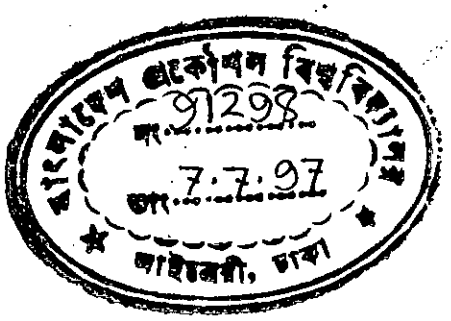
ENGINEERING KNOWLEDGE AND SKILL TRANSFER THROUGH MULTI-MEDIA COMMUNICATION

A project thesis

by

RUBINA HAQUE

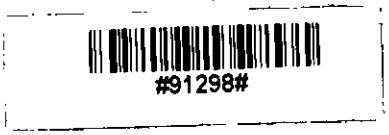


Submitted to the department of Industrial and Production Engineering, Bangladesh University of Engineering & Technology, Dhaka-1000, in partial fulfillment of the requirements for the degree of MASTER OF ENGINEERING in Industrial and Production (IP).

Department of Industrial and Production Engineering
Bangladesh University of Engineering and Technology

Dhaka-1000, Bangladesh

June 25, 1997



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ABSTRACT

In the conventional education system the sources of knowledge and skill receive more attention than the factors of knowledge dissemination. Knowledge dissemination media, specially with the development of multi-media communication technology, will become an important factor for the future education. Thus, the rapid development of the information and the communication technologies may bring an unprecedented structural change in the education system.

The total cost involving teaching fees, educational materials and living and health expenses etc. for a foreign student in a Canadian representative university is currently US$ 42,925. Furthermore, there are problems of cultural and languages barriers. In the proposed model knowledge and skill transfer will be possible through the multimedia communication. Tele-turorial tele-conferencing with teachers and fellowmate are now possible. Through the Internet a student of Bangladesh can be a student of McGill University of Canada without physically moving to Canada. So knowledge and skill transfer becomes time wise and space wise flexible. This mode of knowledge transfer can be more interactive. For an undergraduate engineering education of 120 credit the total cost involving teaching fees, Internet changes, educational materials and living and health expenses is estimated to be Tk.14,22,392 (i.e. US$ 33,566). Developing countries like Bangladesh should encourage such changes and be prepared to take advantage of the technological development of the 21st century.

Chapter One

INTRODUCTION

Knowledge has always been a challenge to mankind. The knowledge domain of a society and thus a education is a measure of its progress. Knowledge has three components, such as source of knowledge and skill, the receiver and the media to transfer the knowledge and skill. The objective is to educate the receiver. The sources of knowledge are, for example, the teacher, the text books, the journals, the environment etc. With the civilization the knowledge and skill delivery from one to many i.e. class room education system has evolved from one to one system (i.e. say Guru-to-disciple). In the early stage the earthen tablets, the stone engraving etc. were the knowledge transfer media. With the development of technology chalk blackboard, OHP, motion picture and later computers have become common tools to transfer the knowledge and the skill in the conventional education system. These tools have made it possible to transfer more knowledge and skill within a given time period. With Internet and its further development with multi-media communication, the scope of knowledge and skill transfer has increased significantly. In conventional education system the sources of the knowledge and skill received more attention than the mode of the knowledge dissemination. Every year hundreds of students of developing countries move to the developed countries for acquiring up-to-date knowledge. Besides exorbitant cost of education, the system has social, cultural and language problem. The rapid development of the information technology has opened an alternative route of education delivery from the developed to the developing countries. To educate a receiver in a developing country the transfer mode such as multi-media through Internet can be a effective mode of knowledge

dissemination in the 21st century modern education system. Such a mode will not show the disadvantages of the present system of study in a foreign country.

This project aims at study in the mode of knowledge and skill transfer through Internet.

The objectives of this study are :

i) To find out the possible role of multi-media communication in the knowledge and skill transfer.

ii) To analyze the feasibility of multi-media communication and its economic analysis.

Chapter Two

HISTORICAL BACKGROUND OF KNOWLEDGE AND SKILL TRANSFER

Education in a primitive society was not the conscious but artificial process that is with us now. Everybody learnt from his environment. A child learned by playing and his knowledge base was influenced by the family background. As he grew up and came out of the family circle into the world at large he learned from the society, from his work place and the nature. The knowledge, thus built up, is informal.

