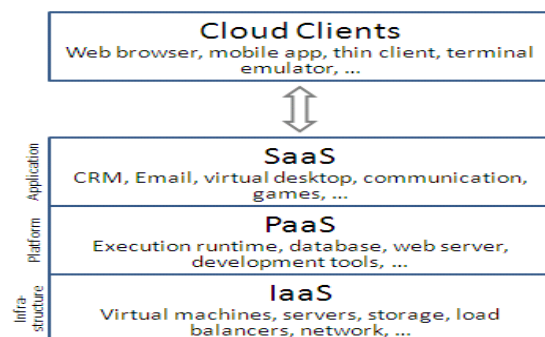
WHAT IS CLOUD COMPUTING?

Cloud computing is a colloquial expression used to describe a variety of different types of computing concepts that involve a large number of computers that are connected through a real-time communication network (typically Internet). Cloud computing is a jargon term without a commonly accepted non-ambiguous scientific or technical definition. In science, cloud computing is a synonym for distributed computing over a network and means the ability to run a program on many connected computers at the same time. The phrase is also, more commonly, used to refer to network based services which appear to be provided by real server hardware, but which in fact are served up by virtual hardware, simulated by software running on one or more real machines. Such virtual servers do not physically exist and can therefore be moved around and scaled up (or down) on the fly, without affecting the end user - arguably, rather like a cloud.

Chart-1: Infrastructure of Cloud Computing
Sources: Authors Compilation

Cloud computing providers offer their services according to several fundamental models: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) where IaaS is the most basic and each higher model abstracts from the details of the lower models. Other key components in anything as a service (XaaS) are described in a comprehensive taxonomy model published in 2009, such as Strategy-as-a-Service, Collaboration-as-a-Service, Business Process-as-a-Service, Database-as-a-Service, etc. In 2012, network as a service (NaaS) and communication as a service (CaaS) were officially included by ITU (International Telecommunication Union) as part of the basic cloud computing models, recognized service categories of a telecommunication-centric cloud ecosystem.

Infrastructure as a service (IaaS): In the most basic cloud-service model, providers of IaaS offer computers - physical or (more often) virtual machines - and other resources. (A hypervisor, such as Xen or KVM, runs the virtual machines as guests. Pools of hypervisors within the cloud operational support system can support large numbers of virtual machines and the ability to scale services up and down according to customers' varying requirements.) IaaS clouds often offer additional resources such as a virtual-machine disk image library, raw (block) and file-based storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software

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bundles. IaaS-cloud providers supply these resources on-demand from their large pools installed in data centers. For wide-area connectivity, either customers can use the Internet or carrier clouds (dedicated virtual private networks).

Platform as a service (PaaS): In the PaaS model, cloud providers deliver a computing platform, typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. With some PaaS offers, the underlying computer and storage resources scale automatically to match application demand so that the cloud user does not have to allocate resources manually. Examples of PaaS include: AWS Elastic Beanstalk, Cloud Foundry, Heroku, Force.com, EngineYard, Mendix, OpenShift, Google App Engine, AppScale, Windows Azure Cloud Services, OrangeScape and Jelastic.

Software as a service (SaaS): In the SaaS model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. Cloud users do not manage the cloud infrastructure and platform where the application runs. This eliminates the need to install and run the application on the cloud user's own computers, which simplifies maintenance and support. Cloud applications are different from other applications in their scalability, which can be achieved by cloning tasks onto multiple virtual machines at run-time to meet changing work demand. Load balancers distribute the work over the set of virtual machines. This process is transparent to the cloud user, who sees only a single access point. To accommodate a large number of cloud users, cloud applications can be *multitenant,* that is, any machine serves more than one cloud user organization. It is common to refer to special types of cloud based application software with a similar naming convention: desktop as a service, business process as a service, test environment as a service, communication as a service. Examples of SaaS include: Google Apps, Microsoft Office 365, Petrosoft, Onlive, GT Nexus, Marketo, Casengo, TradeCard, Rally Software, Salesforce and CallidusCloud.

Network as a service (NaaS): A category of cloud services where the capability provided to the cloud service user is to use network/transport connectivity services and/or inter-cloud network connectivity services. NaaS involves the optimization of resource allocations by considering network and computing resources as a unified whole. Traditional NaaS services include flexible and extended VPN, and bandwidth on demand. NaaS concept materialization also includes the provision of a virtual network service by the owners of the network infrastructure to a third party (VNP – VNO).

WHAT IS E-LEARNING?

E-learning refers to the use of electronic media and information and communication technologies (ICT) in education. E-learning is broadly inclusive of all forms of educational technology in learning and teaching. E learning is inclusive of, and is broadly synonymous with multimedia learning:

- Technology-enhanced learning (TEL),
- Computer-based instruction (CBI),
- Computer-based training (CBT),
- Computer-assisted instruction or computer-aided instruction (CAI),
- Internet-based training (IBT),
- Web-based training (WBT),
- Online education, virtual education,
- Virtual learning environments (VLE) (which are also called learning platforms),
- M-learning,
- Digital educational collaboration.

These alternative names emphasize a particular aspect, component or delivery method.

E-learning includes numerous types of media that deliver text, audio, images, animation, and streaming video, and includes technology applications and processes such as audio or video tape, satellite TV, CD-ROM, and computer-based learning, as well as local intranet/extranet and web-based learning. Information and communication systems, whether free-standing or based on either local networks or the Internet in networked learning, underlay many e-learning processes. There are various e-learning solutions from open source to commercial. There are at least two entities involved in an e-learning system: the students and the trainers. Some benefits of e learning are discussed below: Time: One of the key benefits of online study is that one can learn or take a course through e-learning at any time, as it is convenient for them. Pod casts and downloadable lectures mean that students are no longer constricted by a conventional timetable of lectures. Location: Neither are students restricted by their physical location. With an Internet connection, they can attend live online tutorials, participate in dedicated discussion forums or download course material and notes regardless of where they are. Communication: Another key advantage of online study is that it encourages and enables students to collaborate and communicate with their fellow students as well as their tutors.

Improved training and material costs: With e-learning, each time the course is accessed our return on investment improves because users are dividing the fixed production costs by number of uses. We also have savings through decreased travel, reduced material, and hopefully improved (and more efficient) performance.

Increased productivity: Because e-learning is not bound by geography or time, you can control training's impact on production by training people during down times. In addition, with the current economy, you are asking people to do more with less. So e-learning is a great way to give them the tools and skills needed to enhance their performance.
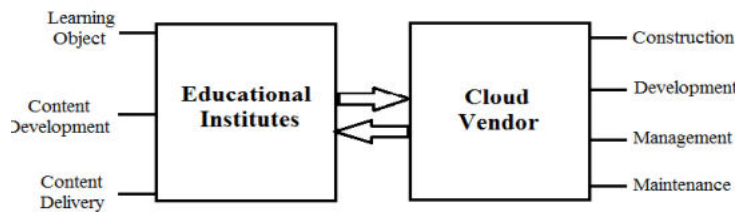
CLOUD COMPUTING BASED E-LEARNING

With the increase in number of students, rapid growth of education content and changing IT infrastructure, the educational institutes are confronted with a dramatic increase in costs and a decrease in budgets, which leads to the need of finding some alternative for their e-learning solutions. In addition, the current e-learning systems are not scalable and do not lead to the efficient utilization of the resources.

As a response to this increase in pressure and to increase the efficiency and availability of their current e-learning system, the educational institutes may adopt a service-oriented approach. The potential efficiency of using cloud computing in higher education has been recognized by many universities such as University of California, Washington State University's School of Electrical Engineering and Computer Science, higher education institutes from UK, Africa, US and others.

In cloud based e-learning systems, the institutions are responsible for content creation, management and delivery while the cloud service provider is responsible for system construction, development, management and maintenance. The institutes are charged according to the usage that directly depends on the number of students.
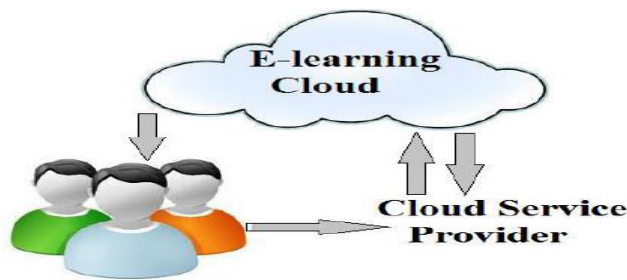
Chart-2: Separation of roles in Cloud based E-learning
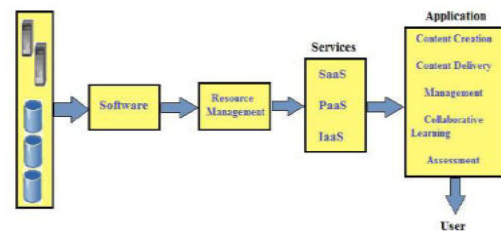

Sources: Authors Compilation

In, Kaewkiriya and Utakrit have proposed a model for elearning using cloud computing which is shown in chart 3.

Chart-3: Abstract Model of Cloud Computing based E-learning   **Chart-4: Cloud Computing Architecture**

Sources: Authors Compilation

Sources: Authors Compilation

In this model, the request from the user is sent to the cloud service provider, which in turn connects to the e-learning cloud in order to give response to the user's query. The architecture of a system that uses cloud computing as an e-learning solution is shown in Fig. 4
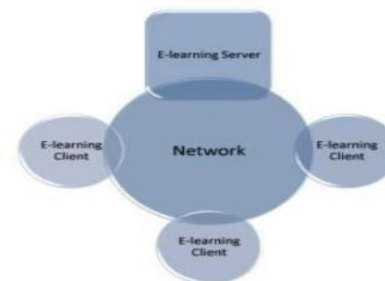
This architecture has five layers:

- *Infrastructure Layer* is composed of dynamic and scalable resources such as physical memory, CPU and memory etc.
- *Software Resource Layer* mainly consists of operating system and middleware to provide interface to the software developers for easy development of applications that will be made available to the end users.
- *Resource Management layer* is used to achieve loose coupling of hardware and software resources so as to provide on demand service.
- *Service Layer* has three levels namely IaaS, PaaS and SaaS that help the cloud users to use various cloud services.
- *Application Layer* includes specific applications to integrate teaching resources with cloud computing model.

BENEFITS OF USING CLOUD COMPUTING IN E-LEARNING

Chart-5: E-Learning System

One of the most interesting applications of cloud computing is educational cloud. The educational cloud computing can focus the power of thousands of computers on one problem, allowing researchers search and find models and make discoveries faster than ever. The role of cloud computing at university education should not be underestimated as it can provide important gains in offering direct access to a wide range of different academic resources, research applications and educational tools. Usually, E-learning systems are developed as distributed applications, but not limited too. The architecture of an e-learning system, developed as a distributed application, includes a client application, an application server and a database server, beside the hardware to support it (client computer, communication infrastructure and servers). E-learning systems can use benefit from cloud computing using:

Sources: Authors Compilation

- Infrastructure: use an e-learning solution on the provider's infrastructure
- Platform: use and develop an e-learning solution based on the provider's development interface
- Services: use the e-learning solution given by the provider.

CURRENT CHALLENGES OF E-LEARNING SYSTEMS

Among the learning technologies, web-based learning offers several benefits over conventional classroom-based learning. Its biggest advantages are the reduced costs since a physical environment is no longer required and therefore it can be used at any time and place for the convenience of the student. Additionally, the learning material is easy to keep updated and the teacher may incorporate multimedia content to provide a friendly framework and to ease the understanding of the concepts. Finally, it can be viewed as a learner-centered approach, which can address the differences among teachers, so that all of them may check the confidence of their material to evaluate and re-utilize common areas of knowledge. However, there are some disadvantages that must be addressed prior to the full integration of e-Learning into the academic framework. Currently, e-Learning systems are still weak on scalability at the infrastructure level. Several resources can be deployed and assigned just for specific tasks so that when receiving high workloads, the system need to add and configure new resources of the same type, making the cost and resource management very expensive. This key issue is also related to the efficient utilization of these resources. For example, in a typical university scenario, PC labs and servers are under-utilized during the night and semester breaks. In addition, these resources are on high demands mainly towards the end of a semester, following a dynamic rule of use. The physical machines are hold even when they are idle, wasting its full potential. Finally, we must understand that there is a cost related to the computer (and building) maintenance, but that the educational center must pay for the site licensing, installation and technical support for the individual software packages.

CONCLUSION

Cloud computing as an exciting development is a significant alternative today's educational perspective. Students and administrative personnel have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand. This automatically reduces the cost of organizational expenses and offers more powerful functional capabilities. There will be an online survey to collect the required data for the use of cloud computing in the universities and other governmental or private institutions in the region. This will help us review the current status and probable considerations to adopt the cloud technology. Beginning with the outsourcing of email service seems attractive. The gradually removal of software license costs, hardware costs and maintenance costs respectively provides great flexibility to the university / corporate management. In this paper, we discuss a cloud computing based e-learning. Describe its definition and some benefits. Cloud based education will help the students, staff, Trainers, Institutions and also the learners to a very high extent and mainly students from rural parts of the world will get an opportunity to get the knowledge shared by the professor on other part of the world. Even governments can take initiatives to implement this system in schools and colleges in future and we believe that this will happen soon.

