TRENDS AND INNOVATION IN MANAGEMENT, COMMERCE, SCIENCE, ENGINEERING AND HUMANITIES
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INVARIANT POINT RESULTS IN BANACH SPACES

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Abstract - In this paper we mainly concerned with the study of Invariant point reaults in Banach spaces.
Keywords - Invariant, Banach, Contractive.

1 INTRODUCTION & CORE AREAS

Let X be a Banach space with norm $\|.\|$. Let $T:X \to X$. Let $x_0 \in X$. During the last forty years research workers have devoted to the theory of operators in mathematical physics in order to find the invariant point of the operators. Actually the source of the inspiration is the following result which runs as follows:

Let X be a Banach space and let T be an operator mapping X into itself such that

$$\|Tx - Ty\| \leq a\|x - y\|$$

$$(1)$$

where $0 \leq \alpha < 1$ and for all x, y

Then there exists a unique invariant point of the operator T in X.
Instead of the condition (1), the following condition on the mapping T had been used to prove the existence of a unique invariant point;

$$\| Tp - Tq <\| p - q \| \ for \ all \ p, q \epsilon X, p \neq q$$

$$(2)$$

We have the following result using the above result:

Let X be a ε-chainable space Banach space, T be a mapping of X into itself which is $(\varepsilon - \lambda)$ uniformly locally contractive, then there exists a unique point $\xi \epsilon X$ such that $T\xi = \xi$.

Let there exist $\varepsilon > 0$ such that d(p,q)$< \varepsilon, p \neq q$ implies$\| Tp - Tq \|<\| p - q \|$.

1.1 Periodic points for such type of mappings have been obtained in the following result:

Let X be a Banach space and $T:X \to X$ be such that $\| Tx - Ty\| < \|x - y\|, x, y \in X, x \neq y$. Suppose that there exists a point $x \in X$ such that the sequence of iterates $\{T^n x\}$ has a subsequence converging to $\xi \in X$. Then ξ is the unique invariant point of T. It was further observed that if $\|\xi - T\xi\| < \xi$, then ξ is a invariant point of T. It was further proved that under certain additional supposition on the space the existence of an invariant point of locally contractive mappings are ensured. The following result is in this direction.

Let X be a Banach space, T an ε-contractive self-mapping on X. Suppose that there exists a point $x \in X$ such that the sequence of iterates $\{T^n x\}$ has a subsequence $\{T^{n_1} x\}$ converging to $\xi \in X$. Then $\xi = \lim_{n \to \infty} T^{n_1} x$ is a periodic point (i.e., there exists a positive integer k such that $T^k \xi = \xi$).

Attempt was made to establish the above result replacing ε-contractiveness by localized version such as $p \neq q, p, q \varepsilon S(x, \varepsilon(x))$ implies

$$\| Tp - Tq \| < \|p - q\| \text{ where } S(x, \varepsilon(x)) = \{z: \| z - x \| < \varepsilon(x)\}.$$

But it was found that it would not be possible. But researchers with the help of well locally contractive mappings as has been defined, proved the existence of a periodic point for such mappings :

A mapping T of a Banach space X into itself is said to be well locally contractive if for each $u \varepsilon X$ there exists S(u,r(u)) such that

$x, y \varepsilon S(u, r(u))$ with $x \neq y$ implies $\| Tx - Ty \| < \|x - y\|$ and $Tx, Ty \in S(v, r(v))$

for some $v \in X$.

2 THIS RESULT IS IN THIS DIRECTION :

Let T be a well locally contractive self-mapping on a Banach space X. If $\{T^n x\}, x \in X$, contains a convergent subsequence $\{T^n x\}$ then $u = \lim_{i \to \infty} T^{n_1} x$ is

a periodic point of T.

It was further proved that periodic points become a unique invariant point under certain additional hypothesis.

A Banach space X is said to be convex provided x and y in X implies there is z in X such that

$$\| x - z \| = \|y - z\| = \frac{1}{2} \|x - y\|.$$

2.1 We next have following result :

If T is a well locally contractive self-mapping on a Banach space X and if for some x in X a subsequence of $\{T^n x\}$ is contained in a compact subset

of X, then T has a unique invariant point.