But with the passage of time and in the early stage of civilization the need for the formal and systematic knowledge build-up was felt in the society. A set of human knowledge source came out distinctly. In this sub-continent they are known as Gurus. It is recorded in the history that young men migrated to these Gurus for the search of knowledge. A knowledge seeker was a companion of the Guru for the 24 hours. He also became a member of Guru's family. The knowledge transfer was formal as well as informal and was more one to one basis. Later, as the number of knowledge seekers grew in number, the Guru started his Asram (informal school). But the mode of knowledge transfer did not change significantly.

The knowledge sources perished with the death of guru. So it was necessary to make knowledge source permanent. As a result people inscribed knowledge on clay tablet, palette (thin wooden slab), oracle bone, stone etc. With the invention of ink, paper and printing technology, the textbooks, the journals etc. became the source of knowledge to ever increasing number of knowledge

seekers. Thus the delivery of knowledge to the mass became possible. The classroom i.e. one-to-many education system evolved from one-to-one education system. This classroom education system is with us now. In this conventional education system knowledge is transferred through chalk and blackboard. Due to the development of technology OHP, slide projector, motion pictures and video etc are used in many institutions. Study shows that the rate of knowledge delivery with OHP is about 50% higher than that with chalk and blackboard[1]. In this conventional education system knowledge seekers have to be present at a definite time, at a definite place and spend 6-8 hours regularly in a day in the institution. The knowledge delivery mode of the conventional education system is mainly full time. The scheduled classes in full time are held at day time and the knowledge seekers can not do any work parallel with education i.e. the system has little flexibility. In the case of part time, the classes are usually held at night and knowledge seekers can do other work parallel with education i.e. the system is more flexible.

Chapter Three

KNOWLEDGE AND SKILL TRANSFER IN THE EXISTING DELIVERY SYSTEM

3.1 Full time/Part time:

Teacher, textbook, journal, laboratory, industrial attachment and environment serve as the knowledge source for the students (Fig.1).

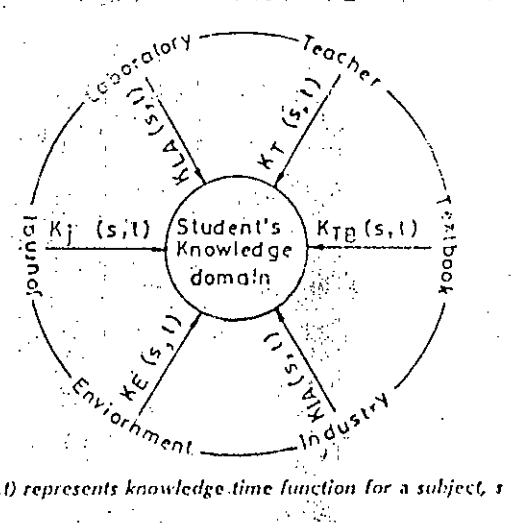

Fig. 1 : Student's knowledge domain influenced by the knowledge source (based on 1)

The knowledge and skill transfer takes place primarily in the classroom environment. And the classes are held in accodance with an announced schedule. In the full time system a student has to be present at a definite time and for a fixed time period, so that the knowledge and skill transfer

may take place. Normally a student can register for 12-18 credits per semester. In the case of part time, student can take less number of courses usually less upto 9 credits and with education he can do a job. Usually classes are held at night in the part time system.

In conventional education system the six factors receive more attention than mode of knowledge dissemination. But the mode of knowledge dissemination needs more attention for effective education. Chalk and black board is a common mode of knowledge transfer in the class room. But with the introduction of hardware like OHP, slide projectors, motion pictures and video tapes, the mode of knowledge transfer became quicker. Study shows that, the rate of knowledge delivery with OHP is about 50% higher than that with chalk and board.

Text books constitute a common knowledge source in the conventional education system. In developed countries text books are up-to-date. Every year text books are published in revised form. But in developing countries text books are not up-to-date.

Laboratory is also a knowledge source. In laboratory, a student learns the experimental procedure and gains first harnd experience in equipment usage, data interpretation and analysis. In developed countries modern equipment are used in the laboratory. But in developing countries laboratory equipment are not up-to-date. For example, the average time lag (oldness) for the text books of a reputed engineering university is 30 years and that for the laboratory equipment 31 years*[2]*.

