

Review Paper

Information Infrastructure & Digital Divide: In the context of Indian Universities — *The Economical and Financial Context*

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ABSTRACT

Each and every organization, institution needs information and allied objects for the growth and proper development and without a sufficient amount of information it is very difficult to sustain and run an organization. Universities and Higher Educational Institutions work and function based on various academic and administrative units and sections; and in each and every section information is very much crucial and valuable. The development of information related activities is called Information Systems and 'Information Infrastructure' is a broad concept which is required for information collection, processing, management and delivery in manual and technological mode. There are different types of sections and sub-sections exit in model Information Infrastructure systems. Each and every universities depend on proper information management systems and there are issues in relation to social, technical, psychological, economical and managerial. In an university system and general organization there are numerous systems and procedures in managing data, information and other documentation. Many institutions keeps information as usual and without any professionalism and that lead to the failure of organizational goal and proper development. Economical and financial issues are alarming in purchasing and maintaining technologies, systems, and Human Resources, etc. And this paper is about the basic of Information Infrastructure with a special focus on economical and financial issues in the context of Digital divide.

HIGHLIGHTS

- ① Information Infrastructure is a concept and system that connects healthy and sophisticated information and documentation system.
- ② Information infrastructure is basically mistakenly considered as technological solutions, however it is beyond that and also it combines with manual documentation procedure.
- ③ Among the issues and challenges of Information Infrastructure some of the important are include 'Economical and Financial' considered as worthy and impactful.
- ④ As far as Economical and Financial issues are concern of some of the alarming issues which include electronic equipments, technologies, content development and skilling requirements, etc.
- ⑤ In developing knowledge grid, manual information systems also financial and monetary aspects and concern are considered as impactful.

Keywords: Information Infrastructure, Educational Systems, Digital Divide, Documentation, Economical Issues, Economical Issues

Information is utmost vital and worthy in respect of development of every kind. It is required in almost all the segments irrespective of its size and nature. Information and its requirement in different areas thus give rise of a proper management and in

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true sense that is called Information Management. Information is a broad concept and growing swiftly due to its evolution and requirement (Paul *et al.* 2013; Aanestad *et al.* 2014; Friedman *et al.* 2017). Therefore an appropriate structure is highly demanded for various information activities including in different forms. Traditionally Information Infrastructure is treated as substitute of the IT Infrastructure. However it is a deep concept and periphery and also considered as an instrument for standard information management. Hence Information Infrastructure is mixed of both technological and manual stakeholders. Information Technology Infrastructure primarily deals with the Networking, Database, Web related, Multimedia Infrastructure etc. There are other contributors and partners and business in Information Infrastructure including ICT Infrastructure Management [Ellefsen *et al.* 2012; Dong *et al.* 2014).

Information is the very dynamic and beneficial term of the world today and this is needed in almost all the zones, sectors and areas and hence a conducive Information Infrastructure is needed for active Information Management. Based on scrutiny and inquiry following could be considered for important characteristics, nature and attributes of Information Infrastructure—

- ♦ Information Infrastructure is a broad space, sensitive and ingredients transactions with following features and characteristics and facts.
- ♦ Information Infrastructure which consists of information and akin capacity such as knowledge, data etc. and plays a leading role.
- ♦ Information Infrastructure may be hand operated or it may be high- tech supported such as Computational Information Infrastructure or IT supported infrastructure.
- ♦ Manual Information Infrastructure knowledge constructs device and documents, systems play a vital role (Chatterjee, 2023; Chatterjee *et al.* 2023).
- ♦ People of Human Resource are also treated as an important for improvement of the healthy Information Infrastructure. Here it is information which is to be note that the planner and the end user of Information Infrastructure are the people or Human Resources.