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SECURITY ISSUES IN PERVASIVE COMPUTING: A HEALTHCARE SCENARIO

H. S. Jalal[24] Dr. Shishir Kumar[25]

ABSTRACT

In the past few years, Pervasive Computing applications have grown tremendously because of recent developments in portable, low-cost, lightweight devices with faster short range and low power Wireless Communications networks. Pervasive Computing environment consists of various small, frequently mobile, handheld and portable smart devices connected to an ad-hoc network structure. These devices are fully efficient in sensing the environment around them and reacting intelligently to the changes in user context in order to simplify the user activities. Security issues increase in pervasive computing environments as it provides a user access to computing resources and services from any location and at any point of time. Pervasive computing has become an essential in healthcare because of so many small devices used. The security plays an essential role in this regard. A wide range of research has been carried in pervasive computing. This paper elaborates the security issues in pervasive computing specially in the healthcare field.

KEYWORDS

Security Issues, Computing, Healthcare, Pervasive Computing etc.

INTRODUCTION

In the past few years, Pervasive Computing applications have grown tremendously because of recent developments in portable, low-cost, lightweight devices with faster short range and low power Wireless Communications networks. Pervasive Computing environment consists of various small, frequently mobile, handheld and portable smart devices connected to an ad-hoc network structure [2, 3]. These devices are fully efficient in sensing the environment around them and reacting intelligently to the changes in user context in order to simplify the user activities. Security issues increase in pervasive computing environments as it provides a user access to computing resources and services from any location and at any point of time [1, 4]. Lightweight Pervasive Computing Devices like PDAs (Personal Digital Assistants), Mobile Phones and Laptops are very portable devices and can be carried anywhere by the user. These portable devices can be connected to the Internet via Wired or Wireless Technology. Wireless Technology like Bluetooth [5], Wi-Fi, WiMAX provide Internet access to handheld devices through various access points.

Personal digital assistants are cheap and effective, and run a wide variety of applications. Many people simply bring their own PDAs to work. Physicians and nurses faced with continuing demands for increasingly efficient health care delivery also use them. According to recent reports such as [6] and [7] from 15 to 20 percent of medical practitioners now use palmtops, and a vibrant specialty software sector has emerged, making hundreds of palmtop medical applications available. However, organizations apply the principle of benign neglect to PDAs containing individual medical records at their peril. Deployments of pervasive solutions in medicine come with legal and ethical complications, and inappropriate disclosure of medical records data involves real and substantial liabilities—liabilities that are about to get even more severe. Specifically, the Health Insurance Portability dramatically changes the legal environment for medical records processing, defining felony offenses and penalties for disclosing individually identifiable medical records.

Various Access Control Mechanisms fail to protect these devices from all types of Information attacks making them vulnerable to attacks from the outside world. In addition to this, Pervasive Computing Devices are more prone to large types of Software Attacks like DoS Attacks (Denial of Service Attacks. When these devices are connected to Infrastructure based networks like Hospital LANs, they also become vulnerable to attacks, which are Infrastructure based. Therefore, there is an utmost requirement for Intrusion Detection System (IDS) to detect suck kinds of attacks in the medical data. Various Researchers have conducted various types of researches in Intrusion Detection carried out for Traditional Networks, which comprise of Computers, Routers, Switches, IP Phones, and Firewalls. Addition of mobile, handheld and portable pervasive computing nodes into existing fixed infrastructure based networks increase the heterogeneity of the resulting network making the problem of Intrusion Detection even harder.

CURRENT PERVASIVE HEALTH MODEL

An assumed model is used to represent the Pervasive Health Monitoring System. This model is based on the technology of wireless sensor network and adhoc network. Before discussing security and privacy, we initially suggest a comprehensive model of WSN-based PEMS to substantiate the system under discussion. As shown, the system consists of some or all of the following components:

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Chart-1
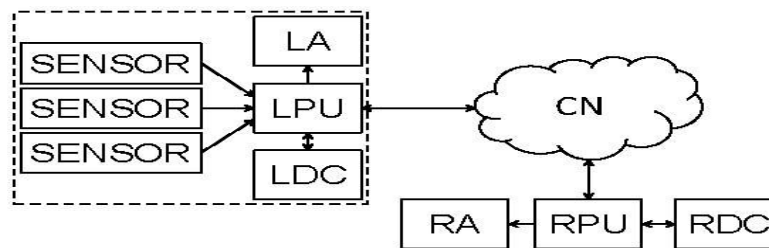
Sources: Authors Compilation

Sensor: Used to captures the medical data and transfers it to the local processing unit.
Local Processing Unit (LPU) processes data from this and other units, sends it to RPU.
Local Data Collection (LDC): stores the data for later retrieval and analysis.
Local Actuator (LA): provides the possibility of triggering a local action, e.g. ringing an alarm.
Communication Network (CN): allows the communication between motes and between motes and the RPU.
**Remote Processing Unit** (RPU): receives data from motes and processes/analyzes this data.
Remote Data Collection (RDC)**:** stores data for analysis and later reference.
Remote Actuator (RA): provides the possibility for triggering an action, e.g. sending an email or sms to a doctor. [8]

The backbone of the current model is wireless sensor network. These networks are made up of miniaturized computers, called motes that contain elements of computation, storage, wireless communication and sensing. The big advantage is the extremely small size of the motes and the fact that they have very low energy consumption, so the monitoring devices may run days or weeks without maintenance or recharge. That way they become ubiquitous, because integration in everyday objects like clothes, rings, or eyeglasses can be envisioned. People will be carrying and using the devices almost without noticing. These are very much suitable for sensing the medical data such as heartbeats, blood pressure, temperature etc. The wireless nodes will virtually disappear. Following are few commercially available motes: [10]

Chart-2
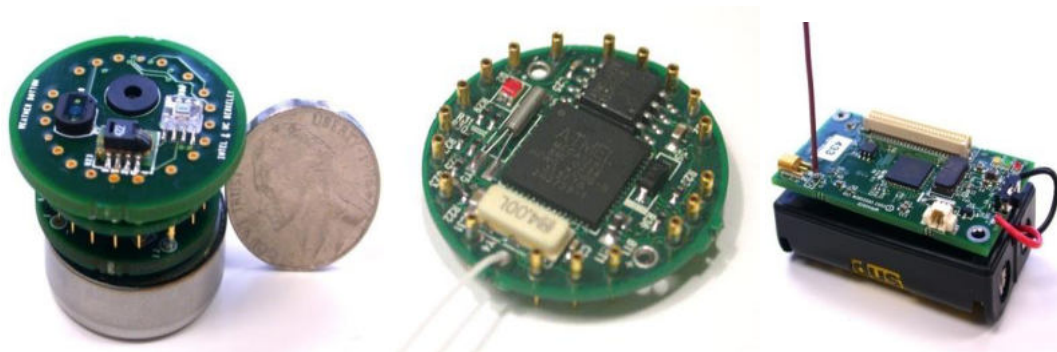
Sources: Authors Compilation

Processor: 4MHz, 8bit CPU.
Memory: Prog RAM Memory (128 KB), Data RAM (4KB),
           On-Board Flash (512 KB).
Radio: 916 Mhz, 52K bps (150-300m max range).
Antenna: On-board, optional external.
OS: TinyOS from Berkeley.
Battery: 2xAA, coin cell (sleep often, sleep deep).

A drawback is that these devices usually have very limited user-interface capabilities and no displays, so local interaction with the device is restricted to simple alarms or button-presses. Furthermore, local computing resources are very limited. The purpose here is clearly to rely on remote systems for analysis and reaction. Given that, only trained personnel should interpret medical data.

POSSIBLE THREATS AND ATTACKS IN PERVASIVE HEALTH

The whole network security consists of the provisions and policies to prevent and monitor unauthorized access, misuse, modification, or denial of the computer network and network-accessible resources. Network security involves the authorization of access to data in a network, which is controlled by the network administrator. Users choose or are assigned an ID and password or

other authenticating information that allows them access to information and programs within their authority. Network security covers a variety of computer networks, both public and private, that are used in everyday jobs conducting transactions and communications among businesses, government agencies and individuals. Networks can be private, such as within a company, and others, which might be open to public access. Network security is involved in organizations, enterprises, and other types of institutions. It does as its title explains: It secures the network, as well as protecting and overseeing operations being done. The most common and simple way of protecting a network resource is by assigning it a unique name and a corresponding password. [9] A list of different attacks is by nature incomplete as constantly new types of attacks are developed and some cannot be envisioned before the system is implemented and deployed. However, it is likely that some of the attacks that are found in today's systems or that are considered for future ubiquitous computing systems will also appear in pervasive health system:

1. **Eavesdropping** is the act of secretly observing the private conversation of network devices others without consent. As medical data is collected, transmitted and stored throughout the system, attackers can try to access that data. One example is the unauthorized snooping on radio communication between motes and subsequent recording of data. As medical data is personal and very sensitive to abuse, this needs to be prevented.

2. **Denial of Service Attack** is an attempt to make a computer resource unavailable to its intended users. Although the means to carry out, motives for, and targets of a DoS attack may vary, it generally consists of the concerted efforts of a person, or multiple people to prevent an Internet site or service from functioning efficiently or at all, temporarily or indefinitely. In the medical data jamming or overloading the system can render the system unusable. In a worst case, scenario sick or injured people are not given the assistance required.

3. **Modification:** This is the case when an unauthorized party gains access and tempers with the data transmitting. This is an attack on the integrity**.** When attackers are able to modify medical data while it is being collected, transmitted, or during storage, incorrect patient records and false system reactions may be the result. This can create either false positives like triggering false alarms and lead e.g. to unnecessary rescue missions. Even worse, false negatives (i.e. modifying alarming data into regular result) can hide abnormal or emergency situations.

4. **Fabrication:** This is the case when an unauthorized party inserts unwanted objects into a system. This is an attack on authenticity. Attackers can simply create fake messages instead of modifying regular ones. This can again lead to wrong data records or false system reaction like rescue teams being sent to help a nonexistent person.[8]

SECURITY SOLUTIONS PROPOSED

A number of security solutions have been proposed to meet the security requirements. In this section, we discuss security requirements for pervasive health monitoring system and give initial guidelines for security solutions addressing the various threats outlined in the last section. The possible solutions to classical security aspects like integrity, confidentiality, and availability and add a special discussion of privacy.

INTEGRITY SOLUTIONS

It includes preventing unauthorized modifications of data while at the same time ensuring that only authorized motes can create and inject data to the network prevents many of the previously discussed attacks. The components in the sensor nodes are vulnerable to physical tampering which cannot easily be prevented on a pure logical level. Using tamper-resistant devices is a viable but costly alternative. In the communication network (CN) lightweight authentication and integrity check methods (e.g. using MAC) can provide integrity protection during transit. In the backend system (RPU/RDC/RA) standard security mechanisms as well as privacy enhancing mechanisms should be deployed. This can include server-based security mechanisms to prevent attacks on the server; access control mechanisms in the medical applications; physical security against access to the hardware, and many more).

CONFIDENTIALITY SOLUTIONS

Eavesdropping on data in the sensor nodes can again be ensured using tamper-resistant devices. Availability of public key cryptography in the sensor nodes should allow for data encryption. In the communication network, data should be encrypted using either shared keys or public key cryptography. In addition, encryption of data in the RDC can increase the protection level. In the ReMoteCare system, SNMPv3 is used to ensure confidentiality in the RPU. Securing of the communication network is still challenging due to resource constraints in the motes [11].

AVAILABILITY SOLUTIONS

Availability in the sensor nodes cannot be ensured reliably, as users controlling individual nodes can easily bring them down by switching them off, removing the sensors or physically destroying them. However, nodes should be protected from remote denial of service attacks like power drain attacks. Denial of Service in the communication network should be prevented by allowing enough redundancy so that failure of individual nodes will not affect the overall system. Single points of failures such as the

Stargate gateway in the ReMoteCare prototype are especially vulnerable to DOS attacks. Overload attacks on the network might be addressed by rate limits for example. Ensuring the availability of the backend does not differ from traditional systems.

Sleep deprivation attacks are a form of denial of service attack whereby an attacker renders a pervasive computing device inoperable by draining the battery more quickly than it would be drained under normal usage. The authors of [12] have proposed a possible solution to it. The multi-layer authentication is designed to prevent energy loss from service request attacks by making sure that all services rendered consume less than a certain amount of energy. Additional resources are committed only to those requesters who have obtained further levels of trust. The energy signature monitor is designed to catch those intrusions that have entered the system to execute an energy-hungry application or service. An initial implementation of the power-secure architecture is underway. Any attack to such nodes where the power availability is critical this authentication can play a vital role.

PRIVACY

Given that data confidentiality is already ensured and only authorized people can actually access the medical data, the major privacy issue is localization. In order to prevent location profiling, sensor nodes should be traceable only in case of emergencies and only by authorized medical staff. A high degree of authentication and authorization is recommended. The traditional security solutions such as cryptography using public key can be associated in the local nodes and the server processing units.