Journal is another source of knowdge. In developed countries journals are published with recent research. Libraries in developed countries have fund earmarked for journals. So a student of a developed country can learn about the recent research work. The developing countries do not publish many journals on up-to-date research. And few countries allot enough fund to the libraries for the procurement of recent foreign journals. Hence current journals are not commonly available in the developing countries.

Environment is also a knowledge source i.e. a student learn from his family, society, peers etc. In developed countries knowledge seeker can learn a lot from his or her environment. For examples, from his family he can learn how a car works, different gadgets of automobiles etc. i.e. he acquires some engineering knowledge in the family environment. But in developing countries a student can not learn so much from his environment. Because he has no modern technological facility in his family.

Industry is another source of knowledge. A knowledge seeker can learn through training/working in a industry. In developed country industries, they use modern technology. So knowledge seeker can acquire up-to-date knowledge in the industry. But in developing countries students do not work in the industry. Nor there is any systematic training in the industries. So industry does not play any significant role as a knowledge source in the developing countries.

Weaknesses and limitations of the classroom education are as follows *[3]*:-

i) Time as well as space bound.

ii) Not much individual care (waiting line for an appointment) possible.

iii) Pace in the class is not congenial to those, who are significantly above or below the average student's level.

iv) Demands of physical facilities for knowledge delivery (class room, OHP, chalk, board).

v) Class routine may not be convenient for some students, who, for example, stay far away from the institution or who are not free during the class hours.

Furthermore, in the developing countries like Bangladesh most of the above mentioned knowledge sources for engineering education are not up-to-date which is mentioned earlier.

These unavoidable circumstances in the developing countries make most of the students bound to move to the developed countries for acquiring up-to-date knowledge. Because in the developed countries the sources of knowledge and skill are approachable. Hence we could approach different sources of knowledge of developed countries from, say Bangladesh, to update the knowledge and skill domain.

3.2 Open University

To the weaknesses of the conventional education system the distance education system in the form of Open University and correspondence schools started working. It is one type of distance education system and uses part time delivery mode. It gives more importance on transfer media than knowledge and skill sources. Open University uses different modes of knowledge and skill transfer than traditional method. Its main objective is to educate distance students and certify them in the respective subject. They transfer knowledge and skill through various media like

a) *Printed materials*
b) *Television*
c) *Radio*
d) *Turorial, etc.*

Bangladesh Open University is situated at Gajipur. When a student gets himself enrolled into the open university, authority supplies the necessary printed books and module to them. According to the teacher's assessment, some chapters of different courses need further explanation for the students. The university authority then arranges some television or radio programme over the chapters for reinforcing the students. The students are earlier informed to about the time schedule of broadcasting. For monitoring the students the authority arranges two tutorial classes in a month. As the university has no classrooms, the tutorial classes are arranged in different institutions (during the

vacation). The student has to be present at a definite time at that place. So this mode of knowledge and skill transfer are not fully time and space bound.

The course teacher sends written assignment to the student. They complete the assignments and send it back to the respective teacher. The student gets back the corrected and graded assignment sheets.

They evaluate the students according to the traditional examination process. The examinations are held at district and thana level.

The university has no full time teachers. They recruit the teachers for two years and they are guided by a co-ordinator who evaluates them. If the co-ordinator is not satisfied with the teachers, their contracts are not extended.

As our teachers are habituated in traditional teaching method, so they are more interested in teaching not listening. For that reason main objective of tutorial has failed. As a result the feed back is not satisfactory. Recently the university arranges a training programme for the teachers.

As the open university of Bangladesh is a new establishment, there are many lacks. But it may play good role in transferring knowledge not only in our country but also abroad as Indira Gandhi national open university doing. A lot of Bangladeshis are the students of that university.

The dissemination mode in open university is more flexible in respect to time and space than traditional mode of knowledge dissemination i.e. full time mode.

Chapter Four

ROLE OF MULTI-MEDIA COMMUNICATION IN KNOWLEDGE AND SKILL TRANSFER

4.1 Data Network

In the last few decades computer and communication technologies have been coming together to support many new application and development. One of the early examples of such a development is data networks. These networks have their beginning in remote computing which emerged because of two reasons. First, the computer users found it increasingly inconvenient to go to a central and possibly far away computer centre to use the computer, and desired computer access in their own premises. Secondly, computer manufacturers and managers were keen on increasing the clientele for their computers for economic reasons and found an opportunity for this in remote computing. A suitable communication network is required to realise remote computing which would carry data from the computer to the remote unit and back.