- ♦ Information Infrastructure is accepted approach and can be unified both in manual and technological nature.
- ♦ A refined IT should hold interlaces of all its technological and other elements properly.
- ♦ Scientific designing and development of Information Systems and Sub Systems with Information Infrastructure are highly required.
- ♦ Keeping aside General Information Activities a typical Information Infrastructure should have proper evaluation.
- ♦ Information Infrastructure as a big field; therefore here decent integration should be for a recent technological input system (i.e. the integration).
- ♦ Convenient Management tools need to follow up in better Information Infrastructure designing and development.
- ♦ Visualization and digitalization are considered as cream characteristics in Information Infrastructure.
- ♦ Information Infrastructure based on corporate formation can hold different features.

Therefore, the structure of Information Infrastructure can be depicted in technological and manually shown in Fig. 1.

Information Infrastructure: Its Fundamental Need and in Educational Sectors

As Information Infrastructure is a broad area and blend of both hand operated and computing systems instrument, ingredients, therefore in recent past the role of Information Infrastructure as a comprehensive solution for information and technological support in an organization is highlighted. It deals with various opportunities but among these, the core valuable; are included (but not limited to the following) —

- ♦ It attempts both Manual and technological assistance; therefore under one roof the Information and Technological support can be possible.
- ♦ It helps in improvement of normal activities of the organization and thus it aids in enhancing productivity and efficiency.
- ♦ Human resources in both information

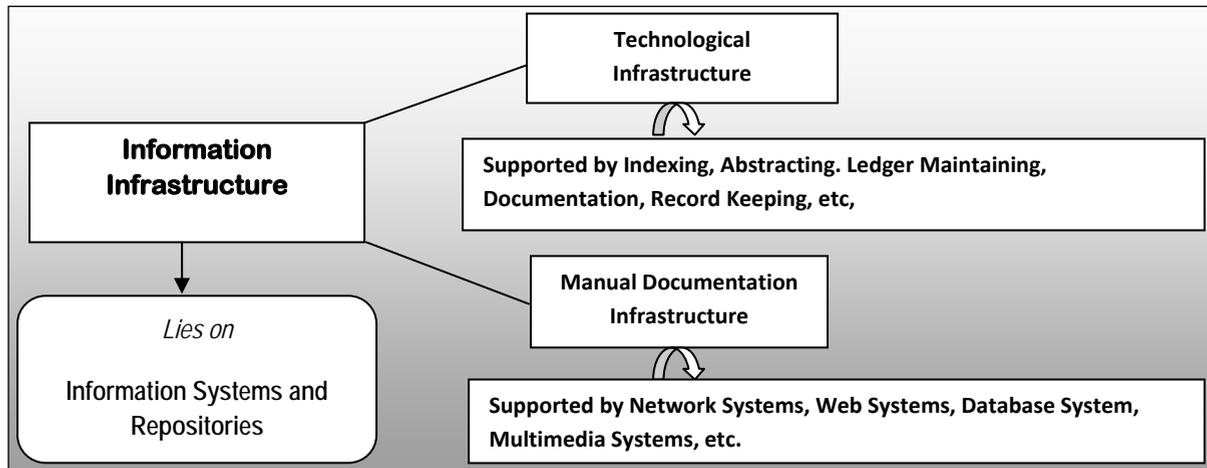


Fig. 1: Supporting system and technologies in Information Infrastructure (manually & technologically)

system parts are frequent and needed but as Information Infrastructure influences both types of information systems hence it helps in sharing of ideas, views, knowledge and expertise among the two types of team.

- ♦ Due to one roof nature the Information Infrastructure helps in cost saving by minimizing creation of two separate entities in an organization.
- ♦ It helps in better knowledge transfer systems and information cycling; including knowledge management (Pyla, 2012; Seo *et al.* 2012; Asrani, 2022).
- ♦ In recent past the development of Information generation is remarkable, hence managing large amount of information become difficult by the traditional system or by office executive, hence in this regard Information Infrastructure play an important role.
- ♦ Time is a significant subject or matter for any kind of institutions and organizations; and in this context by proper input (Information and Technological Support) to the required team it delivers in times.
- ♦ Clarity is another perks of Information Infrastructure and it can solve this problem by different means.
- ♦ The organizations and institutions include incorporated body's decision which is treated as vital and here Information Infrastructure can be useful.