Another way to achieve this is by doing the localization inside the sensor node and deliver the location data to external entities only in case of alarm situations. As the communication network may also be used for tracking node positions, this has also to be taken into consideration. Regarding the backend system, privacy might be enhanced by storing the data using pseudonyms and having a separate mechanism for pseudonym resolution. [8]

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'A NEURAL NETWORK BASED SUPERVISED LEARNING' APPROACH TO IMPROVE INSTRUMENT'S PERFORMANCE THROUGH NARMA L-2 CONTROLLER, AFFECTED BY ENVIRONMENTAL CONDITION

Dr. Avnesh Verma[26] Surinder Singh[27] Sanjeeta Rani[28]

ABSTRACT

A humidity generator has been modified using supervised learning of neural network to enhance the operating conditions for instruments. The two independent variables temperature and humidity are utilized in this analysis. Considering, manifestation of errors in instruments is attributable to severe environmental effects, resulted in their abnormal behaviors. Such environmental condition produces unconditional errors within the instruments. We have got analyzed the data using neural network and rectified the errors using NARMA L-2 controller accessible in MATLAB. Additionally a unique plan has been introduce to unravel these kinds of errors with the assistance of a single layer perceptron (SLP) neural network with supervised learning. The supervised learning technique has been used as trainer component for SLP.

This paper introduces an exclusive feature of equation quandary wherever, two independent variables and intricate aftermath. NARMA L-2 controller tends to deduce nonpareil solutions for this explicit stage as a result, it has the ability to adopt and modify itself in step with the ever-changing environment. The main objective of analysis is to indicate how the utilization of ANNs is suffice to investigate the environmental condition and ready to recommend ideal condition for performance of instrument. It is found that this controller works for low as well as high humidity and temperature levels by maintaining the instrument is operating characteristics at intervals limits. It is proposed that such techniques ought to be simply employable; because of their accuracy and interval is quite higher.

KEYWORDS

Neural Network, Relative Humidity, Temperature, Supervised Learning, Single Layer Perceptron (SLP), NARMA L-2 Controller etc.

INTRODUCTION

An instrument commissioning and manufacturing efficiency mainly depend on the environmental and dealing circumstances. Environmental parameters like; temperature, pressure and humidity are closely allied with appliances and module performance. From the above variable parameters, humidity has a commanding importance because it is going to distress an instrument's performance with a slight modification in its values. Out of the assorted environmental parameters the stability of products are mainly affected through humidity [1]. Humidity is typically characterized as specific humidity, absolute humidity, mixing ratio, vapor pressure and relative humidity. Virtually common measure of humidity is Relative Humidity (RH). Relative humidity is vital because it indicates the attainable evaporation rate (release of latent heat). During a near comfort temperature situation, RH varies in a wide range, unless extremes are not obtained. Higher than 80% humidity level, there is no room left for skin evaporation. If it is less than 20%, the risk of virus spreading, and causes of dry nose, throat, eyes, etc. increases. RH has been defined as associate quantity of water in air relative to the saturation quantity of air hold at a given temperature multiplied by hundred [2-4]. Preferred device for the measurement of humidity is psychometer. However, until date the accurate measurement of humidity is not attainable.

Artificial neural networks are computational networks, which simulate the networks of nerve cell (neuron) of the biological central nervous system. ANN computation is a cell-by-cell simulation. During this simulation, it accumulates knowledge-based information from neuro-physical knowledge and from networks of such biological neurons. Thus, it is different from conventional (digital or analog) computing machine. Neural network is a conceptual network to solve a problem and is based on brain communication system. Throughout ANN processing, the response is stored in inter unit connection of network which is acquired by a process of learning [5]. The application of neural network becomes increasingly important in the field of control, signal processing, pattern reorganization, speech production, business, nuclear power plant etc. To design an intelligent control system factors such as parallel processing, nonlinear mapping and self-learning are very important. Because they increase the decision-making abilities of neural network which are to be taken care of during designing of a controller [6]. ANN is very incredibly useful in detecting and rectifying the errors. Its working is highly efficient in removing errors like root mean square (RMS), absolute errors etc. RH generator has different variables like temperature versus humidity, temperature versus pressure and humidity versus pressure. However, here we will deal with temperature versus humidity [7].

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PROBLEM FORMULATION AND METHODOLOGY

In manufacturing industries, the instrument's health is considered as dependent on thermal comfort level. It is because that when thermal comfort or environment is not suitable for an instrument, then it will have an influence on the properties and characteristics of instrument. The environmental condition constitutes several factors, which affect the instrument behaviour such as temperature, relative humidity and pressure. Attributable to the continuous and abrupt changes in the environmental conditions, the instrument performance gets affected. Out of above, humidity is a major component, which affects the instrument behavior. Since the relative humidity is directly proportional to humidity. It is also known that its presence in air can deteriorates component made up of iron, electronic equipment, chemicals etc. When humidity is within the limits then instruments are prefer to operate and their behaviour are observed to be normal. However, when humidity becomes above the limits or below the limits then it causes instrument failure. To keep the relative humidity within the range we have applied ANN technique. ANN is more popular because of its inherent properties such as self-learning, adaptive and real time operation properties. In fuzzy you do not find such properties. In addition, PID performance degrades for non-linear system and changing environment conditions [8]. In this type of peculiar situation, we have used single layer perceptron (SLP) neural network with supervised learning. It will help in removing errors in each and it will maintain the humidity parameters within limits. It will also be notable that it starts self-learning from the surroundings and will decide the best suitable range of humidity. The formula to calculate RH is given in equation (1)

$$RH = \text{The actual amount of water vapour in the air} \times 100 \qquad (1)$$

From the above equation, the problem is formulated with an objective to control the humidity so that it may not influence the Instrument performance. To achieve the objective an idea has been explored in this paper with the use of ANN technique (Single Layer Perceptron with Supervised Learning) controller. Which will help in removing errors produced owing to change in RH level and will maintain the humidity parameters under control.

To accrue the ambience of humidity irregularities in the instruments, we have used RH generators of Belz Instrument Pvt. Ltd. Faridabad (Haryana), India. We established experimental studies and accumulated the analytical data. During experimentation, the instrument performance has been analyzed under distinguished environment conditions. To analyses and to rectify the errors, we have preferred to use NARMA L-2 controller. Because the NARMA L-2 controller has the proficiency to adopt and adjust it-self according to changing environment. Building a neural network is neither as a conventional programming, nor like building an artificial brain. The structure of a network is conceptually very similar to that of a human brain. Figure 1 shows structure of neural network.

Figure-1: Structure of Neural Network
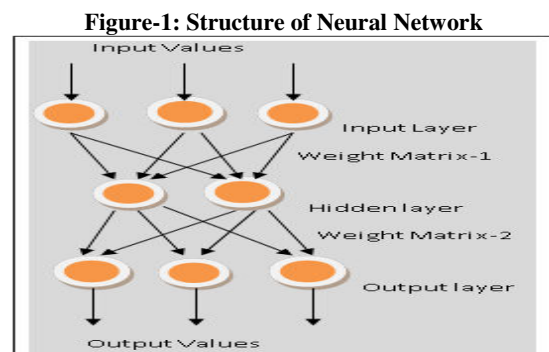
Sources: Authors Compilation

The connections in a neural network have assigned weights, which determine the effect of signals to the neurons. Besides having weights on connections, there is an additional parameter, called bias, which influence the adaptability of a neural network to solve a decision-making problem. Mathematically, the input signal to a neuron is the dot product of the vector of input layer and the weight matrix on the connections into neuron. The result is compared to the threshold value of neuron to determine the output. When the output is greater than the threshold, the neurons will generate/adjust a signal in concordance with the input values. Neurons will not generate/adjust any signal when the output is lesser than the threshold value. To deduce the above condition feed-forward networks have been built to get direct output from one hidden layer. One aspect of building a neural network is determining how one can interconnect several layers of neurons. The input layer receives signals from outside world. This layer typically performs no other functions then buffering the input signals. The output of neural network is generated from the neurons present in the output layer. The output layer in this structure will produce signal passing through highly cumbersome iterations inside the several neurons. Such activities are performed in the hidden layer of the network as shown in figure-1. It is the presence of hidden layer that enables neural network to be able to solve non-linearly separable problems.

IMPLEMENTATION OF ANN

To implement the data in ANN, there are different steps available, gathering data, prepossessing data, building a network, training the network, testing the network etc. Before initiating, the process data has been distinguished between the utility data and the non-utilized data. Then as discussed in section-2, the procured data has been processed. The utilized data has been omitted to target the problem and utilized data has been procured in tabular form. In our work, we have used single layer perceptron (SLP) as shown in figure 2.

The binary equivalent to the decimal number of two digits decimal number will contain seven binary digits, and to accommodate fractional data of two digits, three more binary digits will be required. Therefore, a total of 10 layers will be sufficient to accommodate data.

The neural network is so formed as per the available data: the number of hidden layer is 10, transfer function, weighting/bias learning function and performing function. During the training process, the weights are adjusted in order to make the actual outputs (predicated) close to the target (measured) outputs of the network. The next step is to test the performance of the developed model [9-12].

DATA ANALYSIS

As discussed above the procured data has been separated in two categories; reference data and measured data. In both of these categories, there is a difference in the values relative humidity, for the same value of temperature. These values will be input in the ANN and simulation process will be started. During, process the results will be compared for both the values and if the difference exists after each iteration then the output will be obtained with an error. The next and foremost step is to minimize the error. For successive analysis, a condition will be imposed to curb the error. If this error is small, then the environmental conditions for an instrument are suitable and if the error is large, then the environmental conditions are not suitable. The values of temperature and relative humidity are shown in the **Table-1** below:
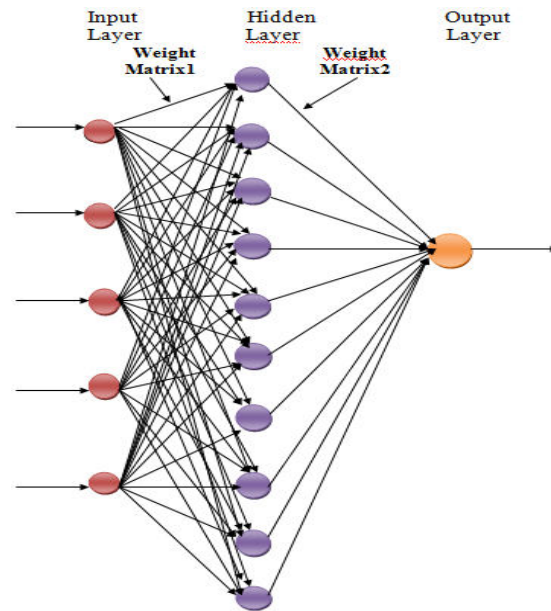
Figure-2: Single Layer Perceptron with 10 Hidden Layers

Sources: Authors Compilation

Table-1: Temperature and Relative Humidity

Temp(^{0}C)	%RH (Ref.)	%RH (Measured)	Temp(^{0}C)	%RH (Ref.)	%RH (Measured)
-10.02	9.8	15.55	20.1	29.8	33.01
-9.98	75.8	76.88	20.1	49.7	53.96
-9.95	28.5	33.48	20.11	79.9	82.02
0.29	10.1	12.17	29.94	10	10.81
0.31	50	51.13	29.97	50.1	55.77
0.32	80	81.54	30.04	94.8	95.48
0.33	95	97.19	39.89	10	10.56
9.98	9.9	14.21	39.98	50.3	51.3
9.99	29.6	33.44	40.01	80.4	81.68
10.02	78.6	79.38	49.88	10.1	14.1
10.17	10	14.04	49.91	30.3	34.07
10.24	94.9	95.92	50.03	80.8	83.52
20	79.4	81.78	50.11	95.8	96.88
20.06	10	12			

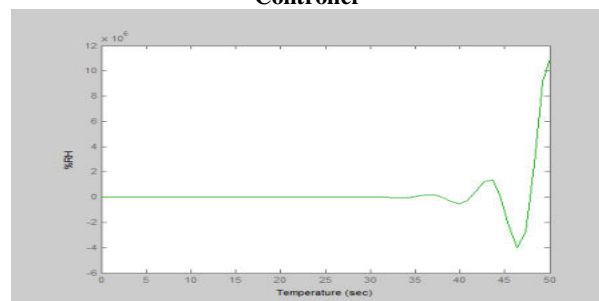**Sources:** Authors Compilation

The data available in **Table**-1 has been simulated for step function without the NARMA L-2 controller. The output results shown in figure 3 are the results obtained after the step response. This can be observed that the output of the results is showing that, with the increase in temperature, the percentage of RH is oscillating with high altitude. Therefore, environmental conditions under these circumstances are not appropriate and suitable for instrument working. Under such abrupt and abnormal conditions, the instruments start producing errors. Ultimately, for prolong usage of instruments under these condition produces permanent errors in measuring instruments. For this season to protect the instrument from numerous errors, the NARMA L-2 controller has been implemented.

**Figure-3: Output response without NARMA L-2 Controller**

Sources: Authors Compilation

In addition, the data has been reanalyzed to observe the output response. In the next section the properties of NARMA L-2 controller has been discussed and it suitability under these conditions has been explained.