In the beginning, data transmission was organised using telegraph or telex networks as they could carry digital signal directly. There were, however, two limitations. First, the speeds were limited. Secondly, these networks did not provide a wide coverage of the population. The possibility of carrying signals at higher speed in telephone networks and their wide coverage led to the serious consideration of public switched telephone network as a candidate system for data transmission. As

remote computing was maturing, the idea of sharing data, information and other resources among computers emerged. The focus shifted from terminal-to-computer communication to computer-to-computer communication. Early efforts were confined to interconnecting homogeneous computer systems from the same vendor. Soon, the advantages of interconnection computers from different vendors were realised and the progress made in this direction has led to the evolution of modern public data networks.

Data networks are classified according to their geographical coverage :

- *Wide Area Network (WAN)*
- *Metropolitan Area Network (MAN)*
- *Local Area Network (LAN)*

Intercity, inter country and international networks are known as WANs. In WANs, data communication is organised using cables, fibre optic lines, radio links, a geostationary or a geosynchronous satellite.

A metropolitan area network interconnects computers within a metropolitan city.

Local area networks (LAN) are confined to a single building or a group of buildings generally belonging to the same organisation.

Public switched telephone networks are designed to carry analog voice signals. In these cases, the data rates are usually limited to a maximum of 64 Kbps(kilobyte per second).

With the development of technology Integrated Service Digital Network (ISDN) emerged in the field of computer communication. An integrated digital network in which the same digital switches and digital paths are used to establish different services, for example, telephones and data. These ISDNs can, however, support data rates of 1.544 or 2.048 Mbps(megabyte per second) *[4].*

4.2 Multi-media technology :

The multi-media technology integrates voice, video, graphic and data services. The initial thrust of multi-media is to build a network infrastructure so that the stand along technology and services in telecommunications, computers, and video entertainment industries can be integrated for end users. This ultimate phase of the information revolution that the developed nations are presently living through will have unimaginable revolutionary impact on the civilization.

The stand along technology for services like Telephone, Faxes, Broadcast TV, Computer Applications have matured in isolation over the years.

The objective of multi-media is to integrate these all, both from the perspective of users who own intelligent terminals which can be hooked to a network and from the perspective of the service providers who own the intelligent networks and its elements.

The network, network elements, and the terminals all have become intelligent enough and such significant advancement has occured in all these areas that the integrations of services are now possible.

4.3 End Terminals :

Such sophistication exists in today's end terminals namely personal computers that they are beyond the needs of simple multi-media services such as vedio telephones (the form of communication where one can hear and see simultaneously). For a VT service, a video permises equipment consisting of video camera, a microphone, a TV set, a set top box - an interface unit to the network - are enough.

The stand alone multi-media technologies for end terminals are already in use. Sound cards, video cards, built-in-modem, fax cards, CD ROM drive, sophisticated window interfaces all are part of a stand alone multi-media personal computer now-a-days.

4.4 Network and Network Elements :

Network and its elements have undergone tremendous evolution over the last couple of decades. The original network were designed to provide only voice grade services with low bandwidth requirements. These networks were basically all analog. With the advent of digital technology, networks all over the world are being changed to digital from analog. AT&T changed all its facilities and switches to digital by early 1990.

ISDN (integrated service digital network) technology has allowed the network to evolve to be more intelligent and to provide more sophisticated services to the users.

In data networking worlds, the improved quality of transmission facility demanded simpler protocols to be used.

Echo cancellation, video compression techniques, encoding decoding algorithms, client server models of computing are some technologies which are being used in the network elements.

Bandwidth is one of the critical attributes in a network that a network provider is concerned of. Since circuit switching is notorious for network resource hogging while the band width is not effectively utilized in a typical voice call, packet switching is a viable alternative. But packetized voice and video suffer degraded quality for nodal delay for processing packets at each node in store and forward network.

Increased processing speed of microprocessors and the new switching technology such as ATM (Asynchronous transfer mode) is making it possible to use store and forward network for all traffic - voice, data and video.

A modern data communications network is shown in figure 2.