- ♦ Information Infrastructure is dedicated to build automation and collaboration environment among these division of institutions and organization.

IT Infrastructure is a broad concept and consists with different kind of components as already discussed such as Data Infrastructure, IT Infrastructure etc. IT Infrastructure is a broad concept and it consist with following generally –

- ♦ Network Infrastructure
- ♦ Data Infrastructure
- ♦ Software Information Infrastructure
- ♦ Multimedia Infrastructure
- ♦ Community Infrastructure etc. (Youmans *et al.* 2012; Hidas *et al.* 2016; Bandyopadhyay *et al.* 2022).

IT Infrastructure is required to design and develop, operate managing enterprise, IT Systems. In traditional context, IT Infrastructure includes only hardware, software, network operating systems, data storage etc. In this concept hardware includes the basic computers, servers, data centre, router, switches and other hardware infrastructure. As far as software is concerned such infrastructure include the system software, application software, utilities even web server, content management, operating systems and also be considered as a part of the software infrastructure. As a whole the concept of Information Infrastructure and its allied facets have been depicted in Fig. 2.

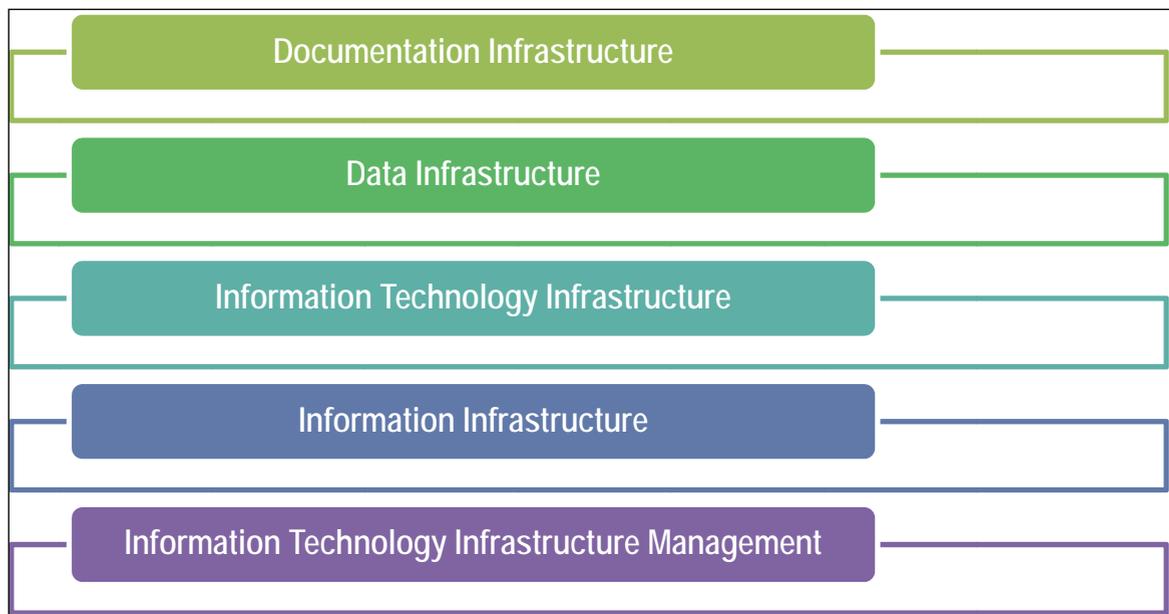


Fig. 2: The allied concepts and nomenclature of Information Infrastructure

Information Infrastructure, Digital Divide and Economic Problems

Information Infrastructure is about the dealing information and similar content systematically and it is an important fact that in many institutions and countries there are disparities within ‘have’ and ‘have-not’ and this is simply called as Digital Divide. The difference between groups and areas that have access to modern information and communication technologies (ICT) and those that cannot or are denied access to them is called the “digital gap” in areas such as telephone and television, personal computers and internet connections are part of this technology, and the term “digital divide” is used to divide people with and without a phone based on availability. The term broadband began to be used in the late 1990s to describe the difference between people with and without internet (Chatzipoulidis *et al.* 2015; Sutherland *et al.* 2017; Chowdhury *et al.* 2022). Digital divide can occur even in communities with limited technology such as weak computers, slower wireless connections, cheaper Internet connections (for example, phone calls), and subscription content is limited. Research and analysis shows that the digital divide still exists today. A 2019 study estimated that 15.3 million urban or metropolitan areas and 5 million rural households in the US still do not have access to broadband internet.

