INFORMATION TECHNOLOGY, KNOWLEDGE PROCESSING AND LIBRARIES OF THE FUTURE: AN INTERLINKED INFORMATION SERVICE

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1. Introduction

Developments in Information Technology particularly Computer Technology, Communication Technology and Document Processing and Delivery Technologies have been revolutionizing the library and information services. The principal focus of collection development, collection organising and services to readers and other information users has been continuously moved into a proactive stage. The focus has been to facilitate information usage. Here again we are planning to meet the needs of the users. The technologies have made the librarianship to be more resilient towards meeting the demands of information users. The profession has found that any information or its sources exists to meet the needs of users. Therefore,. the information technology has to be built on a flexible frame to provide instant, conducive approaches towards identification, location, access, retrieval, and usage of the information to satisfy the end users. In fact, the entire information access activity is focussed to make the stored information animate and ultimately help the interface between information presented and absorbed by the seeker of the knowledge as humane as possible. This really is the focus information storage, retrieval, dissemination, access and absorption process. It is indeed the beauty and rhythm of information flow, we seek to achieve. It is like Purandaradasa saying "Kereya Neeranu Kerege Chelli Varava Padedavaranthe Kaniro". Putting the store of knowledge into the processes of knowledge helps use of knowledge to the benefit of entire society. The developments in Information Technology have been faster and more attuned towards user demands. We shall be looking at these developments. The technology for electronic digitization is evolving rapidly and consequently the contexual environment and implications for library and information service is providing additional facilities such as network

access, electronic document delivery, and information interfacing and modelling facilities at any point of space and time milieu.

2.   Component Information Technologies

The information technology is an aggregation of several component technologies such as the following:

Microelectronics, Optical electronics, Computer technology, Electronic office equipment, Telecommunication, Robotics, Artificial intelligence, Expert systems, Computer controlled machines, Computer input, output and storage devices and control systems. User-interface devices, Graphic projections and other developments. The main framework, the challenge to information resource management, may be categorised as follows: Information need challenges, environmental changes, globalisation, knowledge needs, integration of information from variety of sources, technical challenge providing a variety of information storage, retrieval and access skills, managerial challenges such as people management, interpersonal communication and political and policy changes, such as, vision of future mission and programmes, and commitment to development and better quality of life. A proactive information system must be capable of sensing the trends in the environmental factors in advance so as to be able to develop itself to meet the changing information needs and build resource to satisfy them adequately and satisfactorily.

3.   Information Needs Analysis.

Information is a human product. It is a knowledge developing resource. Information absorbers process it with already known knowledge to themselves and renew, regenerate or assimilate the information to useful knowledge to the benefit of the humanity. Information provided to any seeker has a surprise value or novelty value, and provide scope for generation of new knowledge. A library or information centre is an important component of a larger system. The services provided may be to the individuals within an institution and/or nation as a whole. The information services provided should take into account the overall development process and use the different varities of information systems, products, and services. For example, we could draw information systems, such as, executive information system, management information system, decision support system, knowledge-based expert system, documentation services, library services etc. These are required to be analysed and synthesized to satisfy the different information needs. The quality of

service provided is thus of oriented information seekers needs. The service should provide satisfaction of different types of information needs, timeliness (on demand and in anticipation of demand) relevance to the immediate information needs, comprehensiveness of information to the sources available and to the satisfaction of needs, reliability of information, relatively of affordable cost, ease to use. The important problem is information need identification. Information support is needed for a variety of human development activities such as Planning, Management, Research and Development, Financial Management, Human Resources Development, Counselling, Production, Product Promotion, Marketing and Sales, Services delivery, Post-sales services, Resource mobilisation and acquisition, Systems operation, Purchasing, performance evaluation, Organisation task design and allocation. The focus may be public services, resource learning or other kindred activities. The cognitive process involving information usage may be for problem solving, decision making, coordination, control, monitoring, auditing and evaluation, diagnosis and detection, therapeutics and preventive services, technology transfer, evaluation, knowledge acquisition, awareness about developments and keeping updated to the knowledge and business environment.