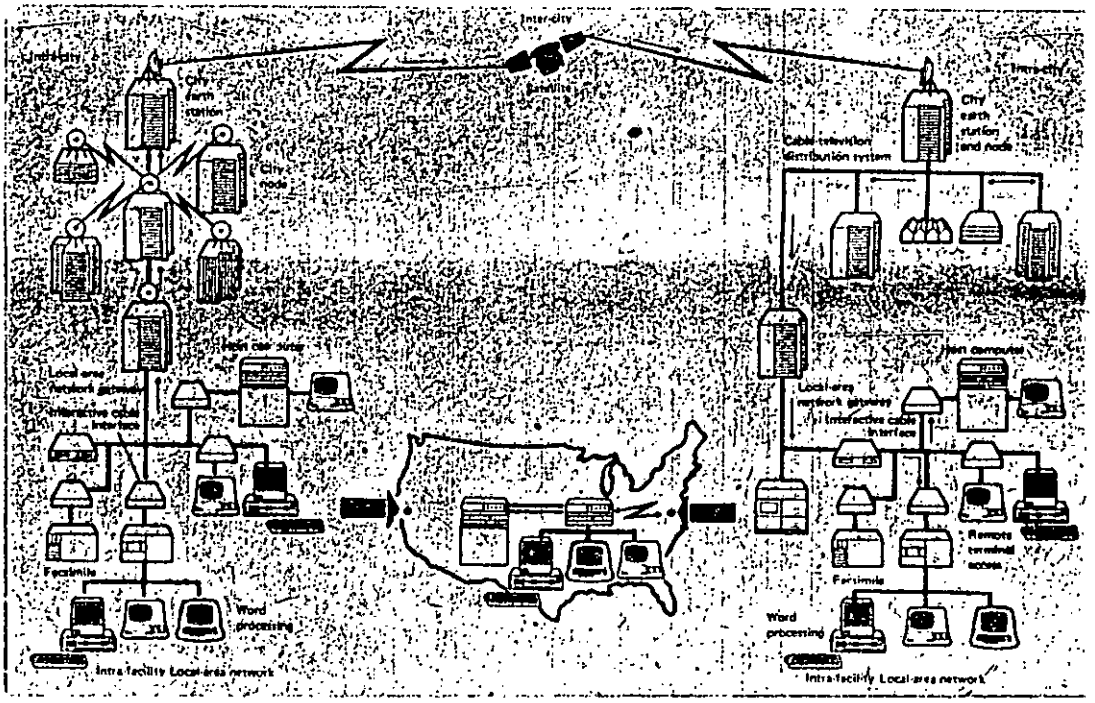

Fig.2 : A modern data communications network (based on 5)

4.5 Recent Advancement in Knowledge and Skill Transfer *using information technology*

With the development of information technology global communication has become possible. The Internet has emerged as a global communication medium that is poised to become a staple of modern communication. In fact, the Internet is the largest global communication network. The Internet is defined as a world-wide web of interconnected university, business, military and science computer networks. This network of networks, all running the TCP/IP protocol suite, is hooked together with everything from dial-up phone lines to high speed dedicated leased lines, satellites, microwave links, and fiber optic links. The Internet is administered not by any single authority, but rather by the inividuals that run each of the separate systems connected to the Internet. As a result the Internet functions on consensus, tradition, peer pressure, natural selection, and the generosity of the sites and the people who have decided the Internet is worth the effort to keep it going.

According to the Internet society, the number of users on the Internet has more than doubled in the past year to an estimated 20 million users. Businesses are beginning to use the Internet for such things as shortening the development cycle of new products, communicating with experts from around the world, receiving customer feedback on software, and accessing supercomputers for industrial research and development.

Networking on the Internet can fundamentally alter the way in which people go about their work. Global access to people, data, software, documents and multi-media changes the way in which people scan for

information, process personal and business communications, and ultimately, solve problems. The Internet enables direct person-to-person communication using electronic mail and group communication using electronic communication forum. In addition, many computers on the Internet store freely accessible information, thus allowing people to share, disseminate and receive data and software.

Many types of organizations provide Internet service. People using commercial on-line services, such as CompuServe, Prodigy, America On-Line for a resonable service charge.

Multi-media communication system has amongst other form files, namely the text files, the video files, the audio and the graphic files. These allow interactive transfer of texts, voice, drawings, video pictures between points, which are logged on to the communication network. These are essential tools and media to transfer knowledge and skill. This has been facilitated by the rapid development of the computer technology. The personal computers of today are powerful and cheaper.