On investigation on invariant point a different approach is found.
If T is a mapping of the Banach space X into itself and if

$$\| Tx - Ty \| \leq \alpha \{\|x - Tx\| + \|y - Ty\|\} \tag{3}$$

Where $x, y \in X$ and $0 \leq \alpha < \frac{1}{2}$, then T has a unique invariant point in X.

The conditions (1) and (3) are mutually independent. Reich obtained some invariant point theorems combining the conditions of Kannan and Banach of the mappings satisfying the following conditions :

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$$\| Tx - Ty\| \le \alpha\|x - Tx\| + \beta\|y.Ty\| + \gamma\|x,y\|$$

$$(4)$$

Where $0 \le \alpha + \beta + \gamma < 1$ and α, β, γ are non-negatives.

It is further obtained an invariant point of an operator, mapping a Banach space and satisfying the following condition

$$\| Tx - Ty\| \le a_1\|x - y\| + a_2\|x - Tx\| + a_3\|y - Ty\| + a_4\|x - Ty\| + a_5\|y - Tx\|$$

$$(5)$$

Where, $a_i \ge 0 \sum_{i=1}^{5} a_i < 1.$

If $a_2 = a_3 = a_5 = 0,$ the condition (5) reduces to the condition (1).

If $a_1 = a_4 = a_5 = 0$ and $a_2 = a_3$ the condition (5) reduces to (3).

If $a_1 = a_4,$ the condition (5) reduces to the condition (4).

2.2 This is important result in this area :
Let T be a self-mapping on a Banach space X. Suppose that there exist functions $a_i, i = 1,2,3,4,5,$ of $[0, \infty],$ into $[0, \infty]$ such that

(a) each α is upper semi-continuous from the right;

(b) $a_1(t) + a_2(t) + a_3(t) + a_4(t) + a_5(t) < t, t > 0;$

$$(6)$$

(c) for any distinct x, y in X.

$$\| Tx - Ty\| \le a_1\|x - Tx\| + a_2\|y - Ty\| + a_3\|x - Ty\| + a_4\|y - Tx\| + a_5\|x - y\|$$

$$(7)$$

Where, $a_i = \{\alpha_i(\|x - y\|\} /\|x - y\|.$

Then T has a unique invariant point.

Later the concept of quasi contraction was introduced as follows :
If $T : X \to X$ is a mapping, then T is called quasi-contractive if

$$\| Tx - Ty\| \le q\max \{\|x - y\|, \quad \|x - Tx\|, \|y - Ty\|, \|x - Ty\|, \|y - Ty\|\}$$

for all $x, y \in X$ and $0 \le q < 1.$

Let $T : X \to X$ be a mapping. If $\| Tx - Ty\| \le \|x - y\|$ (8)

for all $x, y \in X,$ then T is called a non-expansive mapping. It has been proved that the existence of invariant point in a reflexive Banach space using the concept of normal structure for the non-expansive mapping. This type of mapping may have a fixed point not necessarily unique.
It has been found that the existence of invariant point of non-expansive mappings in a uniformly convex Banach space. It is to be noted that a uniformly convex Banach space is a reflexive Banach space and it also has normal structure. But the converse is not true.

For a subset A of a Banach space X let

$$\delta(A) = \text{Sup}\{\|x - y\|: x, y \in A\},$$

denote the diameter of A and let T be a mapping of X into itself. Let $\{T^n x\}$ denote the sequence of iterates of $x \in X$ and let

$$0(T^r x) = \{T^r x, T^{r-1} x, \dots\}, r = 0,1,2,\dots, T^0 x = x.$$

If $r(x) = \lim_{n \to \infty} \delta(0(Tx)) < \delta(0(x))$ at a point $x \in A$

Where $d(0(x)) > 0$,

then T is said to have a diminishing orbital diameter at x. If T has a diminishing orbital diameter for every $x \in X$, then T is said to have a diminishing orbital diameter over X.

3 WE HAVE THE FOLLOWING RESULT :
Let K be a compact subset of a Banach space X and suppose there exists a contractive, jointly continuous family of functions associated with K as described in definition mentioned above. Then any non-expansive mapping T of K into itself has an invariant point in K.