4.   Information Storage Technology

Electro optical storage media for compact storage and fast retrieval of the text has been made available in the form of CD-ROM. We are aware that the print-on paper is a favoured media for reading and assimilating. But the rapid growth of CD-ROM and its enormous capacity to store and retrieve has taken the lead. CD-ROM is growing stronger in collection development. Librarians attempt to exploit general bibliographic databases on CD-ROM to identify core collection, to study client usage patterns, and to analyse their holdings in relation to these findings. Another aspect of CD-ROM's effect on collection development concerns the printed indexes. It can act as fast retrieval aid to users. The flexibility, low cost and ease of use of CD-ROM services and database managers could revolutionise collection development practices in libraries. CD-ROM has changed the life and the work day of the reference librarian in many ways, and with tremendous consequences. Many librarians feel that the number of mediated searches would get reduced. However, the demand for learning multiple search systems and revamping their user instruction programs has placed a major burden on time and energy. The CD-ROM has also changed the life of users as well.

However, the newest electronic services to be added, CD-ROM and OPAC databases are reaching thousands of users everyday, while older on-line options may reach only hundreds per month or even less. The factor of increased access alone generates many more searches as well as a greater demand for information than ever before. Inevitably, the additional number of users and their informational requirements affect library budgets, collection development, management, technical services and especially reference. Reference librarians seem to be spending more time to understand the patron's information needs. CD-ROM librarians gained more awareness and perspective on the reference process and as a result, instituted an overall higher level of service and training in other areas of user services as well. CD-ROM databases is popular among research scholars in India and have begun to use for exploratory searches in a variety of topics. ADONIS is also beginning to have good access and document delivery facilities in biomedical field. A compaction of about 3,00,000 pages of text for quick search per CD-ROM gives scope for less tedious search through documents.

A number of institutions are attempting to have CD-ROM network. A CD-net system accessed by only one workstation operates about twice as fast as stand alone CD-ROM workstations accessing the same field on the same CD-ROM database shows that search time can increase by a factor of five. However, copyright experts caution librarians to check CD-ROM agreements and contracts to stay within the limitations of fair use when copying from optical databases.

The other formats such as CD-I (Compact Disc Interactive), DVI (Digital Video Interactive) CD-ROM-A (CD-ROM extended Architecture), CDTV (Commodore Dynamic Total Vision) and Photo CD from Kodak, all appear as players or rather, competitors in the emerging multimedia market. They all intertwine together towards multimedia access at a point of search. However, true multimedia should include all forms such as audio, full motion video, still photos, text and graphics. These varying components must interact and function exterously with the user as well as fully integrated so that one can hear audio and see video simultaneously. The product must provide also high quality output, such as stereo sound.

Multimedia is a true medium in itself, one cannot create satisfactory multimedia by "translating" a print source into a multimedia document by enhancing it with a few pictures and sounds.

After few years of experience, librarians now understand that CD-

ROM thrives only with a well structured support system and in doing so, places extraordinary pressures on library budgets and staff. Inspite of many organisational and funding obstacles, librarians in general appear not only to be coping well but also to be forging sound methodology and using educated foresight in strategic planning for future developments in hardware and software.

However, greater volume of information will be stored and distributed electronically through some format of optical technology in the near future. This will live along with increasing point on paper media. CD-ROMs represent only a single development within a society shifting its methods of communication from decades of public discourse designed by the demands of mass audience, to a form of individualised communication and interaction. Clearly, we are moving from a culture that had the luxury of valuing information as a resource to be shared freely to one where information is a national commodity to be redressed, restructured, and bought and sold either directly or indirectly. CD-ROM and electronic optical media acts a catalyst in paradigm towards universal access to information by individuals.