Now-a-days with the development of computer communication tele-working, tele-conferencing have become possible. Kay Devine's*[6]* research has shown that in Canada 9.2% of the respondent organizations provided work at home arrangements, while a 1993 Market Facts Survey found that 4.1% of Canadian households had an employee working from home (up from 3.9% in 1992). While the statistics on the numbers of teleworkers vary, most experts predict that the number of people working from their homes will continue to rise. In

interviews the work at home operators stated they are calmer with customers and feel they give better customer service.

The National University of Technology at Fort Collins, Colorado, USA is arranging the live transfer of lectures from more than 40 US universities via the satellite system to student groups geographically far apart and takes the advantages of flexible resource utilization.

In interactive multi-media texts graphics, sound, video and animation sequence packaged together. If information is conveyed to the student under the combination of texts, color, graphics, animation, sound, moving picture, then the attention will be increased. Studies[7] have shown that people retain 25% of what they hear, 45% what they see and hear and almost 70% when they actively participate in the process. This last option is suitable for interactive multi-media.

Lee and Sullivan[7] report that multi-media based lectures are more effective than traditional classroom instruction. According to experiment performed on 200 engineering students at Virginia Tech. 76% responded it to be effective. This effective lectures can be quickly and easily distributed to the students on the networks.

Wild and Winnford[8] report that the students of University of Hawaii and Southern Methodist University, Dallas, USA made use of electronic mail to collaborate in a complex linear programming decision making task. In spite of the cultural and the language barriers the students performed quite well in both their written and oral reports. They gained confidence in their own analytical ability and improved their

communication skill. Effective group decision making was possible, though group members were physically far apart.

Multi-media applications take a long time to develop. Munroe, Lawdy and Newell [9] report that to produce 1 hour of traditional lectures it takes about 10 hours, preparation of 1 hour of multi-media can take 100 to 200 hours. This situation can change dramatically by the development of better multi-media tools.

Presently there is a move towards a global transfer and sharing of knowledge through the Internet with multi-media as the medium. Hall, N*[10]* reports that the Global Network Academy, considered the world's first virtual university, completed its first online course in August, 1994. Perhaps this is the new way forward for education and multi-media.

Chapter Five

A PROPOSAL FOR USE OF MULTI-MEDIA COMMUNICATION IN KNOWLEDGE AND SKILL TRANSFER
: *A new education System*

Knowledge and skill transfer can be possible through multi-media communication. In the proposed new educational model a student needs a personal computer hooked to the network through a modem. He does not need to move to the places of knowledge sources. He can get himself enrolled say, at McGill University of Canada through Internet without physically going to Canada. The University authority or respective subject teacher will download the multi-media based lectures and assignments at the respective student's personal computer. The students can learn the topics, solve the assignments and submit the same at their flexible time. The students may review the material of the topics as many times as necessary until they have thoroughly mastered the subject. So a student using the Internet will not be time bound to follow the class routine as it is in the conventional education system. For monitoring the student the teachers can arrange tele-tutorial on an announced date. Students can contact with the teacher as well as peers for their problems.

With the help of virtual reality laboratory experiment can be conducted. Most of the educators agree that laboratory experiments are an integral part of learning engineering principles. The question is whether students learn as much with virtual simulation as compared to hand-on-experiment. Although the answer to this question can only be found

through a longitudinal evaluation of students. As attempt is taken here to list the advantages of each approach.

In hand-on-experiment student learns the experimental procedures and gains first hand experience in equipment usage, data interpretation and analysis. Although students miss this hand-on-experiment in a simulated virtual experiment, learning efficiency can nevertheless increase because

(1) experiment preparation time is minimized;

(2) students can be taught to be critical of video media by being required to base opinions on real measurement done on video;

(3) experiments can be performed in slow motion, fast motion and backward and forward movement, if necessary; and

(4) experiments can be repeated to ferret out problems that may occur during data reduction.

Virtual experimentation should enable students to test many more alternative conditions than when using the laboratory. They can also be encouraged to design their own experiments to test their own theories and understandings. Another good use of simulated virtual experimentation is to incorporate experiments into class lectures to demonstrate theories and show the correlation between 'real' phenomenon and theoretical models.