NARMA L-2 Controller

The NARMA L-2 controller has been trained for the given data by implementing a plant. When simulation starts, the input source i.e., step block provides a signal, which acts as one of the input signal to NARMA L-2 controller. The output of controller is input to the plant, which is after the controller. Now the plant's output is feedback to NARMA L-2 controller as the other input. Now it becomes a feedback loop. By comparing both the inputs, it generates a signal, which is used to control the plant, and helps in reducing errors. In addition, the final output will be displayed on X (2Y) graph or display. However, if the generated signal is not suitable to control the plant and for removing errors, then this process will be repeated until the suitable signal is obtained.
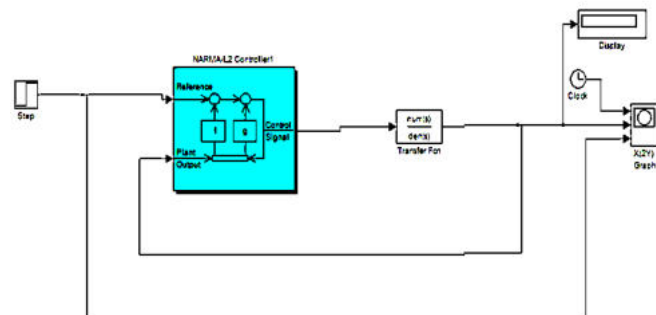
Figure-4: NARMA L-2 Controller [13]
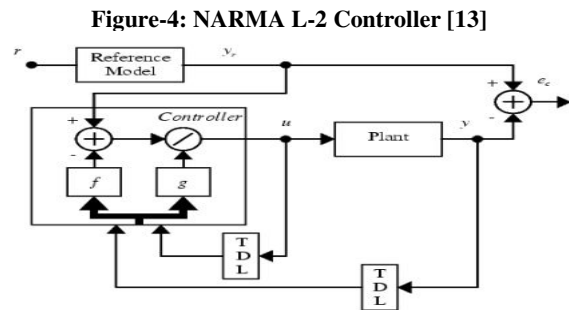
Sources: Authors Compilation

The 'f' and 'g' blocks shown in figure 4 of NARMA L-2 controller are functions of the erstwhile values of both the output and control effort [13]. Thus, the relation between the next value of output and control effort at current step appears linearly. This controller will process the values of temperature and relative humidity simultaneously. In this controller, the feedback is linearized and is so designed that the plant model will work in a companion form. The other feature of NARMA L-2 L-2 controller is also important because it can approximate the value in the same form. The advantage of obtaining simulation results through this type of controller is that it can transfer nonlinear system dynamics into linear dynamics [14-19].

SIMULATION RESULT AND DISCUSSION

The simulation block of humidity generator shown in figure-5 is working with its various components present inside it. The simulation will be initiated through the step function pulse/signal, which will provide a step between two definable levels at a specific time. Now the NARMA L-2 controller is processing the data given in **Table-1**. After processing the dynamics during simulation, the nonlinearities will be cancelled. Now the neural network has been processed representing the companion form system model and demonstrates the nonlinearities free results in figure 6. The processed data now moved to the next block, which is a Laplace domain, based variable. The verification and checking of the block order is done in this block. The

Figure-5: Block Diagram of Humidity Generator using NARMA L-2

Sources: Authors Compilation

block will identify whether the order of denominator is greater than or equal to the numerator or not. The data will pass through when the multiplier of the output system has the same order of denominator and numerator. If there is any mismatching then the simulated data is again feedback to the controller for its again processing.
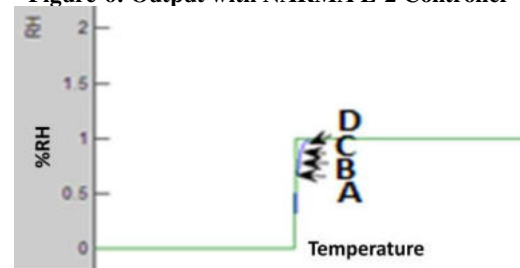
Figure 6 shows the simulation result of humidity generator using NARMA L-2 controller. As discussed in previous section of simulation, the temperature and relative humidity data has been reprocessed. The simulation results shown in figure 6 are quite smooth and steady in comparison with the results shown in figure 3. The output response represented by green line shows input and a slight variation in green line shows the negligibly small error. Here, by using neural network we develop a humidity generator, which controls the humidity by minimizing the error and makes a comfortable environment for an instrument. During the process the iterations of past values to maintain defined output has been processed in 'f' and 'g' blocks. This helps in maintaining the relation between the next value of output and control effort linear.

Figure-6: Output with NARMA L-2 Controller

Sources: Authors Compilation

Another advantage in this controller is observed that it can process the values of temperature and relative humidity simultaneously. In this controller, the feedback is liberalized and is so designed that the plant model will work in a companion form. In this figure the output oscillates from state A to state B, state B to state C and from state C to state D and finally settled at a steady state position. In addition, at point D, disturbance (error) value is reduced to minimal value and after that no variation is observed. Here, it shows the smaller absolute error and the performance of the system is improved. In this way, an instrument can adjust to its changing operational conditions of its own.

Table-2: Modified Relative Humidity

Temp(^{0}C)	%RH (Modified)	Temp(^{0}C)	%RH (Modified)
-10.02	10.8	20.1	30.77
-9.98	76.8	20.1	52.57
-9.95	29.76	20.11	80.19
0.29	10.41	29.94	10.23
0.31	50.59	29.97	52.83
0.32	80.89	30.04	95.39
0.33	95.89	39.89	10.21
9.98	12.84	39.98	51.22
9.99	31.13	40.01	81.22
10.02	78.74	49.88	12.58
10.17	11.99	49.91	31.41
10.24	95.86	50.03	80.95
20	79.62	50.11	96.69
20.06	10.73		

Sources: Authors Compilation

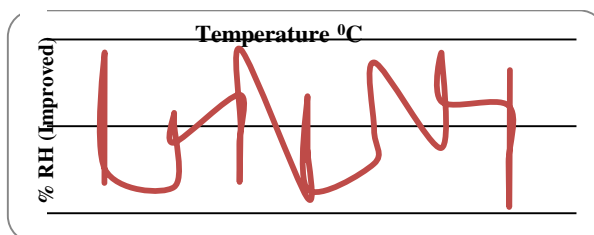**Figure-7: Modified %RH**
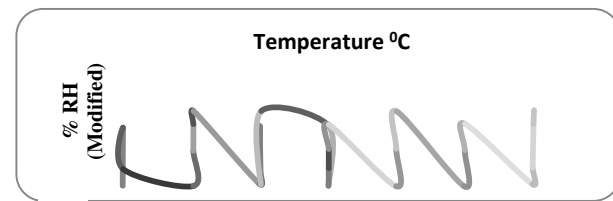
Sources: Authors Compilation

As discussed earlier during the simulation the measured values of % RH given in **Table-1**, will be improved at every iteration. The **Table**-2 shows the modified values of % RH after the completion of simulation. The modification in the values is clearly indicating the improvements in environment and performance of the instruments. Figure-7 depicts the **Table**-2 in graphical form.

Table-3: Comparison of Evaluated Errors

Errors Without Controller	Errors With Controller	% Age of Error Reduction	Errors without Controller	Errors with Controller	% Age of Error Reduction
3.21	0.97	69.78193	1.28	0.82	35.9375
4.26	2.87	32.62911	4.00	2.48	38
2.38	0.22	90.7563	3.77	1.11	70.55703
4.31	2.94	31.78654	2.72	0.15	94.48529
3.84	1.53	60.15625	1.08	0.89	92.59259
0.78	0.14	82.05128	2.00	0.73	63.5
5.75	1.00	82.6087	2.12	0.29	86.32075
4.98	1.26	74.6988	4.04	1.99	50.74257
1.08	1.00	93.51852	1.02	0.96	95.09804
0.81	0.23	71.60494	2.07	0.31	85.02415
5.67	2.73	51.85185	1.13	0.59	47.78761
0.68	0.59	13.23529	1.54	0.89	42.20779
0.56	0.21	98.21429	2.19	0.89	59.36073
1.00	0.92	96			

Sources: Authors Compilation

A comparative study of errors with and without NARMA L-2 controller has been further analyzed. The outcome of both experiments i.e., with and without NARMA L-2 controller and %age of error reduction has been given in **Table**-3. As it is evident from figure 8a of error reduction analysis that on applying controller the errors / abnormalities has been reduced drastically. This is significant here because a slight improvement in RH can make the operating conditions comfortable. The figure 8.b depicts the improvement after error reduction, which clearly indicates that non-linear quantities have been removed 67.06%. Thus, it maintains the steady state linear characteristics of the components employed in the instruments. In this way, the adaptability of instrument to environmental condition improves and stability of the system maintains. It is also evident that during severe atmospheric conditions the instrument failure rate can be reduced.

Figure-8: (a) Error Reduction Analysis   **Figure-8: (b) Percentage of Error Reduction**
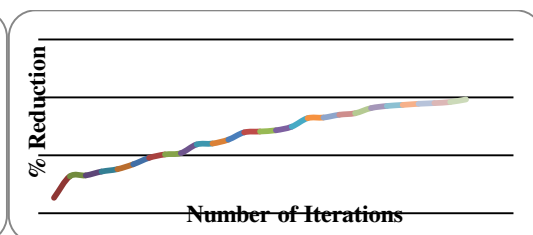
Sources: Authors Compilation

It is evident from the Figure-8b that with the increase in the number of iterations the controller is becoming more and more intelligent. The efficiency and accuracy has also been enhanced which can also clearly be interpreted form the figure. The continuous and rising trend of the curve proves that with more processes and with the passage of time, the ANN controller's inherent property of becoming intelligent increases and overall errors reduces drastically.

CONCLUSION

It can be concluded that the NARMA L-2 controller is a substitute to the proposed control system. The simulation results extracted from ANN is suitable for the deregulation environment. It works for low humidity to high humidity; low temperature to high temperature maintaining humidity at a control level. This controller has processed two values i.e. temperature and relative humidity simultaneously. Thereafter it converts all nonlinear quantities into linear quantities. The controller results in this research predict the operating instruments accuracy can be maintained optimal operating condition by controlling environmental conditions i.e. relative humidity and temperature. It is also predicted that these techniques are easily employable and its accuracy is high.

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WEB BASED TECHNO ECONOMIC MODEL FOR EMPOWERING RURAL REGIONS AND PEOPLES OF RURAL INDIA

Ruchir Saxena[29]

ABSTRACT

Rural Sector that produces 17% of GDP and employs 53% of the labourforce in India. However, the conventional rural business structure contributes very low-income capability, which leads the rural population to live below poverty line. Therefore, we introduce an e-application system, which can provide real time information, personalized knowledge, machinery to enhance productivity and platform to do trading directly without interfering mediatory. The model is customized from e-commerce framework for rural agriculture sector, which works in two ways; reshaping and restructuring of production and market structure. Application has different section Trade exchange platform, Social networking & multimedia, KBIS, SCM, Rural E-Information System etc, which contributes towards empowerment.

KEYWORDS

Rural Sector, Techno Economic Model, Rural Regions, Information System etc.

INTRODUCTION

India is a country of villages. Villages are the units of rural society and the centre of culture. Definition of rural area (by Planning Commission, Insurance Regulatory Development Association IRDA) [1]:

"THAT WHICH IS NOT URBAN"

- Population of less than 5000.
- At least 75% of the male workforce engaged in agriculture activities.
- Absence of a municipality / corporation.
- Density of population is less than 400 per sq/km.

The heart of Gandhi's vision was "Swadeshi" which does not mean wearing khadi and spinning wheel, which means local self-reliance on the village to rejuvenate rural India and ecommerce may be fuel to force this dream.

India's economy grew at an annual rate of 5.3% in the quarter-ended march 2012.

Table-1: GDP per quarter in FY08-12

	Quarter 4	Quarter 3	Quarter 2	Quarter 1
FY 12	5.3	6.1	6.7	8
FY 11	9.2	8.2	7.6	8.5
FY 10	8.6	6.5	8.6	6
FY 09	5.8	6.1	7.5	7.8
FY 08	8.8	8.8	9.3	9.2

Sources: www.financeconcept.com/2012/05/most-of-factors-that-lead-to-indias.html?m=1

The Gross Domestic Product (GDP) in India expanded 1.30 percent in the fourth quarter of 2012 over the previous quarter. GDP Growth Rate in India is reported by the OECD. Historically, from 1996 until 2012, India GDP Growth Rate averaged 1.63 Percent reaching an all time high of 5.80 Percent in December of 2003 and a record low of -1.70 Percent in March of 2009.

In India, the growth rate in GDP measures the change in the seasonally adjusted value of the goods and services produced by the Indian economy during the quarter. India is the world's tenth largest economy and the second most populous. The most important and the fastest growing sector of Indian economy are services.

The contribution of agriculture in GDP has dropped approx 5% in last 8 year to 14 percent.

Minister of state for agriculture Mr. Tariq Anwar said, "Further as per the advance estimates released by CSO on February 7, 2013 contribution of agriculture to the GDP is likely decline to 13.7 percent in 2012-2013" he added [2].

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Graph-1: Contribution of Agriculture Industries & Service towards GDP in Year 2011
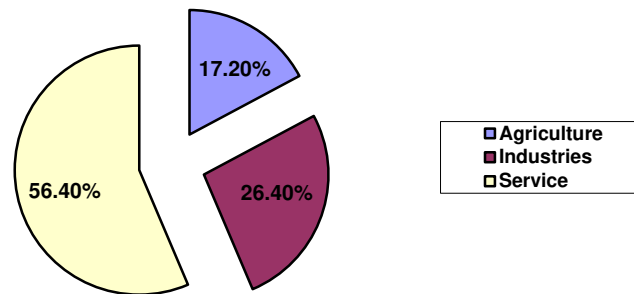
Sources: Authors Compilation

In 2011, agriculture sector contributes 17.2%, industries shares 26.4% and service sector holds 56.4% in total GDP. Contributing of agriculture sector in GDP is decreasing continuously, but still a crucial part of economy. In 2011, 53% labour force of the total worked in agriculture sector including 19% and 28% in industry and service respectively [3]. The data shows that the service & industry sector productive more than the agriculture. Therefore, the growth of agriculture sector is an important job towards economic & social growth of India. Therefore, strong decisions and actions required from policy builders to develop a solid foundation for highly productive, internationally competitive and diversified agriculture sector.