3.1 Using the condition mentioned below :

$$\|Tx - Ty\| \leq \beta[\|(x - Tx\| + \|y - Ty\|],$$

where $0 < \beta < \frac{1}{2}$ and $x, y \in X$.

Later on the condition mentioned above extended the condition $0 \leq \beta < \frac{1}{2}$ by $0 \leq \beta \leq \frac{1}{2}$ or $\beta = \frac{1}{2}$. In such cases in addition to the reflexivity he needed the following conditions.
Let X be a reflexive Banach space and let K be a non-empty closed convex bounded subset of X. Let $T: K \to K$ be such that

$$\sup_{y \in H} \|y - Ty\| \leq \delta(H)/2$$

(9)

Where H is any non-empty convex subset of K that is mapped into itself by T and $\delta(H)$ is the diameter of H.

$$\sup_{y \in H} \|y - Ty\| \leq \delta(H).$$

(10)

Where is any non-empty convex subset of K containing more than one element and which is mapped into itself by T.

Further it is obtained the result for invariant point theorem for a non-expansive mapping, mapping a closed bounded convex subset of a Banach space X into itself which has uniformly normal structure. It is further proved invariant point theorems for certain different type of mappings under the assumption that the Banach space X has uniformly normal structure. If is showed that every uniformly convex Banach space

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has uniformly normal structure. It was an open question that whether a Banach space with uniformly normal structure is reflexive, It is proved that every Banach space with uniformly normal structure is reflexive.

Later the condition (5) with $\sum_{i=1}^{5} a_i < 1$, has been extended by $\sum_{i=1}^{5} a_i \leq 1$

and proved a invariant point result for a continuous mapping in uniformly convex Branch space.

4 PROOF

It has been obtained invariant point result for a mapping satisfying the condition with the condition $\sum_{i=1}^{5} a_i \leq 1$ instead at $\sum_{i=1}^{5} a_i < 1$ in reflexive

Banach space with some additional conditions on the mapping.

5 CONCLUSION

Existence of invariant points for self-maps on a Banach space by altering distances between the points with the use of certain control function has been established in the literature. Comprehensive literature on the existence and uniqueness of invariant points of contractive type mappings on a Banach space can be found in the literature.

Let R^+ denote the set of all non-negative reals and N denote the set of positive integers. The following result has been proved :

Let X be a Banach space, T a self-map on X. $\varphi: R^+ \to R^+$ is an

increasing and continuous function from $[0, \infty]$ into $[0, \infty]$ satisfying

$\phi(t) = 0$ if and only if t=0. Let a, b, c be three decreasing functions from

$[0, \infty]$ into $[0,1]$ such that a(t) +b(t) + c(t) < 1 for every t>0.

Suppose T satisfies the inequality

$$\phi(\|Tx, Ty\|) \leq a(\|x - y\|)\phi(\|x - y\|) + \frac{1}{2}b(\|x - y\|)\{\phi(\|x - Tx\|) + \phi(\|y, Ty\|)\}$$
$$+ c(\|x - y\|), \min\{\phi(\|x - Ty\|), \phi(\|y - Tx\|)\}$$

for all $x, y \in X$ with $x \neq y$. Then T has an invariant point.

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ROLE OF PUBLIC LIBRARY AND A FUTURE VISION OF ICT ENABLED SERVICES WITH SPECIAL REFERENCE TO INDIA

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Abstract:- Public libraries are primarily institutions of basic learning having a mission which involves in providing collection and services to meet information needs of local community. These serve as local gateway to knowledge and information and provide conditions for lifelong learning, community development and independent decision making by an individual. Majority of population in India lives in rural areas where new technologies are not within the reach of people, that is why a gap has widened between information rich and information deprived community. The paper also discuss how internet and web technologies have paved the way of interactive communication between libraries and its clients whereby a remote user can be connected by several technical options in a more affordable manner. An attempt has also been made here to provide a futuristic vision of ICT enabled public library services in India to help the entire rural as well as urban community especially unprivileged masses.

1. INTRODUCTION

The potential impact of the internet on the public demand for the services and resources of public libraries is an issue of critical importance. Public libraries are social institutions offering services based upon books and information for various public groups on social, political, economic, cultural and other matters. Among the different types of libraries evolved by the society in modern times, public libraries are the most popular because of the functions they perform.