In multi-media communication students can be evaluated according to the traditional examination. The question of the examination will be downloaded at the respective student's PC on an announced date. Students answer the questions and submit the answer sheet. And the

question should be conceptual. This mode of knowledge and skill transfer is theoretically not time or space bound, i.e. a student through Internet can work any time or from any PC within the network. So sickness is not a problem in this mode and it saves physical facilities.

Furthermore, in the conventional education system there is limited communication from a student to a teacher. But through Internet there is no time limit. So individual care from the lecturer is available.

As well as in a class a teacher gives lecture which is based on average students. That makes the intelligent students bored and the below average students cannot go through the lectures properly. But through Internet all students will have equal opportunities to acquire knowledge and skill.

Through Internet a student can work at his/her own speed without disturbing anyone of the peers and a shy student can become assertive.

Moreover, a university can deliver its courses independent of or in collaboration with other institutions and can be offered at all tertiary levels (Certificate, Diploma, Undergraduate and Postgraduate).

Besides this, the proposed model has more inherent advantages, such as the global acceptability of the credit acquired, the flexibility of time, space and the teacher; the reduction of socio-economic cultural difficulties; language advantages (a student may choose the language of his/her preference for the knowledge transfer); the environment and facility for facilitation of life long learning.

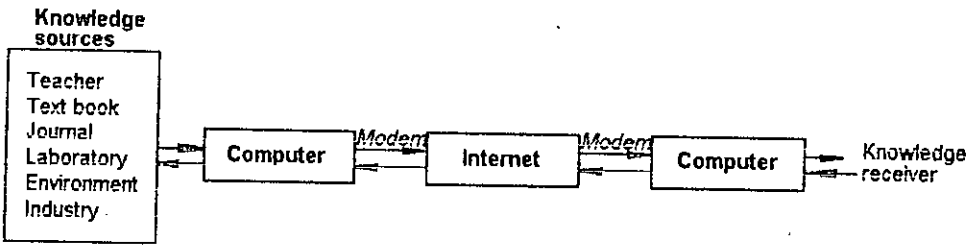

Fig. 3 : Proposed educational model through Internet

Chapter Six

ANALYSIS OF THE TECHNOLOGICAL AND ECONOMIC ASPECT OF THE PROPOSED MODEL IN ENGINEERING UNDERGRADUATE STUDY

6.1 Technological Aspect

During the past decade a tremendous development has been taking place in the information technology. The London Economist in an article published recently predicted: *"The cliche of the Information Age is that instantaneous global communication, television and computer network will soon over throw the ancient tyrannies of time and space[11]"* The information super highway, mainly dominated by the Internet, has been making instantaneous global tele-communication very quick and in expensive. By the way, the Internet is not a company. It is a vast, distributed, co-operative computer network.

Almost anyone can join directly by getting a connection and a machine and agreeing to use something technical called *"The TCP/IP protocol"* which is just a common language all the computer systems agree to use in order to communicate.

One Internet user can gain immediate access to world-wide computing resources and the data search is not only accessible to thousands of computers for files but also to hundreds of Bulletin-Board services meant for business, research, education and decision making. Many universities and libraries maintain large repositories of fascinating reports, manuscripts and unpublished dissertation which are already

available on the Internet. Innumerable Internet users all over the world including our neighbouring countries are utilizing these services.

A recent estimate indicates that every 20 second one computer is being connected to the Internet. The first major survey of Internet use among the general population of USA and Canada shows that an estimated 24 million adults, about 10.6 percent of the combined population of these two countries had used the Internet in the three months preceding the survey.

Now Bangladesh enters into global information super highway. Presently five organizations in Bangladesh offer Internet service and two more organizations will start to give Internet service very soon. So there is an opportunity of choice. The services that a Bangladesh Internet user can have are:

- **E-Mail :**

  Send and receive electronic mail to and from another E-Mail user in the world inexpensively and speedily on real time basis.

- **Tele Discussion :**

  Participate in discussion groups and join a real-time conversation with hundreds of people all over the world on a topic of mutual interest. Students in one university classroom can converse with teachers/students in another university without any travel involved.

- **File Transfer :**

  Copy and transfer files (data programs, graphics) from one computer to another. Many universities and research organizations maintain large repositiories of fascinating reports, manuscripts and unpublished dissertations which are already available on Internet.