There are several challenges to rural sector discussed by World Bank site, CDRI, IFPRI [4]

1. Slow down in agriculture and Rural Non Farm Growth - Some of the factors hampering the revival of growth:
    a. Poor composition of public expenditure,
    b. Over regulation of domestic agriculture trade has increased cost, price, risk & uncertainty, under mining the sector's competitiveness,
    c. Inadequate infrastructure & services in rural area,
    d. Despite large expenditure in rural development, a highly centralized bureaucracy with low accountability and inefficient use of public funds limit their impact on rural growth.
2. Difficult to engage extension agencies or private institutions in technology enhancement to increase productivity.
3. Ineffective management of rural risks factors, expansion plans slow down the growth and export.
4. Improper data and information platform.

INDEFENSIBLE SITUATION

Rural India brings into a mind a huge heterogeneous entity, which is synonymous with extreme poverty, agriculture laborers who often plough hard in the sun-emaciated bullocks to earn skimpy incomes that hardly make their ends meet and so on. In short, they are the wagers not entrepreneurs.

Rural people have weak bargaining power & dependency on intermediary's traders without other marketing choice. Rural industries completely depend on these mediators for sale or purchase. Because of these mediators the artisans, farmers etc., having great potential in various arts in rural areas, become wagers not an entrepreneur.

Minimum access to real time information is a biggest hurdle in rural growth. Therefore, the mediators can take advantage by setting a minimum price for the commodities. In industry-dominated markets, the input price is usually high. Because of high cost and low commodity price artisans, farmers loosing grip in market place by little earning power.

E-COMMERCE SUCCESS METER

The success of e-commerce as a revolutionary concept depends; therefore, on what different ways we can apply the simple principle of the digital world to real life and process of governance. The mandate of any e-commerce application is to provide a set of services in an efficient, convenient, equitable and cost effective manner to ensure the welfare and well-being of its users and to facilitate the growth of the economic activities. An epithet that has gained popularity in this context is SMART e-commerce [5]; Simple, Moral, Accountable, Responsive & Transparent. SMART capture all the important attributes of good e-governance. *Simple* would mean simplicity of process & procedure accessibility. The 'S' in SMART is perhaps the toughest because it is Simple to be Difficult but it is Difficult to be Simple.

The word Moral in SMART connotes emergence of an entirely new system of ethical values in the political & administrative machinery.

Who is *Accountable* to whom and in what way?

Responsiveness: in the context of good governance, means to be alive to the needs. It includes quality of service and its timeliness. *Transparency* brings with it a few other virtues into the public life-equity, a level playing field, the rule of law, rationalization of systems especially in areas award of public work, social benefits.

The direct and indirect cost in the conventional way is far higher than in case of electronic delivery.

There will be significant steps towards development and empowering of rural business, which can be seen through e-commerce success indicators such as [6]:

- Low cost of accessing and obtaining knowledge that leads to timely, accurate and reliable information.
- Changing their scheme and plan according to price prediction and market demand for more profit.
- Low transaction cost by slicing the procurement cost and lower price for input supply.
- Higher yield with enhance productivity and quality output.
- Higher income related to faster processing time, prompt payment and higher profit margin.
- Larger investment and creating business opportunities, identity and branding.

*E-COMMERCE APPLICATION MODEL*

Framework

The application model in this study is based on the e-commerce framework for rural agriculture sector [7] [8], as in the figure which emphasis on two directions:

1. Re-Constitute Market Orientation:
   a. Alternate Trade Exchange Platform
   b. Quality Input Supply

2. Reshape the rural production:
   a. Promoting New Techniques & Services
   b. Higher Information Exchange

Framework is supported by two factors *Rural Intelligent Information Centre and Expert View*.

Good manufacturing practice and food safety methods in the framework will improve international market access.

Chart-1: E-Commerce Framework for Rural Agriculture Sector
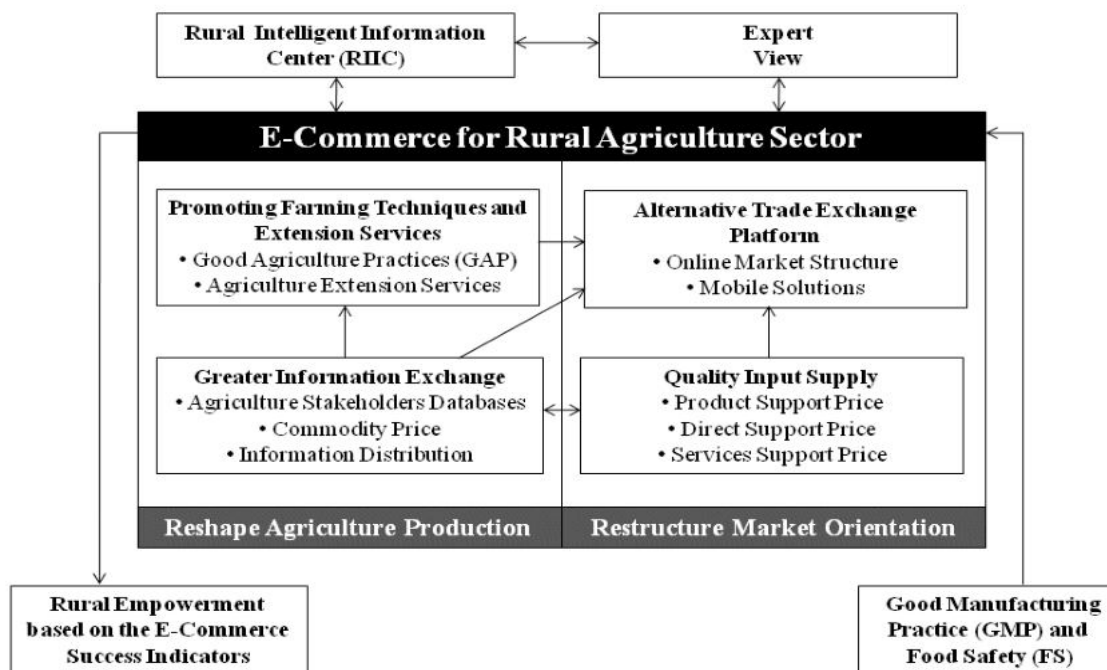
Sources: Adapted from "E-Commerce Framework to Improve Rural Agriculture Sector in Cambodia" (2011).
E-Commerce Model

This model has six components, which indicate the success aspects discussed earlier. These factors are important in developing the functional modules, integrating experts knowledge, and provide infrastructure & technology to implement e-commerce application system in rural.

Trade Exchange Platform i.e. Gateway: Shopping Cart, Payment Gateway, product or commodity portfolio, providing online market structure, providing new solution using mobile techniques.

*Social Networking and Multimedia: W*e can use social networking to communicate and disseminate information widely and rapidly and make the most of animation tools to promote new techniques and services.

KBIS: Knowledge Based Information System can provide expert view on related matters; can also provide suggestions and techniques of R & D on subject matters.

Supply Chain Management: It is a key to success in Indian rural markets. It can provide quality input to gateway. Contributing to improved relationship with suppliers & customers and generation of income, improving competitiveness by reducing uncertainty, improves services.

Search Engine for Real Time Information: No delay in information i.e. the information will be in time whenever and wherever it is needed.

Rural E-Information System: Installing the tools and networking to access e-commerce application system in rural areas.

Chart-2: E-Model for Rural Division
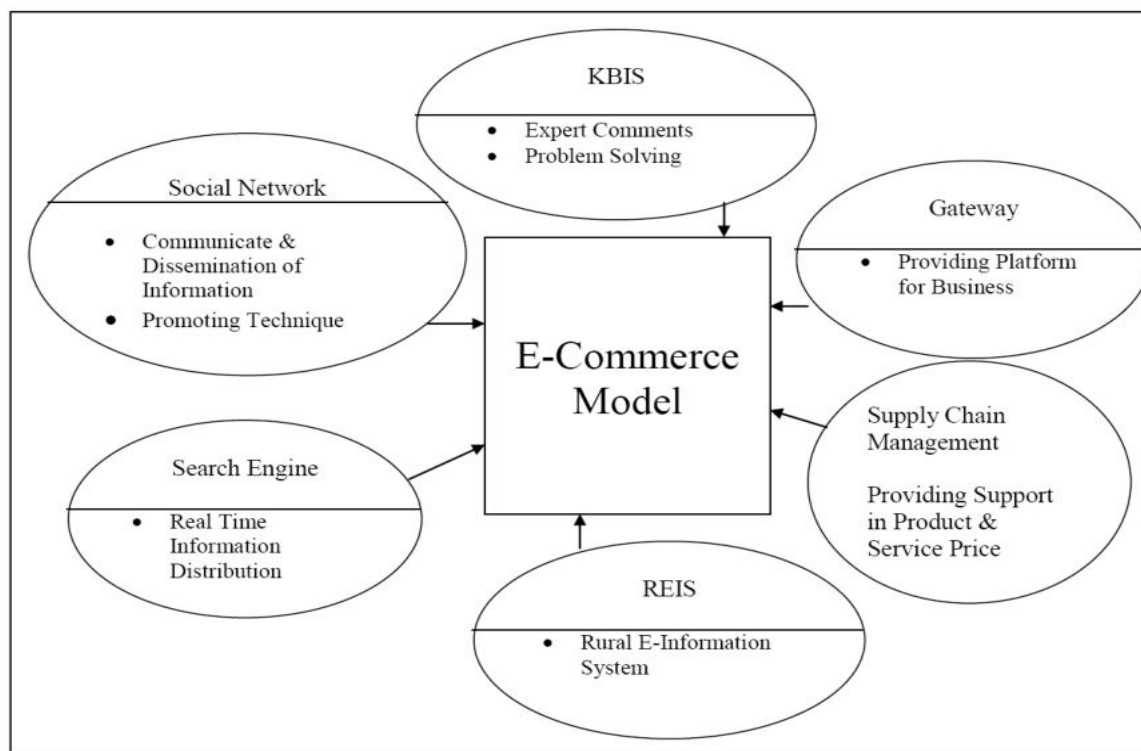
Sources: Authors Compilation

E-Commerce Application System: The model must be implemented into the working application and tested to estimate the success factors on the way to empower the rural areas.

The e-application should be designed based on user centric values that focus on the target client characteristics and behavior, works and methods, their expectation and capabilities.

Four design principles in the development of e-commerce application are [9]:
Local User Need: First principle is to know the need of the local user. Know the proper content, which is going to be implemented. Prepare the functionality of the system.

Dialogue and Personalization: Network building and enhancing relationship with users through the performance of information.

Sophisticated System: System will be user friendly, ease to use effective.

Lowest common denominator: As per the conditions and availability of things in rural area, the application should be minimum infrastructure and internet connectivity requirements.

Chart-3: N layer Application of Ecommerce for Rural Area
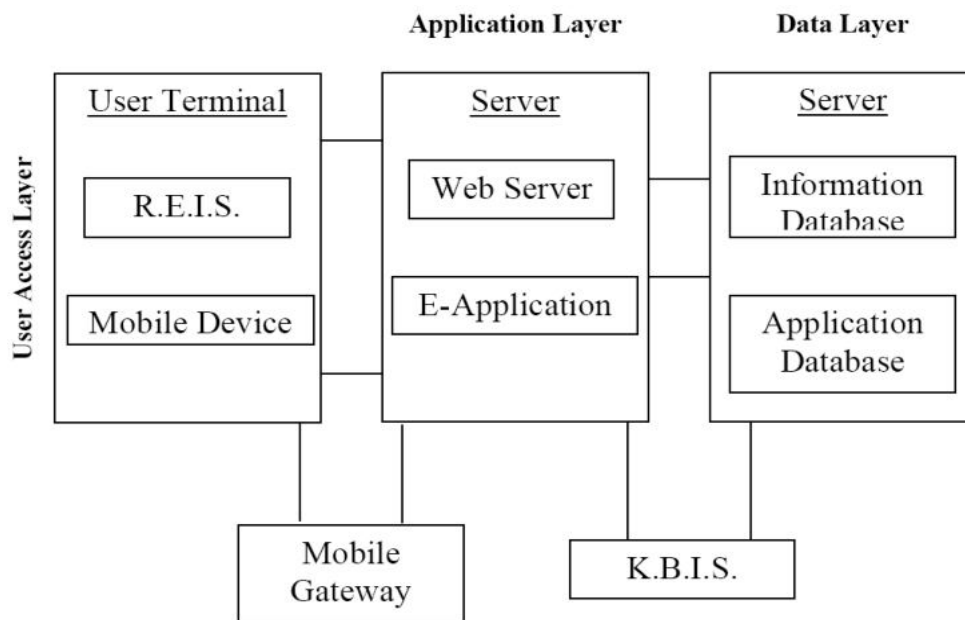
Sources: Authors Compilation

It is an N layer solution based on database, which is centralized, and application serve, which is connected to client terminals. An open source web development tools will be used to design server-side functions and open source database will used to maintain and create relation database.