The lack of access to digital devices, including computers, mobile phones, tablets and the Internet, is called “digital segmentation”. Access to resources and information is unfairly divided and distributed due to the digital divide. People who do not have access to the Internet and other ICTs suffer because they cannot find or find employment, shop or sell online, participate in independent processes, or conduct research and education. This is especially true in the information age, where information and communication technologies (ICT) have become the technologies that underpin business, international trade and relations (Singh, 2010; Asrani, 2022). Calculation of the difference on the Internet can be done in several ways. Each field has its own criteria with different measurements and features. Another site focuses on the geographic area that Internet Service Providers (ISPs) take advantage of, while others focus on saturation pricing for devices such as laptops or smartphones. According to the United Nations Broadband Commission for Sustainable Development, approximately 3.6 billion people are still not connected to the internet. That means 4.1 billion people (about 53.6% of the world’s population) are online. It is a fact that still not a good percentage have reached worldwide internet connectivity and a sample dataset of ITU is depicted in Fig. 3.

The data and fact clearly show that, internet play a vital role in the development of the information

technology based Information Infrastructure, and as much as internet users and system will grow it will help and promote general information infrastructure [Chowdhury *et al.* 2022; Chowdhury *et al.* 2022).

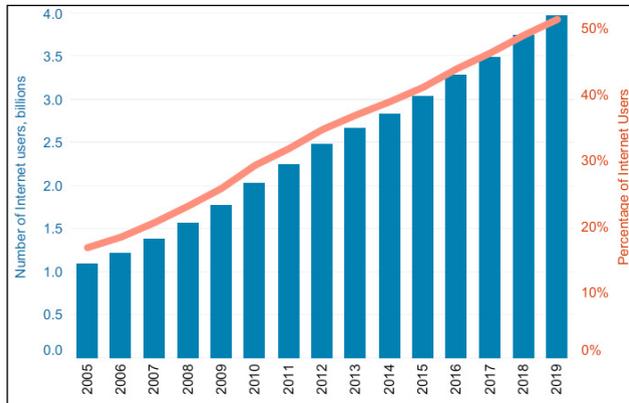


Fig. 3: Worldwide internet connectivity as on 2019 in the context of Information Infrastructure

Today universities and institutions are purely dependent on Information Systems and Information Infrastructure and in this context social, psychological, technological and economical factor considered as worthy and impactful in developing a modern information infrastructure. Digital Divide is also indirectly connected with the proper development of Information Infrastructure in certain context. This aspect of Digital Divide matter is highly connected with the educational institutions and universities. In India there are huge disparities in ICT uses in general and also in educational institutions and universities, and several reasons are knocking in this regard. Information Infrastructure therefore required in developing better and sophisticated educational systems and the aspect of Digital Divide is must be addressed in this context (Krishnan *et al.* 2012; Hu *et al.* 2017). There are various reasons regarding Information Infrastructure development in lacking and out of which economical issues and constraints treated as most vital and crucial.

Economical and Financial Concern of Information Infrastructure: Context of Universities

Information infrastructure is one of the important parts of data management. From Data Collection to data formulation, from data processing to storing of the data - every step is important in Information

Infrastructure. Information infrastructure is necessary to manage all kinds of data in an organization. It very tough to implement the Information infrastructure in any organization, as it has associated with some economic and financial issues (Mondal & Mete, 2012; Akman & Mishra, 2014; Luo *et al.* 2015). To create a proper infrastructure to store and manage large amount of data it requires a financial support. Figure 4 shows the Economic and Financial Issues and Information Infrastructure.