They play a significant role in the welfare of the society. Public Libraries have a social mission and are devoted to the development of the community. It has been providing information for education, leisure and entertainment for decades and will continue this function for many more years. Users are able to read and borrow anything available in the system. The library is seen as a safe place for people to meet or simply browse through rows of books (Hendrix, 1998). Whatever may be the changes that are taking place, Public libraries cannot set back from their established roles i.e. culture, education, reading, literacy, and information.

2. PUBLIC LIBRARY- DEFINITION

Public Library has been explained differently by different experts depending upon the importance they give to its objectives. However, the most widely accepted definition of a public library was formulated by UNESCO in 1949 which was later revised in 1972 (UNESCO 2004).
According to UNESCO manifesto, the definition of a public library is as follows:-
    a. Public Library is financed for the most part out of public funds.
    b. It charges no fees from users and yet is open for full use by the public.

c. It is intended as an auxiliary educational institution providing a means of self education which is endless.

d. It houses educative and informative materials giving reliable information freely and without partiality.

3. FUNCTIONS OF A PUBLIC LIBRARY

A public Library generally performs the following functions:

- **Access to Tools of information and Education-** It is the primary function of a public library to select and to organize need-based literature and other means of information and education suitable to the requirements of the local community in which the library is located.

- **Instrumental in Informal Self-Education-** Public library is one of the agencies on which an adult heavily relies. It proves him/her suitable learning material to develop his/her skill and competence in areas of interests. Self education may be obtained through a public library such as methods of agricultural operations, scientific methods of poultry, bee keeping etc.

- **To Promote Cultural and Social Activities-** A public library lends active support to many socio-cultural groups, such as children's club, youth forum, dramatic club, teachers association, lawyers or doctors associations, film society etc. to conduct their activities through its premises or through its rich informative, educative and cultural materials.

- **Preservation of Local Material-** Another important function fulfilled by a modern public library is to identify and collect cultural material of importance available in its jurisdiction. These may be works of art or sculpture, paintings, documents, musical instruments etc. In a nutshell, a public library goes in search of all such materials which link the people of the locality with its cultural past.

- **Strengthening of Democratic Spirit-** By bringing together in its socio-cultural activities seemingly different segments of the society on a single platform, the library slowly develops a sense of amity, a sense of respect for other groups, an appreciation of the differences in languages, religion, customs and manners. Thus sectarian life styles are substituted by democratic life patterns. In this sense, a public library justifies its existence as a democratic institution.

4. ROLE OF PUBLIC LIBRARY IN THE SOCIETY

The society is of multi-lingual and multi-cultural nature. In such type of society a sense of respect and regard for other linguistic and cultural groups is essential to strengthen the cultural unity in diversity. Hence, a public library needs to address itself in organizing functions and get-together meetings of different cultural groups to give vent to the aspirations and contributions of different cultures. Occasions like national festivals, religious festivals, and birthdays of national or religious leaders could be utilized to serve such an objective.

Another notable role a public library plays in this sphere is the work relating to the preservation of local cultural materials. In order to identify and procure such materials, a public library solicits the assistance of historians, archaeologists, literary persons and leaders of

the area. Thus the library serves as a link between the past and future. The UNESCO Manifesto declares that the public library is concerned with the refreshment of man's spirit by the provision of books for relaxation and pleasure (UNESCO 2004).

The term book is interpreted here in the widest sense to include all recorded materials of mankind depicting his excellence in prose, poetry, drama, music, painting, dance and sculpture and collected together to provide a soothing effect to the working mind. As a public library is required to meet the individual needs of the local public, local or regional cultural materials are given a place of utmost prominence. Thus, a Public library is essentially a free library financed by public funds providing impartial service to all the members of a local community despite its cast and creed and a democratic institution providing information, education and culture to each user according to needs.

5. PUBLIC LIBRARIES IN INDIA- CURRENT STATUS

India can now claim to be the world's largest democracy: its population growth has made it the second country in the world after China to cross the one billion mark (Arora, 2001). As its population grows, it is faced by enormous challenges in areas such as literacy and education, areas in which it has long been acknowledged that the public library has an indispensable role to play. This role accords with the dentition in the UNESCO Public Library Manifesto (UNESCO, 2004), which declares that the public library is ―the local gateway to knowledge, [and] provides a basic condition for lifelong learning, independent decision-making and cultural development of the individual and social groups‖.