Many animation and multimedia functionalities will be used to create client interface in association with HTML, XML, CSS, and JavaScript. Mobile Gateway can better enable the rural empowerment. Every second person has a mobile phone. The SMS and MMS gateway allows to share information rapidly and at grassroots level. They will receive alerts for offers to buy or sell. They will access real time prices.

The motive of REIS is to provide connectivity to the KBIS for expert views through this application. Based on earlier studies the better place to implement REIS is the house of the leaders. Therefore, the peoples can follow these applications.

Promotional Approach

It is important to know how to introduce e-commerce application and technologies to target users; farmers, buyers etc. The introductory approach for e-application system can be in different steps:

- From capacity building,
- By amplifying awareness of e-commerce,
- Teaching benefits of e-application system back to the community,
- By creating training teams, which will educate regarding benefits of e-application system to communities?

Word of mouth is a good carrier of messages in rural sector and the leaders can play an important role in implementing e-application system. Training teams consist of these rural leaders, NGO particularly working in rural empowerment etc.

CONCLUSION

In conclusion, the study says that the implementation of the proposed model has the ability to enhance good, ethical business activities and hence improve the economic conditions of the beneficiaries, which can result in a good contribution of rural sector towards Indian economy.

The model has the capability to improve market access. Model can provide a simple structure to get real time information.

The proposed study is unique in the sense that it will build a network of income generating activities carried by rural community. The strength of the study lies in its huge pool of resources to be made available on rural sector. The beauty of the study lies in providing a focused e-model only dedicated to rural region.

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TECHNOLOGY BASED TRANSFORMATIONS IN ORGANIZATIONAL INTERNAL COMMUNICATION

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ABSTRACT

The study considers impact of training on internal organizational communications as an important organizational factor that has an impact on employee's command on the internal communication tools. It incorporates three dimension i.e. communication climate, formal and informal communications. In the study the data was collected, to measure the impact of training on the above three dimensions of organizational communications, especially from the employees of Commercial bank of Ethiopia, Ethiopian insurance company and Tele-corporation of Ethiopia.

The results clearly indicate that there is significant impact of training on all dimensions of communications. 62% employees responded that they are not facilitated with the refresher course and training to cope up with technical changes in organizational work culture and communication. Employees wish to be technology savvy but they are not getting the basic awareness training for such changes. However, sufficient tools and technologies are already there in the organizations. It is also observed that 38% employees having training and they are utilizing the technological tools effectively and perform their communication tasks efficiently and effectively.

KEYWORDS

Organizational Communication, Technology Tools, Internal Communication, Technology Savvy etc.

INTRODUCTION

Communication is the key to bring people together at one place to make it a workplace. A workplace is formed when people work together for a specific purpose and that work is impossible without having communication among working people. Such type of communication is known as organizational communication, and refers to communications and interactions among organizational members: managers and non-managerial employees. As a result, convenience and availability, considerations have led to new technologies in audiovisual data transfer becoming increasingly attractive to the employees and potential clients. The organizational communication is crucial to get involved into better relationships within an organization, to transmit information, to have trust on and cooperation with each other, to understand and co-ordinate the work, to improve communication climate and learning, and hence to increase overall workplace satisfaction. The organizational communication may be mostly effective or it can be mainly ineffective, and can definitely affect employee internal communication.

The development of new information and communication technologies has made an impact on the field of organizations communication among employees. New tools have made borderless communication possible. They facilitate human interaction more speedy with the cost effective manner. However, at the same time create new challenges for employees if they do not have proper training and command over the software. Over the last few years the use of new types of tools are introduce for the smooth communication among the employees (internal communication) and outside world (External Communication). New technical, information and communication technologies and the workforce changes associated with them can support and drive innovative work practice, improve care processes, and affect efficiency and productivity. There are also positive impacts as well as challenges for staff, including the need for enhanced training.

Introducing new technologies does not guarantee positive outcomes. Simultaneous developments in leadership, financial resources, personal and organizational relationships, engagement with patients and families, care coordination and staff development are needed. There is also a need to consider how the workforce needs to develop to gain most potential from new technologies. The most important question to address may not be how are staffs currently being reorganized in the wake of new technologies, but rather how should staff best be deployed to take full advantage of the potential available.

REVIEW OF LITERATURE

Today, organizational communication is more complex due to communication media and high-speed transmission. Organizational communication is a dynamic process and involves complex communication techniques, networks and channels. It does not involve only upward and downward communication, but managers and employees communicate with each other in various ways at different levels. It may be the formal or informal, verbal or non-verbal, written or oral; and its levels include interpersonal (or face to face)-level communication between individuals, group-level communication among teams, groups and units, and organizational-level communications involves vision and mission, policies, new initiatives, and organizational Knowledge and performance. All the directions and flows of organizational communications are combined into a variety of patterns called

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communication networks. Communication plays a vital role in designing rules, regulations and responsibilities, and presenting to the members of the organization. Kreps (1990) states that, "communication in an organization serves to establish managerial control, provide workers with job instruction, and enable managers gather information for planning." It shows that communication is involved in all types of managerial functions. Mangers and communication specialists first develop strategies to achieve goals, construct relevant massages and then transmit through different channels for conversations with employees and workers. Poor planning may be the result of poor communication and it always results in the failure of the accomplishment of the goals, which becomes the reason for dissatisfaction at workplace. Similarly, if employees are not told about organizational strategies and their responsibilities, they cannot perform effectively. Employees need to understand and coordinate their work activities; but if information is poorly communicated to them or they lack to communicate themselves, they cannot understand the task, which leads to the confusion and to the job not being done or not completed properly. Therefore, poor communication decreases their communication with the work.

As people work together, they develop some important formal and informal relationships with each other. All people are of different personalities and natures, their thinking, perception, and viewpoints are different. They cannot understand each other until and unless they effectively communicate. According to Jim Lukazewski (2006), "The greatest continuing area of weakness in management practice is the human dimension. In good times or bad, there seems to be little real understanding of the relationships between managers, among employees, and interactions between the two. When there are problems, everyone acknowledges that the cause often is a communication problem. People want open communication channels and a system of common understanding.

Easterby-Smith et al. (1999, p.3-8) divides the literature on OL into two significant distinctions between OL school of thoughts. One follows the social view while the other follows the technical view:

Social Perspective: Easterby-Smith et al. (1999, p.3-8) explain that social perspective emphasizes on how people make senses of experiences at work obtained either through explicit sources or tacit sources. In this view, learning can be seen as a process of social interactions. Three dominating schools of thoughts contributed largely to the social perspective of organizational learning are to see it as a socially contracted, a political process and a cultural artifact.

Technical Perspective: The technical view assumes that organizational learning is about the effective processing, interpretation of, and response to information both inside and outside the organization. Such information can be in both qualitative and quantitative term but it is explicit in public domains. Technical perspective covers the concept of Argyris & Schon (1978)'s single-loop learning and double-loop learning. Single-loop learning (SLL) is an incremental and low-level learning, which occurs when errors in processes are detected and corrected encouraging the firms to continue with their current policies and goals. Whereas, Double-loop learning (DLL) is a radical and high-level learning, which occurs when error is, detected and corrected in the way that forces the firm to modify its norms, procedures, policies and goals? Further, Levinthal & March (1993)'s research lies in this perspective and discuss that OL copes with the problem of balancing the competing goals of developing new knowledge (exploration) and exploiting current competencies (exploitation) in the face of dynamic tendencies to emphasize one or another.

THRUST AREA AND OBJECTIVE OF THE STUDY

The sole objective of this research is focused on the impact of technology training on communication tools to support managerial activities for phenomenon success in effective internal communication. To achieve goal the specific objectives were formulated. Further the research paper focused on to achieve the following- Identification and assessment of existing communication infrastructure in the organizations, Evaluation of effective utilization and deployment of communication tools and technologies, analysis of internal communication technological usage and deployment in the organization and finally Critical analysis and evaluation of impact of technology training and awareness facilities in transforming the organization's internal communication culture.

RESEARCH METHODOLOGY

The research methodology includes both qualitative and quantitative research methodologies through surveys of the existing systems used in the industry and literature reviews of published work related to the topic. Data required for the research were collected from various governmental organizations, observation, and secondary data collection. The proposed systems performance has been tested by various data sets to achieve optimal solutions.

The data for the study were collected from employees / associates of three service sector organizations at Ethiopia; Commercial Bank of Ethiopia, Ethiopian Telecommunications Corporation and Ethiopian Insurance Corporation. The sample frame comprises 97 employees from the above organizations. A sample size of 50 employees/associates was collected at randomly. The collected data from the three major organizations in Ethiopia were collected, coded and entered for analysis purpose through SPSS16 (a statistics tool). SPSS16 were used to analyze the collected data. The analyzed parts were presented in data analysis and interpretation with the use of table and percentage. In addition, the researcher presented the data graphs of all tabulated table to get clear insight of the data for the interpretation.

RESULTS AND DISCUSSIONS

Majority of the respondents are male that is 70%. Maximum of the respondents are in the age group of 20-30 that is counted as 58% and the work experience of the respondent's frequency falls in the category of 6-10 years that is 38%.

Educational Background & Job Category of Respondents

Graph-1

EDUCATIONAL BACKGROUND OF THE RESPONDENT
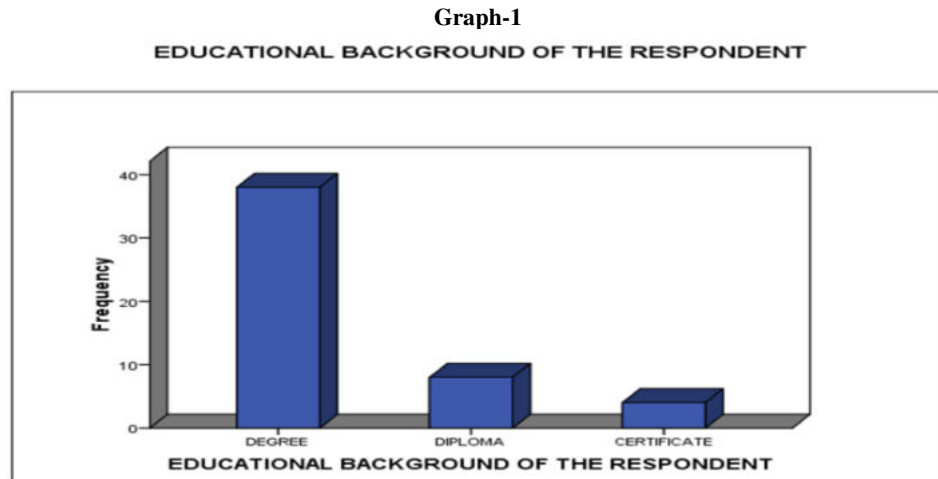
Sources: Primary Data

The 76% of the respondents are having degree. 16% of the respondents are having diploma and 8% of the respondents are having certificate as their educational background. The majority of the respondent is having degree and certificate holders are in the minority.

Table-1: Job Category of Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Manager	8	16.0	16.0	16.0
Assistant Manager	6	12.0	12.0	28.0
Accountant	5	10.0	10.0	38.0
Clerk	14	28.0	28.0	66.0
Customer Service	11	22.0	22.0	88.0
Supervisor	6	12.0	12.0	100.0
Total	50	100.0	100.0	

Sources: Primary Data

The respondents consists of 16% Managers, 12% Assistant Manager, 10% accountants, 28 % Clerks, 22% Customer Service and 12% are Supervisors. The majority of the respondents are clerks and customer service executives, minorities of the respondents are accountants, and the average frequency is in the category of managers, assistant manager and supervisors.

All the respondents with irrespective of the job categories are having the awareness of the communication technology. 100% of the respondents are aware of the communication technology used for the internal communication.

Technology is Helpful for Effective Communication

Table-2: Technology is Helpful for Effective Communication

	Frequency	Percent	Valid Percent	Cumulative Percent
YES	50	100.0	100.0	100.0

Sources: Primary Data

The entire respondents believe that technology is helpful for the effective communication. 100% of the respondent irrespective of their job categories accepts that technology is very much helpful for the effective communication.

Respondents Frequency of Using Communication Technology

Table-3

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Daily	36	72.0	72.0	72.0
Rarely	4	8.0	8.0	80.0
Once In A Week	7	14.0	14.0	94.0
Sometimes When Need Arises	3	6.0	6.0	100.0
Total	50	100.0	100.0	

Sources: Primary Data

72% of the respondents use communication daily, 14% of the respondents use technology once in a week, 8% of the respondents use rarely and 6% respondents use it sometimes when need arises. Here data indicates that maximum respondent use the communication daily or once in a week and 14% of the respondents use the technology rarely or sometimes when need arises.

Table-4: Job Category of Respondent * Respondent Frequency of Using Technology
Cross tabulation

			Respondent Frequency of Using Technology				
			Daily	**Rarely**	**Once in A Week**	**Sometimes when Need Arises**	**Total**
Job Category of the Respondent	**Manager**	Count	8	0	0	0	8
		%	100.0%	.0%	.0%	.0%	100.0%
	Assistant Manager	Count	5	0	0	1	6
		%	83.3%	.0%	.0%	16.7%	100.0%
	Accountant	Count	4	0	0	1	5
		%	80.0%	.0%	.0%	20.0%	100.0%
	Clerk	Count	13	0	1	0	14
		%	92.9%	.0%	7.1%	.0%	100.0%
	Customer Service	Count	6	1	3	1	11
		%	54.5%	9.1%	27.3%	9.1%	100.0%
	Supervisor	Count	0	3	3	0	6
		%	.0%	50.0%	50.0%	.0%	100.0%
Total		Count	36	4	7	3	50
		%	72.0%	8.0%	14.0%	6.0%	100.0%

Sources: Primary Data

In order to find out which job category uses the most frequently technology, a cross tabulation was used 100% managers use communication technology daily, among the Assistant managers of the organizations 83.3% uses the technology daily and 16.7% use sometimes when need arises. Among the accountants 80% use technology daily for communication and 20% uses sometimes when there is a need. Among the clerks, 92.9% use daily, 7.1% use once in a week. It is observed that 54% of the customer service, 9.1%, 27.3% uses once in a week and 9.1% uses communication technology when need arises. 50% of the supervisors rarely use the communication technology and 50% of them uses once in a week.