Electronic Equipments and Financial Concern

A good infrastructure needs to be established to handle the data efficiently and deals with huge amount of data. To build the infrastructure, it is necessary to invest in various electronics equipments. It is necessary to purchase computers (Desktops and Laptops), server, routers, switches, repeaters, various networking devices and others hardware. It is also necessary to set up network connections using various types of Information and Communication Technologies (ICT). As it involves financial investment, developing countries have considerable problems in building this infrastructure. The initial infrastructure investment cost is huge, so it is also difficult for the educational institutions to establish information infrastructure in the institutions (Paul & Ganguly, 2013; Paul *et al.* 2014; Chatterjee *et al.* 2023). The educational institutions need proper financial support to implement the information infrastructure to achieve the goal of digital education.

Technologies and Economical Concern

Technology is one of the important parts in information infrastructure. Technologies are the backbone of information infrastructure. Various kind of basic and emerging Technologies are used to implement information infrastructure. Basic information technologies like- software technology, Network Technology, database Technology, Web Technology and multimedia Technology have used to manage the information properly. The technological implementation plays a vital role to manage the huge amount of data. To implement different kinds of Technology, it needs strong financial support and funding for designing and developing the software which is suitable for the

academic institutions. Proper funding is very important to implement the Technologies in existing system. Similarly, wide networks, sophisticated network and dedicated network are also important in information infrastructure. So to implement various kinds of Technologies a huge amount of funding is required.

Content and Economical Concern

Contents are the one of the important elements in information infrastructure. Contents are the expression of any concept in written form. Whether it is general information infrastructure any institutional information infrastructure or any Academy information infrastructure, it is used in everywhere. The main aim of the information infrastructure is to manage the content efficiently and effective. It is one of the toughest jobs to create the content and manage them systematically. There are various tasks associated with content management. Content designing, content development, content writing, content storing, content management and so on at the different part of content handling (Seo & Thorson, 2012); Chowdhury *et al.* 2022). Adequate financial and economic support is required to perform various tasks associated with content management.



Fig. 4: Economical and Financial Issues and Information Infrastructure

Skilling, Human Resource and Economical Concern

There is different type of tasks associated with information infrastructure. Some people are responsible to create the content, some are responsible for operating the system, some are responsible for managing the system, some are responsible for the maintenance of the system, some personals are responsible for technological

support, responsible for technical support, some are responsible for execution and the management of the system and so on. All types of tasks requires various kinds of skill sets and working knowledge. Different types of skills are required for the manual handling of the data or technologically handling of the data. To grow different type of skill sets in employees proper human resource planning are required. It is necessary to give proper training to the resource persons (Singh, 2010; Sutherland & Jarrahi, 2017). It requires a huge economical and financial support to give the proper training to the resource persons.

Knowledge Network and Grids: Financial Concern

Digital education plays some vital roles in this modern era. Digital education could be possible in on-campus based physical mode as well as internet based online mode. E-Learning becomes popular among the students due to some advantages over on campus best physical mode. Efforts are underway to digitize educational content. Various knowledge networks and knowledge grids have been established for digitization of education system. There are different types of Knowledge Network available, like- National Knowledge Network, Infilbnet, National Digital Library of India (NDLI), Universal Digital Library, Directory of Open Access Books (DOAB), Internet Archive, British Council Online Library, Delhi University Library System (DULS), National Academic Depository (NAD) and so on. It is very tough to build the repositories. To build an active Knowledge Network, it needs huge amount of technical, technological, human resource and financial support (Paul *et al.* 2013). It is very challenging to create any Knowledge Network with high volume of content. It needs wider plan and nationwide network. Hence, the financial support to build this vast knowledge network is a challenge.