Further electronic and optical apparatus for storage retrieval and access provides scope for worldwide communication. In an era of digital, electronic technology, intellectual works are simultaneously available to many individuals who may access them from a central store of works, or "database". With new technologies, intellectual works are, moreover, reproducible at very fast speeds and low costs. And now perfect copies can be made from copies. The technology is also extremely versatile; the media are very high in capacity, and many different types of works can be stored and communicated digitally. In addition now almost anyone can reproduce a work, as highly capable machine beome ubiquitous in homes and offices. These machines can be linked by switched telephone circuits so that intellectual works can be transferred in much greater quantity and with impunity. Further more, the new technologies are dynamic, in that they are interactive, and constantly evolving. (Grace, D.L. 1991). Copyright law changes for electronic publishing, intellectual property rights and fair use; strengthening scholarly communication in 1990s. (Proceedings of Ninth Annual Conference of Research Directors. pp1-5.OCLCO online Computer Library Center, Denver, Ohio).

The development leading to electronic library which may break "print prison" to provide multimedia access to subjects of varieties. We can also have "virtual library" which housed electronically, will provide

immediate and direct access to bibliographic reference system with a variety of associated subject indexes. Sceptics say that this may lead to different perspectives. To quote Seiler and Supernant, "society will totally convert to digital information and with society, so will libraries" many libraries we now have will substitute for small and large libraries that are now geographically dispersed. General purpose libraries, each like a Library of Congress but holding more information, will be located regionally. Such regional libraries might be sold as turnkey systems with a common hardware platform and bundled with identical collection of information and software (Seiler (L) and Supernant(T),(1991). When we get libraries we want, will we want the libraries we get. (Wilson Library Bulletin.65;1991;p.p. 29-30). All these leads to change in librarianship practice. But will the library profession accept these changes as a bystander, rather model these developments to conducive intellectual access and environment supportive to creativity. We can also see that compact storage and remote access may reduce stacks of library into a small cubicle and all the advance organisation techniques built in to accede supportive to cognitive modelling by the information searcher. A wired in and compact access to knowledge would surely lead to productivity in the intellectual tasks. Besides print on paper, which has already accumulated and likely to cumulate more into it, we need to build an electronic library collection =with special skills and access to knowledge through a variety of media. Compactness, intensive and purposive searches to build a searching knowledge.

5. Knowledge Processing Systems/Technologies

Knowledge Base Systems (KBS) are computer applications that generate quality solutions to problems requiring computer based reasoning with knowledge. This kind of computer processing of knowledge is termed as knowledge processing. Knowledge refers to those kinds of data that can improve the efficiency and effectiveness of a problem solver. Three major types of knowledge fit this description; facts that express valued propositions, beliefs that express plausible propositions, and heuristics or rules of thumb that express methods of applying judgement in situations for which valid algorithms generally do not exist.

Expertise in knowledge is distinguished by the quality and quantity of knowledge they possess; they know more, and what they know makes them more efficient and effective. Expert knowledge, whether applied by human or machine, works in situations that do not admit optimal

solutions. It is used by problem-solvers to find an acceptable solution that meets or exceeds requirement with a reasonable expenditure or resources. Specifically, expert knowledge helps problem-solvers to improve their efficiency by marshalling relevant facts, avoiding common errors, making critical distinctions between problem types, pruning useless paths of investigation, ordering search, eliminating redundancy, reduce ambiguities, eliminating noise in data, exploiting knowledge from complimentary disciplines, and analysing problems from different perspectives or levels of abstraction.

The objects are data structure used to represent knowledge about physical things(e.g. arteries, computers, and equipment) or conceptual things (e.g. plans, designs, and requirements.) Objects used in object oriented programming systems are organised into hierarchical classes, and each class of objects has information about its attributes stored in instance variables associated with each instance of the class. When a knowledge base is organised into objects, it is often represented by an object tree that shows how the different objects relate to one another. Objects provide considerable leverage in representing the world in a natural way and in reusing code that operates on common classes of objects.

Rules represent declarative or imperative knowledge. An imperative rule tells the KBS how to behave. "If available sunlight is less than level 3, switch to battery power" A declarative rule describes the way things work, without specifying what to do about them". If photoelectrics receive sunlight less than level 3, the electricity produced is less than 1000 watts".

KBS components construct explanations of their problem - solving behaviour by transforming assertions and rules into lines of reasoning. These lines of reasoning show how a set of assumptions and a specific collection of assertions and heuristic rules produce a particular conclusion.