The above cross tabulation shows that the use of the communication technology is maximum at the job category of managers, assistant managers, accountants and clerks, responses is distributed among the customer service executive, which is medium and least used at the supervisor levels.

Purpose of Using Technology

Only 16% respondents use communication technology to communicate with colleagues for their official work, which is the least purpose of using technology among the employees. 24% of respondent use to take the information and upgrade their knowledge. 18% use technology to have access with social sites. The majority of the respondents use the technology to communicate with friend for other purposes. Communicating with friends has maximum frequency of 42% among the respondents.

Graph-2
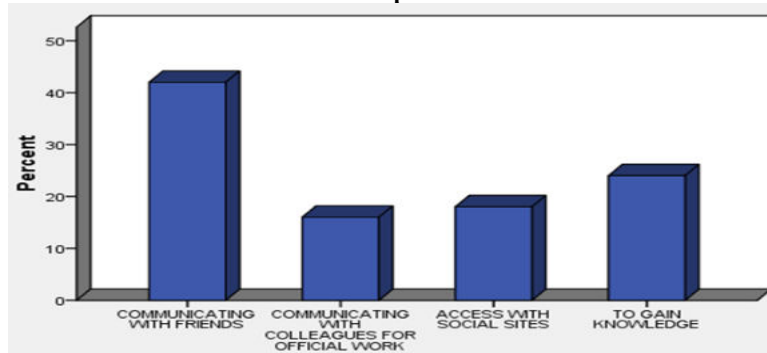
Sources: Primary Data

Technology is used for Internal Communication Widely

Table-5

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Disagree	4	8.0	8.0	8.0
Disagree	21	42.0	42.0	50.0
Agree	18	36.0	36.0	86.0
Strongly Agree	7	14.0	14.0	100.0
Total	50	100.0	100.0	

Sources: Primary Data

42% of respondents are disagree with the statement and 8% of respondents are strongly disagree that technology is used widely for internal communication, whereas 14% respondents strongly agrees with the usage of technology in the their organizations.

Employees Has Necessary Skills to use Technology

Table-6

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Disagree	36	72.0	72.0	72.0
Neither Agree nor Disagree	2	4.0	4.0	76.0
Agree	10	20.0	20.0	96.0
Strongly Agree	2	4.0	4.0	100.0
Total	50	100.0	100.0	

Sources: Primary Data

According to 72% respondents there is no necessary skill with the employees of the organization to use the communication technology, and minority of the respondents (20%) belief that organizational employees is having necessary skill to use the technology.

Up gradation or Adopt the Technology with Growing Demand and Competition

Table-7

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Disagree	32	64.0	64.0	64.0
Neither Agree nor Disagree	2	4.0	4.0	68.0
Agree	14	28.0	28.0	96.0
Strongly Agree	2	4.0	4.0	100.0
Total	50	100.0	100.0	

Sources: Primary Data

The majority of the respondents (64%) are disagree with the statement that organization upgrade or adopt the technology with the demand and competition. Respondent agree with statements are 28% and 4% of the respondents are strongly agree that there is willingness of the organization to upgrade or adopt the technology.

Employees are Facilitated with Refresher Courses and Training for Adoption of New Technology

Table-8

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Disagree	31	62.0	62.0	62.0
Agree	19	38.0	38.0	100.0
Total	50	100.0	100.0	

Sources: Primary Data

The respondents views are falling in two categories disagree and agree. Employees response shows that majority of the responses 62% are disagree with facilities of courses and training programme when new technology is upgraded or adopted. 38% of the responses show there is facilities provided refresher courses and training programs.

Employees Receives all Professional Information Necessary to perform their Professional Tasks

Table-9

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Disagree	29	58.0	58.0	58.0
Neither Agree Nor Disagree	10	20.0	20.0	78.0
Agree	10	20.0	20.0	98.0
Strongly Agree	1	2.0	2.0	100.0
Total	50	100.0	100.0	

Sources: Primary Data

58% of responses show that employees do not receive professional information, which is necessary to perform the professional tasks. 20% of response shows that employees receive the necessary to perform their professional tasks through the communication technology.

CONCLUSIONS

Employees are aware but not skilled in communication technologies and it is responded. Among the respondents, it is accepted that use of technology may transform the traditional internal communication culture to technology based communication culture. Study point out that the usage of the communication technology tools and techniques for interpersonal communication is not effective. Although the organizations are having technological tools like internet, intranet, desktops and other handheld devices at different level of management, but they are not frequently used for internal communication amongst all levels of the management. The most common reason behind is the staff i.e. they do not have techno-communication skills. Another reason is disinclination of the organization to adopt or upgrade the latest tools and technology for communication.

Observations justifies that employees do not receive any information, which is necessary to perform their professional task through communication technology. Further, the awareness of the technology is there among all the employees but technology is used in the limited levels at managers and assistant managers only. Other job categories are not much familiar with use of technology for interpersonal communication. Employees use the communication technology for other than communication purposes. Factors that affect the technological communication climate are the employees not having the necessary skills and motivation to use such tools and technology. Another reason is disinclination of the organization to adopt or upgrade the latest tools and technology for communication.

Based on this analysis it is clearly observed that appropriate IT infrastructure with other supporting modern tools and technologies already exist in the organizations but lack of awareness and improper training processes are not allowing them to harness their full potential towards new paradigm shift in communication climate. Today we are living the world where anytime, anywhere via any device culture has already been adopted. Regardless of specialized high-end training to employees; they may use their mobile devices to turn "anytime, anywhere via any device" culture into reality.

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CRITICAL ANALYSIS OF MANAGEMENT INFORMATION SYSTEM OF SELECTED INDIAN MICROFINANCE INSTITUTIONS

Abhishek Behl[32]

ABSTRACT

With the advent of technology, banking sector has grown in terms of profit. Peeping into the reasons of the same, we would find various factors but core-banking solutions have given an entire new face to banking and financial sector. Management information system (MIS) laid a strong foundation on which any institution dealing with finance as a department relies on. Expansion of business, serving their existing client base, adding new customers to their family and to generate an aura of competition amongst the market are some of the key reasons firms across globe are using MIS systems. Microfinance sector needs MIS for gearing up economic stability, increasing performances and manage flow of funds because a high outflow of funds might fluctuate the economics of loan disbursement. This gives an idea and an area of research on MIS systems in Microfinance institutions (MFI).

This research paper focuses on various MIS systems available in the market. It focuses on the current structure of MIS systems in MF sector and research on the existing scenario of competition with respect to various vendors offering similar services. The findings of the research indicate that currently there is diversity in the services and packages offered by vendors and there is a need to build up common software for all the microfinance institutions to bring in uniformity. Core banking solution has evolved in the area of banking and software giants like Infosys and TCS to bring in a uniform standard have offered the support.

KEYWORDS

Microfinance, Microfinance Institutions, Management Information System, Software, Technology etc.

INTRODUCTION

Microfinance services as defined by Microfinance Services Regulation Bill "providing financial assistance to an individual or an eligible client, either directly or through a group mechanism" The importance of this sector can be judged by the fact that this basket has people winning Nobel Prize. With the tremendous amount of efforts laid by Prof. Yunus in Bangladesh, South Asia became a hub for research and advancements in microfinance. Studies have depicted that there are more than 12,000 microfinance institutions having close to 700 million active borrowers. There are still over 5 billion in the unbanked sector, which thereby forms a huge chunk of people.

When compared to banks it is seen that because of high transaction of money by a large number of people the overall operations costs come down. (Ashta, 2009) Bankers were unable to offer loans with low amount and a relatively high operations cost to the people. The issues further piled up when the problem of fulfilling Know your customer (KYC) norms were not fulfilled. The customers under this head were mostly new to this system of saving money or getting a loan from a certified institution.

Absence of proper information, credit history and lack of collateral became the dependent variables for increased risk. Lending at higher rates was the only option to solve a problem for which group lending was a probable solution. This idea of group lending led to weekly repayments of amounts to have a uniform track of payments (Yunus, 2003). Various models were formed with the idea revolving around group lending by various firms like BRAC, Accion, and FINCA etc.

Once the models were made, many third party products were also introduced to the poor out of whom insurance is one of the most successful of all. Many MFI are converting themselves into banks or finding loopholes to be able to accept deposits either from public or through clients/borrowers (Ashta, 2011).

Out of the existing MFIs, less than 200 are profitable (Ashta, 2011). The transaction size of the loan is small which thereby decreases the profit margin of these MFI's (Rosenberg, Gonzalez & Narain, 2009). Technology will have to play a major role in solving this problem. Although innovation has, kick started the thoughts of existing players to enter microfinance yet this research focuses on how a sector of technology can play a vital role in changing the face of microfinance in any country.

REVIEW OF LITERATURE

Management Information System (MIS) is one of the key to any organization. Once any organization has laid its principles, values and has defined how are they looking forward to gain profit, MIS systems becomes an integral part of the decision making

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process. For any strategic decisions to be made by the firm, MIS are always referred (Edstrom, 1973). MIS therefore is a tool, which can shape any raw values into meaningful and readily used data.

Earlier studies show that a better and efficient implementation of MIS leads to low risk levels and better decisions. (Baura et al.,1991). Information Technology as a sector whether outsourced or developed in house is a necessity for modern era and is required for the success of any institution (Clemons & Row, 1991).

Recent studies in Microfinance sector indicate that in order to implement a better, efficient MIS in microfinance arena, we need to understand the basic requirements of the sector. In addition to the basic requirements previous researches (Iyenger, Quadri & Singh, 2010) has also shown that IT support and Standardization are equally important if microfinance models have to compete with the existing models of bank. Due to lack of proper legal documents and laws in place, financial institutions are not categorized. This has also led to downscaling of banks. Banks have even opened subsidiaries to take care of microfinance and generate profits keeping them under the tag of Non Profit organizations (Iyenger et all, 2010).

As microfinance deals with below poverty line people, capturing data through business correspondents (BC's) and Business Facilitators (BF's) are difficult. Census database depicts that India with a literacy rate of approx 74% has its 80% illiterate population in the villages falls below poverty line bracket. Thus, centralization in MF is not linked to become conservative (Tavakolian, 1989) but due to a major part of illiterate decentralized users.

Secondly, the problem of infrastructure in rural areas is also a major area of concern. Any MFI which sets up a centre in these areas face problems of infrastructure support from the neighboring area and this in turn kills the motivation of doing business and surviving there(Iyenger et al., 2010).

Thirdly a dedicated IT support and a proper structure for disbursement of loans and recovery thereafter are also important. Recovery seems to a major issue for any MFI.

OBJECTIVES OF STUDY

The above issues reflect that there is a scope of various questions related to MFI and implementation of MIS in MFIs. This research paper aims at:

- To understand the state of Management Information System used by MFI.
- To study the diversified software support and its linkage to specificities of Microfinance market.
- To study the relationship between the drivers of MIS used by MFI.

The latter questions is a part of Shared Information System (Barret & Konsynski, 1982) where a high quality MIS is shared by various organization depending on their usage. Thus, the cost can be saved and eventually distributed amongst all the end users, thereby reducing the operations cost for MFI.

THEORETICAL FRAMEWORK

The comparison of the software will therefore bring out the complicated diversity of the Microfinance Market as well as the wide variety of the software in the market to address this diversity. The comparison will not help in choosing any particular software, because after understanding the diversity and the segmentation, this would be the next step: which particular software to choose among the ones competing for that niche.

A second area of research will highlighted earlier is to establish whether some microfinance global networks use the same software and whether the software is controlled by the microfinance institution, such as the control of Mifos by Grameen. The answer is not obvious because recently one large microfinance agency decided that it should not be in the software business because the software industry was very different from the Microfinance sector.

This paper could help the research go more into the details of the Software as A Service Offering, which seems to be an answer to the needs of the sector. If this is so, why is the other software is doing as well? Can the services be outsourced to a third party software company so that experts can tackle the problem of maintaining standards across MFIs?

RESEARCH METHODOLOGY

The research methodology starts from database from CGAP (Consultative Group to Assist the Poor) which gives reviews on the software used by MFI to manage their information systems. More than 100 software have been reviewed by the organization across various geographical boundaries. Our research is based on South Asian Microfinance organizations i.e. from countries like India, Bangladesh, Sri Lanka etc. and thus the target technology providers boil down our number to 24. We have taken 25% of the service providers as our sample size, therefore 6 technology partners are used for our research.

DATA ANALYSIS

A brief description of software and its manufacturer is provided in Table 1. The software release dates indicate that some of them have been in the market for more than 5 years while others are relatively new to this arena of competition. The first column denotes the currently used version of the software in the market by the provider and therefore it signifies the need for updates in the current version. Management Information Systems are directly proportional to organizational growth, thus advancements and changes in software systems would definitely be values add for any MFI. (Brancheau et al., 1996) denotes that a responsive IT is one of the major concerns of managers.