Manual Documentation Systems and Finance

It is assumed that Information infrastructure is technology dependent or it may not be. It may be maintained in the form of manual documentation. Manual documentation has been maintained in various offices and educational institutions. In University system manual documentation system is also maintained there. For the proper organization

off the data it is required to maintain the manual documentation parallel with Technology based documentation. It is noticed that the manual documentation is also maintained in various kind of organizations like Bank, post office, Insurance office and so on. In case of any error the manual documentation plays vital role. For the proper maintenance of the documentation it is associated with economical and financial support.

Information Repositories and Budgets

Information play the vital role for any country. The more information you have, the greater is the power of your knowledge. The volume of information increases exponentially for any organization. Therefore it needs proper planning to maintain and store the information using different basic and emerging Technologies. Information repositories play an important role to store the information in proper and organized way. Information repositories could be local level, National level all international level. We find the utilization of information repositories in difference fields. Information repositories are very much needed to provide various kind of information when it required. Building a large repository is a very challenging task. It needs a huge amount of funding to build a huge repository.

Continuous Infrastructure and System up gradation with emerged Financial Aspects

It is necessary for any system to update to cope up with technological advancement. As the time goes various Technologies have and provide some additional features and faster mechanism. Different emerging Technologies like artificial intelligence, machine learning, data science, cloud computing Technologies, BigData Analytics, Internet of Things (IoT), block chain Technologies and so on. To reduce the cost of operation and make the system secure it is necessary to adopt the new technologies. The adaptation of new technologies and establishment of Information and Communication Technologies (ICT) a huge economical and financial investment. It is also necessary to give the proper training and various development programs to the resource persons. The continuous up gradation of human resource is also necessary for any organization. The skillful resource people are the key of to success for any organization. To increase the productivity of any organization, it is necessary to provide different types of training program to the employees of the organization (Krishnan & 2012; Sutherland & Jarrahi, 2017). So to investment in human resource is also associated a financial burden to any organization.

The concept and issues of economy and finance in relation to Information Infrastructure is depicted in Fig. 5.

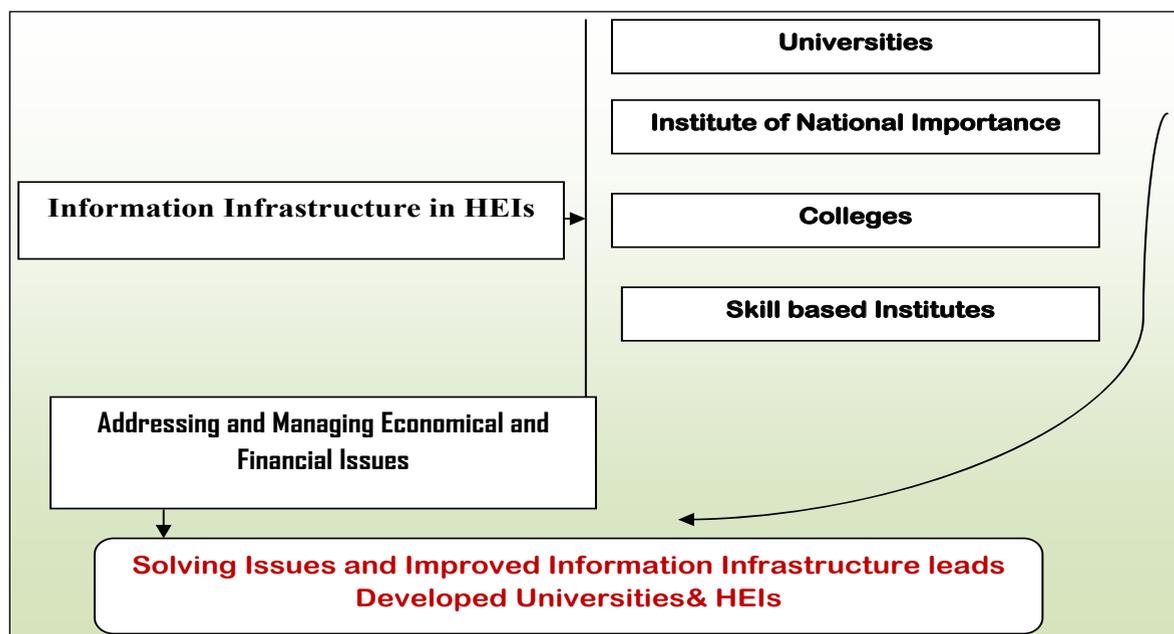


Fig. 5: Solving Economical Issues to the Information Infrastructure and its ultimate results