The term Inference Engine refers to the part of a KBS that specifies the logical process by which new facts and beliefs are derived from known facts and beliefs.It also contains the control strategy that orders the search for inferential solution. For example, an inference engine that used modes ponens and forward chaining may combine a fact (e.g. lathe #6 has error #34) and a rule (e.g.if any lathe has error #34, rest lathe #6). The choice of what type of inference engine to employ for a particular problem depends on what type of problem-solving approach is most appropriate overall.

This leads to a consideration of problem-solving architectures including the following;

Heuristic classification is a method of solving problems by using heuristic rules to aggregate problem data into problem categories, map problem categories into enumerated solution categories, and a select set of solution from the solution categories. For example, given data in the form of medical symptoms of running nose, teary and itchy eyes, rules may be used to classify the data into problem category called allergies. Additional rules may be used to map allergy problems to a solution category called antihistamines. Refinement rules are then applied to select one specific anti-histamine from the class of antihistamines.

Constraint propagation is a method of solving problems by propagating restrictions on allowable states, values, or conclusions to the objects in a KBS. Decisions can be communicated by propagating acceptable values of variable in a network of constraints. A solution to the networks of constraints is a set of legal values for all variable in the network. KBS derive their value primarily through an ability to recognise and satisfy complexes of symbolic-constant sets. They extend the class of constraint satsifaction problems amenable to computation by addressing non-linear and arbitrary symbolic constraints such as requirements on spatial, temporal, or logical relationships.

Blackboard systems use multiple independent knowledge sources to analyse different aspects of a complex problem. Each knowledge source contributes its information to the common working memory, referred to as the blackboard. · A master control program continually examines the black boards and orders the agenda of what to do next.

Blackboard architectures compose solutions from component substitutions, each of which may be generated or notified by its own knowledge sources or mini expert systems.

Forward chaining is one of several inferential control strategies that used existing or newly deduced data to trigger future deductions and conclusion about the data. Forward chaining in rule-based systems begins by triggering all of the rules whose "if clauses" are true. It then uses the facts it has established to determine what additional rules might be executable, because their "if clauses" are satisfied. The process is repeated until the program reaches its goal or runs out of new possibilities. This technique is typically used for state-space search or data-directed reasoning.

Backward chaining is another inferential control strategy that works

from goals to what is already known or needs to become known to satisfy those goals. Back chaining is initiated when(1) a user establishes some goal to be sought, and (2) the system identifies one or more rules whose consequences would satisfy the goal. The matching goal is triggered, and if none of the conjuncts in its antecedent clause is already known to be false, the system establishes subgoals for not-yet believed conjuncts

The system then attempts to satisfy the goal rules by satisfying the subgoals. This leads the system to evaluate other rules that would confirm the "if clause" conjuncts. Thus, the system works back through its rules until a question is asked or a previously stored fact or belief is found. Back chaining is typically employed in problem solving.

This leads to spreading activation principle. Each action creation several new facts, beliefs, or subgoals which in turn trigger multiple candidate successor inference actions. This problem arises because the problem solver is undiscriminating for its applications of knowledge and inference. For this purpose, several researchers have suggested that this problem is due to lack of awareness of "shallowness" techniques to identify awareness, focus of attention , and deliberate control to KBS. Reasoning about one's own reasoning is called metalevel reasoning. The general level for metalevel reasoning involves several elements. Metaplans are plans about plans that are used to improve the effectiveness of the planning process. Metaplans prescribe several approaches that are intended to improve planning.

Agendas are used to control the activity of the knowledge system through selective ordering of successive actions. Triggered actions are posted on an agenda, and an agenda management system determines which of the many pending actions the system should execute next. For the deliberation about scheduling decisions to be effective, the system must maintain and update information about the state of the problem-solution and use this to evaluate the apparent desirability of pending actions. The state of the problem solution effect is a representation of the past and present results or the problem-solving process. It is used to describe the effectiveness of past actions and the estimated effects of alternative future actions.

Evaluation is the process of estimating the quality of reasoned results, the credibility of uncertain inferences, and the expected value of pending efforts. Scheduling refers to the process of specifying and satisfying temporal constraints on resources. In particular, a metalevel is generally used to schedule inference engine activity based on evaluations

of expected value of pending triggered inferences. Thus, the metalevel provides a means of using knowledge to control the inference engine. This has been critical as a means of building practical systems in situations where uncontrolled inference would result in combinational explosion.