In this vision of public libraries, they are seen as people-oriented institutions which should service the widest population possible. However, public libraries in India are in a state of abject. Possessing neither regularly renewed print collections nor vibrant non-print multimedia resources that could lure in illiterate or semi-literate folk; they suffer from a variety of infrastructure, manpower and monetary constraints, as well as being low in the priorities of policy makers and implementing bodies. At the same time as India's expanding population looks for innovative support and services from its libraries, the country has emerged as one of the global leaders in information technology and one of the largest exporters of knowledge workers.

In this digital era, the people of India should thus come to think of the public library not only as a champion of books and knowledge but as a major access point to the benefits of the digital age. But again, as a developing country, the economic conditions for libraries and information centers are poor in this regard, especially by comparison with the developed world. On the one hand, there has been a significant degree of implementation of automation and networking in special and academic libraries. But in rural areas, where a majority of population lives, public libraries are almost wholly dependent on financial support from central or state government for their collection development, infrastructure and human resources, and as a result planning for modern tools and IT facilities in public libraries has not taken place.

Though there are a number of constraints faced by Public Library system in India for effective dissemination of information, they are providing traditional library services with utmost care and trying to serve the community in the changing atmosphere also. A number of public libraries especially in the urban sector have adopted Information Communication Technology (ICT), thanks for the help received from RRRLF. But despite these advances, majority of the population are still denied the benefits of these services (Parameswaram & Vimal, 2008).

6. INFORMATION AND COMMUNICATION TECHNOLOGY IN LIBRARIES

ICT has been one of the major factors causing changes in the way people communicate, locate, retrieve, and use information. Libraries and information centres have embraced the ICT more profoundly than many other fields, and most of them are currently using electronic products and services. It is evident that ICT has created a division in the modern society: information poor and information rich. The countries that had the ability to utilize ICT for information resource development have generated information-rich societies while those countries which were weak in utilization of ICT have created information-poor societies.

As information is directly related to knowledge and skills which influence socio-economic development, one could hypothesize the relationship between information and development. This has speculated the assumption that information-richcountries have developed economies and information while poor countries have less developed economies (Yapa, 2003). Because economy and information are closely related and information resource development leads to economic development, policy makers pay special attention to the development of information resources. It is recognized that ICT is a tool which could be manipulated effectively for information resource development.

This explains why economists in the Developed World are interested in ICT. Library systems were re-structured to accommodate ICT in library operations, because of the belief that the success of a library can be measured by the extent of ICT use by the library (Yapa, 2003). H.K. Kaul has opined that —Our public library system in the country failed totally in bringing knowledge to the doorsteps of every individual. It is advisable for us to look at the problem afresh, especially when the computer and communication technologies have now become available to us at a minimal cost (Kaul, 2002).

7. ICT ENABLED PUBLIC LIBRARY SERVICES IN INDIA- A FUTURE VISION

The new technology which today is available is just a new tool to produce, store and distribute information. It also makes the communication more effective and rapid. That is why we call it nowadays ICT, Information and Communication Technology and not only IT, Information Technology. As means of communication this new technology is comparable with the book. We all know that ICT has already changed the way libraries function. As information and knowledge institutions, public libraries in developed countries are

probably among the institutions within the public sector that have been most actively involved in the digital revolution.

The Indian scenario in this regard still depicts the gloomy picture as only libraries of national repute have started using ICT in providing services and state public libraries and district libraries are still deprived of this vital service. However the Indian government has started taking stock of the situation and states are enacting Public Library Acts. Punjab government's recent announcement to pass this Act is a step in this regard. Therefore, in near future it is expected that all public libraries would get equipped with ICT and following services would be provided by them:-

- **Networked Library Services**- Communication services on Internet are now more accessible for public use. Blogs, Wikis, Pod Casting, RSS feeds, email, instant messaging and SMS are powerful communication tools available through Internet. These services have the capability of changing the nature and delivery of library services. SMS, E-mail and chat services are already popular among public libraries to deliver reminder, notification and reference service. Sending SMS via on-line is comparatively cheap or free. As ICT is implemented in public Libraries in India, these would be aware of how to make use the advantage of these new age communication services to keep connected to the community.