Table-1: Sample Description

Product Name	Parent Company	Latest Version
Matrix	Elitser IT solutions India Pvt Ltd	2.01
MF Resolve	Grandatim IT Ventures	1.12
OMNI Enterprise Microfinance Solution	Infrasoft Technologies Limited	3.01
Delphix	Sathguru Management Consultants Pvt Ltd /Basics Limited	7
MFASYS (Mobile Enabled Micro Finance Accounting System)	Snowwood Infocom Technologies Pvt Ltd	3.0
Southtech ASCEND Banking	Southtech Ltd.	5.0

Sources: http://www.mixmarket.org/

Some of the major areas where MIS systems are practically useful are customer relationship management (CRM), shares management, tracking loan and deposits, Payroll etc. The study signifies that almost all perform the basic functions like Accounting, CRM, Tracking loans and deposits. Payroll is one of the neglected areas, which often technology providers miss out. Checking out their support in different regions, English is found to be used as a global language for interaction, while a few of them even used French and Spanish to cater their clients across other countries as well. Research also found that every technology partner has a different area of building clients i.e. some of them have for-profit organizations as their client base while others have non-profit organizations as their client base. The pattern of lending can also be traced and can be sub divided into individual lending and group lending.

Table-2: Salient Features of Products

Product Name	Language Used	Features in Latest Version
Matrix	English, Hindi and Indonesian apart from languages of India and Indonesia	Deposits, loans, customer management, and accounting
MF Resolve	English	Deposits, loans, customer management, and accounting and reporting
OMNI Enterprise Microfinance Solution	Arabic, English, Spanish	Group and individual loans, savings, guarantees, insurance fund, and transfers. Transaction and accounting management
Delphix	English	Loans and savings/deposits products , check book and cards payment ,budget, payroll, assets, and cost management
MFASYS (Mobile Enabled Micro Finance Accounting System)	English, French, Portuguese, Spanish	Loans, savings and linked insurance accounts management for Individual Lending, Self Help (Solidarity) Group and Joint Liability Group models, HR and Payroll modules
Southtech ASCEND Banking	English	Multi-currency accounting , Teller and cheque management ,Customization of loans/advances and savings/deposits products

Sources: http://www.mixmarket.org/

Table 3 indicates the outreach of each technology. The customer base is not very high for any of the technology providers. Globalization has not occurred much for them. It is evident from table 3 that they neither made a high impact in their respective country and nor have they tried to have a global presence. One hypothesis which may explain global strategies of some software manufactures and which may influence customer adoption of the software is that other similar companies, belonging to the same MFI network, across the world are using the same software (Ashta, 2011). Thus if in some country a model is being replicated, a similar software or the exact software vendor should be used in order to easen up things but it is not happening. This in turn give chances for new software developer to even replicate the existing model with little bit alterations to suit the needs to this tailor made model from the already existing one.

Table-3: Outreach of Each Software

Product Name	Total Number of clients	Number of technical staff	Location of Technical Support	Variety of Zones where they have Presence
Matrix	18	6	3	2
MF Resolve	7	3	1	1
OMNI Enterprise Microfinance Solution	26	10	6	4
Delphix	3	NA	1	1
MFASYS (Mobile Enabled Micro Finance Accounting System)	6	NA	3	1
Southtech ASCEND Banking	9	11	4	2

Sources: Authors Compilation

The next important thing to be discussed is the pricing information. As we know, pricing is one area, which leads to charging of high interest rates by MFIs. The findings from the research reveals that there is a variation in aggregate fees accumulated from various divisions viz licensing fees, maintenance fees, general consulting fees and training fees. Maintenance cost is a percentage of licensing cost and it is expressed in terms of dollars when licensing costs is negligible which happens for fresh and relatively new technology partners. MOSTFIT is an exception in the entire study. The data for the same reveal that 10 cents per borrower becomes 1000 dollars for 10000 borrowers. Its general consulting fees is relatively higher when compared to others who offer same services at $1-2 per day.

Table-4: Pricing Alternatives

Product Name	Minimum Licensing Cost	Annual Maintenance Cost	Implementation Cost	Training Cost (Per day)
Matrix	USD 2291 per license (discount per volume and number of customers) with a 15% annual maintenance	Variable	Not disclosed	2 weeks of user training, 2 weeks of system administrator training
MF Resolve	$20,000 for every headquarter, $500 for every additional branch up to 10 branches, $0.5 for every additional customer	15% per year	10%-20%	Included in implementation fee
OMNI Enterprise Microfinance Solution	Standard license price is between $70,000 and $250,000 and depends upon factors such as size, country PPI, and usage model	20% for purchased license volume. Cost of programming varies from $250 to $750 per day depending upon the countries PPI	Implementation cost varies from 45% to 85% of license cost and depends upon complexity and country PPI	Cost is included in the implementation budget
Delphix	Delphix core module: $1,300 / user (up to 25 Users); Special pricing if more than 25 users. Per additional module: $200 / user .Oracle Database: from $2,000 to $7,000	18% of the total license cost	Not exceeding 25% of the total license cost	$300 / day (2 weeks required for users, and 2-3 days for system administrator)
MFASYS (Mobile Enabled Micro Finance Accounting System)	$43,500, for large customers .$550 per branch .$0.022 per active client per month (no active customers yet) $20,000 per additional module Client specific customization is charged at $15 per man hour	15% of application software license per year	Installation including simple migration is done free of charge, while more complex data migration is charged for at $15 per man hour.	$12 per hour per technician. Typically totals $720 based on 3 trainers for 2 days, 10 hours each. Onsite user training of users in English and local language is provided
Southtech ASCEND Banking	$105,000 for mandatory head-office modules (security administration, central configuration and consolidation, customer database, accounting, loans and advances, cash management, and accounting	15% per year for all licensing fees and enhancement costs	$150 per person/day. Average implementation assistance is $20,000, which includes preparation of data conversion tool, testing of tool	$8,000 for two week training session for users (average of 15 users) $4,000 for one week system admin training session (average of 4 users)

	.$2,775 per branch for mandatory modules with 2 concurrent users $9,500 for optional modules (document management, deposit account, pay order, check management, SMS and email services). $1,700 per branch for optional modules with 2 concurrent users		using real data, first branch including HO roll-out, and onsite support for 3 months.	

Sources: http://www.mixmarket.org/

Looking at table 5 we cannot compare the pricing strategies to judge which software is doing well and which is underperforming. Also, every software might be made with different kind of customers or clients is mind thus the pricing strategies are bound to vary due to different technology and different features imparted by the same.

Table-5: Cost Involved

Product Name	Cost for 15000 clients	Cost for 40000 clients	Cost for 100000 clients
Matrix	NA	NA	NA
MF Resolve	$ 44,250	$ 44,250	$ 46,250
OMNI Enterprise Microfinance Solution	$ 112,000	$ 212,000	$ 312,000
Delphix	Not disclosed	Not disclosed	$ 74, 720
MFASYS (Mobile Enabled Micro Finance Accounting System)	$ 29,820	$ 74,220	$146,220
Southtech ASCEND Banking	$194,000	$ 251,000	$ 483,000

Sources: Authors Compilation

Using the above data for our sample of six software packages, we calculated for correlation coefficients and tested for significance. These are presented in a correlation matrix in Appendix. To understand this, a few adjustments have to be kept in mind.

For number of languages, two software are multilingual Unicode and we have taken a figure of 100. A lower number does not make any material difference to correlation coefficients as long as it is above 4 (the highest number of languages in our sample). For the size of institutions served, the data used is essentially the number of segments that the institution is serving out of the four ranges that CGAP has defined. This is our measure of scalability. If an MIS is capable of serving only the small segment, it is not considered as scalable.

For location of clients and for location of technical staff, we have used the number of zones in which the clients and technical staff are present, respectively. Therefore, a high number would indicate that all six zones are being served and a low number would indicate that only one zone is being served. The same zones are used for the presence of technical experts.

We will restrict our comments on the significant relationships only, unless the lack of significance is important. The level of significance can be seen from the appendix.

RESULT & FINDINGS

Table-6: Analysis of Data

	Years in use to date	Features (application)	Languages used	Type of Institutions	Total Number of clients	Number of clients using this product	Scalability	Number of technical support staff	Cost of 100,000 clients	Cost of 40,000 clients	Cost of 15,000 clients
Years in use to date	1.000										
Features (application)	0.400	1.000									
Languages used	-0.045	-0.101	1.000								
Type of Institutions	-0.489	0.241	-0.015	1.000							
Total number of clients	-0.472	0.240	-0.998	0.505	1.000						

Number of clients using this product	-0.454	0.230	-0.990	0.601	1.000	1.000					
Scalability	-0.589	0.181	0.220	0.555	0.540	0.573	1.000				
Number of technical support staff	-0.121	0.888	0.207	0.577	0.135	0.156	0.700	1.000			
Cost of 100,000 clients	-0.241	-0.007	-0.425	-0.116	0.889	0.896	-0.089	-0.015	1.000		
Cost of 40,000 clients	0.005	0.428	-0.267	0.089	0.867	0.305	0.314	0.269	0.637	1.000	
Cost of 15,000 clients	-0.499	0.304	0.007	0.550	0.842	0.867	0.891	0.612	-0.267	-0.211	1.000

Sources: Authors Compilation

The first column indicates that the number of years of presence has a strong negative correlation to the number of loan options allowed (individual lending, group lending and village banking). Thus, a hypothesis could be that older software manufacturers offered only individual lending and that ones that are more recent have had to offer more lending methodology options such as the group lending/village-banking feature to get into un-served niches.

The second column indicates a high positive correlation between the number of applications and the number of technical staff. However, the correlations could be both ways. Staffs that are more technical are needed if the product is more complex. At the same time, staff that is more technical may allow offering more applications within the product because the technical staff could resolve customers' problems and ensure client satisfaction. Thus, software manufacturers who do not want to engage technical staff would offer fewer applications with more reliability to avoid client dissatisfaction.

The third column indicates that the number of languages offered is inversely related to the number of clients. This near perfect inverse correlation is affected by the multilingual Unicode function. It may mean that manufacturers with few customers are looking for customers in other languages. The fact that this column is inversely related to the number of zones in which technical staff is located seems to be prima facie strange. However, if one keeps in mind that the multi-lingual operators are present in the Indian sub-continent, it becomes evident that the Unicode offering is to take account of the multiplicity of local languages.

The types of institutions being served seems to be unrelated significantly to any other factor analyzed here. This is an important finding because it goes against the first specificity mentioned by (Iyengar et al, 2010) that sector specific mutations between for-profits and not-for profits and banks and NGOs complicate the MIS market. We do not find support for this proposition based on our analysis. However, the fact those CGAP reviewers considered it important enough to report reflects that industry observer's support the (Iyengar et al, 2010) view.

The number of customers for the software and number of customers for this particular product version are perfectly correlated and, therefore, the other variables are all correlated to similar extent to these two variables. Therefore, one set of comments for the two columns would be sufficient. We can see that number of clients is very highly positively correlated with number of zones in which clients are located, number of zones in which technical staff are located and, curiously, with prices for the segment served (in number of clients). A possible explanation to account for all of this could be that software manufacturers are looking for worldwide markets to get economies of scale rather than searching for intensive capturing of a local market. For this, they are offering technical services in more countries. Perhaps, the offering of technical support in more countries, is driving up costs and, therefore, prices. Clients, however, are willing to pay the higher prices because they are reassured that it is a globally desired solution or perhaps because they are obliged by a parent in their network to take this solution.

Scalability, or the number of segments of institution size for which the software is offered, is highly correlated with price for the smaller MFI segment. Thus, offering scalability has a cost, which is noticeable compared to cheap basic software targeting only smaller customers. However, once we move to larger segments, offering scalability does not make any significant difference (the small non-significant correlations are even negative). Scalability also requires more technical staff. Finally, there is significant correlation of scalability with the flexibility of lending methodologies.

CONCLUSIONS

Microfinance is a fast growing sector where MIS is a strategic need for up scaling to get both economic sustainability and social outreach and performance. It should help in lowering transaction costs and interest rates. A study of the MIS for this sector is therefore crucial. Partly, this diversity is owing to the need for the software to differentiate themselves from others positioning in the same niche. We can see that this part of the diversity is based on commercial strategies, notably pricing.

The evolution of the software market may be based on the evolution of the microfinance sector. Many of the successful microfinance models are replicated across the world and compete with each other. It is possible that they networks use the same software in different countries. This would explain further, why many clients are willing to pay higher prices for software, which is being offered in more global zones: there may be a forced lock-in once the parent organization uses software for all the other replicating MFIs. Therefore, a key success element of the marketing plan of software vendors would be to satisfactorily implement their software for the first such client and then use this success to diffuse to the rest of the network.

Today, there are hundreds of software vendors chasing thousands of MFIs. The microfinance market, as we have indicated, is far from saturation and there are billions of unbanked. However, growth is taking place at a fast rate and some markets such as Peru and Bangladesh, and some States in India (Andhra Pradesh and Karnataka) are nearing saturation. Therefore, further growth will depend on mergers and alliances. This would also lead to a limitation, in turn, of the number of software vendors specialized in this sector who would survive.

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