As universities are the highest apex institutional body in a country like India, there are many financial and infrastructural issues. To solve this issues the institutions could arrange proper funding and government should take the responsibility to solve the issues by allocating proper funding for the projects. To establish and to access any information infrastructure, it is necessary to have sufficient number of digital devices like-computers (Desktops and Laptops), server, routers, switches, repeaters, various networking devices and others hardware. To purchase these digital devices the institutions need money and adequate technological support. Technologies play a vital role in establishing information infrastructure to any university. Information Technology (IT) and Information and Communication Technology (ICT) are responsible for the technological establishment of information infrastructure (Paul & Ganguly, 2013; Sorokin *et al.* 2017). Various emerging Technologies like artificial intelligence, machine learning, data science, cloud computing Technologies, BigData Analytics, Internet of Things (IoT), block chain Technologies and so on are responsible for faster and efficient system. The technological advancement helps in more systematic management in less cost. To incorporate this technological assistance the universities should invest which is also associated with financial concern. The government should also allocate funding for the incorporation of basic and emerging Technologies. A good information infrastructure should have a large content based which is the main part of this information infrastructure. It is a tough job to build the huge content base. To create this content based it needs financial assistance from the government and from the other bodies. To create, manage and operate it needs lots of skillful persons. Thus, it is necessary to give the salary to the employees responsible for the information infrastructure. So the universities should pay the salary to the employees which are also the need of the financial support from the constant body. As the knowledge networks are for creation, it to provide the knowledge to the learners. It has a huge database of contents. It is very tough task to build a knowledge network for any institution. As it needs a strong support of technical, technological, content and human resource, each of the parameter needs a strong financial support to build an efficient

knowledge network. To overcome any contradiction and to solve logical error it is necessary for the universities to maintain manual documentation parallel with technological support. The universities maintain this manual documentation for the physical evidence of any document and some other purposes too. The universities should allocate the funding for the maintenance of these manual documentations. The large volume of information has been stored in local, National and international level of repositories. The universities need to invest to maintain this different level of repositories as they needed (Seo & Thorson, 2012; Dong *et al.* 2014). The maintenance of the system is also a vital issue for the universities. To improve the performance of the system it is necessary to update the software and incorporate the modern technologies with the existing system. It is also necessary to provide continuous up gradation of skill of the human resource manages the information infrastructure system. All of the tasks are very much necessary for the smooth, systematic and efficiently executable information infrastructure which needs a strong financial support what the universities have. The government and the other financial body should take the responsibility to solve the financial issues faced by the universities for the betterment of the students. Therefore solving digital divide can a great solutions in order to develop good and healthy Information Infrastructure and its ultimate benefits.

CONCLUSION

Information Infrastructure is recognized in all types of corporate such as private, public, profit making and nonprofit making, small or large—for all due to its prominent attributes; each and every organization use the broad concept i.e., Information Infrastructure. Technologies are crucial for information task and therefore in Information Infrastructure it is taken as important and practiced everywhere. However due to the requirement of Information in all different areas or organizations. There should be proper and efficient mechanism in Information Infrastructure design, development, evaluation etc. Government and each and every organization need to practice proper Information Infrastructure in technological and manual means for solid and healthy development and information solutions. Development of the proper manpower,

awareness, initiatives etc. from different levels are also required for the healthy progress. Economical issues are main constraint for developing any kind of Information System and Infrastructure for manual and technological process and development and countries and states including administration must need to address the issues and solve the same at the earliest for a developing Knowledge Economy.

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