- **Multimedia Collection**- ICT has changed library and information services globally. Digital media has revolutionized the information source and advances in ICTs have dramatically changed the information provisions. The Internet has provided universal access to information. Technological innovation has changed the rate of conversion of knowledge, information and data into electronic format. Development in the software arena has generated powerful knowledge management software which has transformed the way knowledge is organized stored, accessed and retrieved. Therefore, in the near future we can expect to have our public libraries equipped with all type of collection including multimedia.

- **Community Skills Development**- Functioning effectively in the information age of the 21st century is not just a matter of computer or technological competence. It also calls for a new kind of information literacy or intelligence attuned to the digital world and the changing nature of what counts for knowledge, and for what we have termed civic literacy. The main thrust of the efforts of public libraries would be in developing citizens' capability and confidence in using ICT. In this regard, the public library would establish an in-house training team to provide a tailor-made, flexible training programme to staff. The team would also deliver ICT training to the public on a countywide basis, focussing on those groups most marginalised in our community, for example refugees, the elderly, travellers and those on low incomes

- **Digitized Heritage Service**- With the implementation of ICT in public Libraries, an archive of local reminiscence materials, based on citizens' stories, photographs and objects from an earlier period of the town's history, would be digitized. The

resources of library will stand networked or mounted on the web and these shall be accessed from a PC located in the reference library. This application would also provide access to other information such as opening times of the cultural institutions, special exhibitions and events, and to other services such as ordering photographic prints or downloading images.

- **Online Catalogue and Related Services**- This would facilitate remote access to the full range of library services, including the ability to renew or reserve books and other stock, and to check the user's own borrower record. Accessing an electronic database of community information, tailored to the library would be feasible. Posting an inquiry to the Ask a Librarian' service, using the electronic portal to access the digital resources of the library and partner organizations and Finding information helpful to selecting reading material e.g. top ten reads' of the month would be possible. The library's catalogue being online, would allow users to perform basic search/browse functions from any networked PC.

- **Library Extension Service**- Library services have traditionally used mobile libraries as a way of reaching remote users from library service points or physically unable to access the library. Information on local community groups and in one particular case, information on local tourist attractions was presented with commentary and images alongside. With the application of ICT, the information would now be hosted on the library's website or loaded onto a CD-ROM and networked. It will further pave the way to establish gateways to information compiled in collaboration with other agencies. Examples of these include local education and training opportunities; local services and support agencies for people from minority groups; information for careers about available support services and rights entitlements; learning materials dedicated to sport education and training and alerts regarding health related issues.

- **Education and Training for Staff**- Training are crucial in opening up online services for people using public libraries. Staff working in public libraries must be encouraged to attend continuing education programs and skill enhancement to use ICT technologies to the fullest extent in delivering public library services. The public libraries must be under the control of a full time library professional and they should get allowances and service conditions comparable to the counterparts in academic, research and special libraries. What is needed most a competent librarian who can organize the services in a balanced manner for all sections of the community served by the library.

8. CONCLUSION

The public library system in India is condemned to remain peripheral to the actual information needs of the masses; that it is in a depressed state, and serves as little more than a warehouse of recreational reading materials, a majority of which are in regional languages. Traditional in-house library services themselves cannot be stretched to meet the material needs of patrons who face distinct and different challenges involving library access and information delivery.

Special funding arrangements, proactive planning, and promotion are necessary to deliver equivalent library services and to achieve equivalent results in community teaching and learning, and generally to maintain quality in public library services. Library leaders must have the skills to create and nurture a new type of library culture in which change is encouraged and new visions of service can be implemented (Kent, 2006). According to Susan Kent library leadership issues mainly revolve around three factors: architecture, technology and planning. In view of the public library setup in context to India, all these factors seem to be nowhere worked out yet.

Christopher Edwards in his article has rightly pointed out ―Providing access to information has traditionally been about buildings, based around institutions offering services to onsite users. Building tomorrow's libraries will not simply be a matter of installing rows of computers with Internet access: our users will increasingly expect to be able to access material from where they live and work. Providing access will increasingly be about developing electronic information services such as Internet portals and acting as a broker between content providers and remote users‖ (Christopher, 2001).

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