The recent application of knowledge processing combine some of the techniques we have described produce overall solution to a particular problem. Knowledge processing techniques are principally used for three reasons;

1. To improve the reasoning of the application system.
2. To increase the flexibility of the application system.
3. To increase the human -like qualities of the system.

The development of knowledge-processing technologies is leading to knowledge economies. Learning, problem-solving and decision -making is redefined dramatically to encompass not just formal students but also life long learners. A new meaning for library and information services for housing a variety of knowledge technologies towards providing catalyst for knowledge which is ever anew and even relevant to human needs and betterment.

6. Information Modelling and Interface

Information modelling and interfacing calls for user-friendliness. It is an important area of future library activities as people are becoming sophisticated in their information need and use people-oriented information systems. Information modelling provides a base for interface analysis or meditation studies. It also provides a framework for design of information systems.

A clear trend is coming together in which conceptual information system models provide variety cognitive models are moving out of laboratories and into real world. Semantic data modelling techniques provide a level of terminological precision. It is also to build facilities towards semantic memory system.

A vision of future information scenario, a global perspective and institutional perspectives provide an integrated information interface facility.

1. Everyone has access to the information they need, when they need it, and in a form most useful to them.
2. A complex of networks of information flow will connect the world;
3. Multiple and competing models for interpreting information

will be available;

4. Information systems will be flexible enough to adopt quickly to changing enterprise and environmental needs;

5. Information, information systems and information technology are harmonised in controlled and known ways.

6. Network organisations have flexibility to maximize effort from entrepreneurial activity.

7. Problems can be addressed quickly and effectively by the creation of cross functional teams or other appropriate organisational structures.

7. Document Delivery Services

A model delivery service of the future would be doing the following in addition to what is existing today.

1. A network access to documents from different libraries. Access to electronic databases, high density storage access, and other library connections.

2. Rapid text delivery down loading from specified online databases.

3. Search electronically, holdings list and get virtual access to documents through a subscriber network.

4. Directly accessible databases and the texts in electronic format for browsing, reading and retaining.

5. Provide universal access to individuals electronically and provide multi-media alternatives;

6. Take into account hypertext and media options in multilateral searches and retrieval;

7. Take into account the different ways users want to interact with information and provide appropriate options for access to materials;

8. Between 1,00,000 and 2,00,000 computers are currently connected directly to the INTERNET with six times as many end users. By the end of the decade at least 1 million computers will be connected to INTERNET with even more users all over the world.

Electronic delivery of document from global distance have shown that access and delivery of information is free of ownership, borrowing and lending problems.

8. Conclusion

An integrated library and information service system will use information technology to provide:

1. Shared computing resources through INTERNET.
2. It provides communication interlink for organised and cohesive information flow and use.
3. It helps to process information at different levels of aggregation.
4. It provides scope for collaborative and continuous research with cross-functional speciality team towards missions and target activities.
5. Multimedia integrated packages of information with built-in and adaptive user friendly interface facilities.
6. Instant and continuous document and information access through global networks of library and information services.

The development of knowledge processing technologies is a reflection of an even larger transformation occurring in our society. Stan Davis and Jim Botkin say that aptly. To quote them, "Learning in agricultural economies i.e. often church led, focuses on children between 7 and 14 years of age, and is sufficient to last all the years of a working life. In industrial economies, learning has been government led, and the age range of students is between 5 and 22. In knowledge economies, the rapid pace of technological change means that learning must be constant and that education must be updated throughout one's working life. People have to increase their learning power to sustain their earning power". It is thus, an imperative that more than any institution in our future society, that libraries are governed and propelled knowledge-processing technologies with power to constantly help learning, problem-solving, decision-making, monitoring, evaluating, correcting, and developing towards better quality of individual, familial, institutional and social life.

9. Reference

STAN DAVIS AND JIM BOTKIN. The coming of knowledge based business. Harvard Business Review, 1994; September-October. p165-170.