- **Telnet :**

  An Internet user can convert his/her computer into a terminal of a remote computer. He can talk with many people at a time through Internet.

- **Chat :**

- **News Services :**

- **Software Services :**

  Furthermore, the Internet user can digitize engineering drawing including cable, pipe line and other maps.

The speed of work in the Internet depends on the speed of the server from where the user takes the connection. It is important that if the power of user's modem is equal to server's power then the user can get the same power service, otherwise not. For example, if one's modem is 28.8 Kbps and the server's modem is 14.4 Kbps, then one will get only 14.4 Kbps performance. If the situation is reverse then the same will happen.

The service charge and connection fees of all the companies in Bangladesh are more or less same. All the companies which give the Internet connection in Bangladesh and their necessary information are given below :-

- **Information Service Network Ltd. (ISN)**

  Address : ISN, TMC Building (4th floor)
  52, New Eskaton Road, Dhaka
  Phone : 834452, 842785-88

  Starting date : 4th June, 1996

  This company classified its clients into five groups to take connection such as -

Membership fees	
General	Tk.10,000.00
Student	Tk. 5,000.00
Group-1 *(5 to 10 connections each)*	Tk. 7,500.00
Group-2 *(10 to 25 connections each)*	Tk. 5,000.00
Group-3 *(Over 25 connections then fees will be fixed through negotiation)*	Negotiable

The cost of service will be Tk. 3.00 per minute. There are 40 telephone lines to access the ISN system.

Information Service Network Ltd. is the first public limited company which gives the Internet service to the Bangladeshi people. ISN's computer network is connected with the global information super highway via a VSAT (Very Small Aperture Terminal) of 64 Kbps capacity provided by the Bangladesh T&T Board.

The number of present subscriber of ISN is 525 (as on survey)

- **Grameen CyberNet Ltd.**

  Address : House No. 1, Road No. 80
  Gulshan-2
  Dhaka
  Tel. 872109

  Starting date : 15th July, 1996

  The number of its subscriber is now more than 700 (as on survey)

  Connection fee

General	Tk.10,000.00
Student	Tk. 5,000.00
Group-1 (at a time 1)	Total Tk. 50,000.00

  The cost of service will be Tk. 3.00 per minute.

- **Proshika Net**

Address : Proshika Building, I/A Gha
Section-2, Mirpur, Dhaka
Phone : 802717, 805945-6

Starting date : November, 1996

Its connection fee is less than the previous two company.

Office	Tk. 8,000.00
Student	Tk. 2,000.00
Private	Tk. 5,000.00

Service Charge :

Office	Tk.	2.50 per minute
Private	Tk.	2.00 per minute
Student	Tk.	1.75 per minute

- **Agni Systems :**

Address : 78, Bhasathi Condominion
Plot No. 50, Road No. 17
Banani, Dhaka
Phone : 882379

This company does not have its own server. It uses other's server on rent.

Connection fee	Tk.10,000.00 (Full Internet)
	Tk. 5,000.00 (Only for E-mail)
Service charge	Tk. 3.00 per minute
Present subscriber number	350 no.

❑ **Kifenet Services :**

Address : House No. 23/A, Road No. 6
Dhanmondi R/A, Dhaka
Phone : 506731

Does not have its own Server.

Connection fee :

General	Tk. 10,000.00
Student	Tk. 5,000.00
Service Charge	Tk. 3.00 per minute.

A comparison table between the companies which give the Internet connection in Bangladesh.

Item	ISN	Grameen Cybernet	Proshika Net	Agni system	Kifenet system
Connection fee for student	Tk.5,000.00	Tk. 5,000.00	Tk. 2,000.00	Tk. 10,000.00	Tk. 5,000.00
Service charge for student	Tk. 3.00 per min.	Tk. 3.00 per min.	Tk. 1.75 per min.	Tk. 3.00 per min.	Tk. 3.00 per min.
Server	exists	exists	exists	none	none

The comparison shows that the connection fees and service charges are same for ISN, Grameen Cybernet and Kifenet. Agni system and Kifenet system do not have their own server. Proshika Net is cheaper than the rest of the companies. But presently the services are not good enough. To develop a knowledge delivery system using Internet, this project makes use of ISN delivery system.

If their services are improved then the education cost will be cheaper.

Fig. 4 shows how a subscriber can connect his computer with Internet in Bangladesh[11]

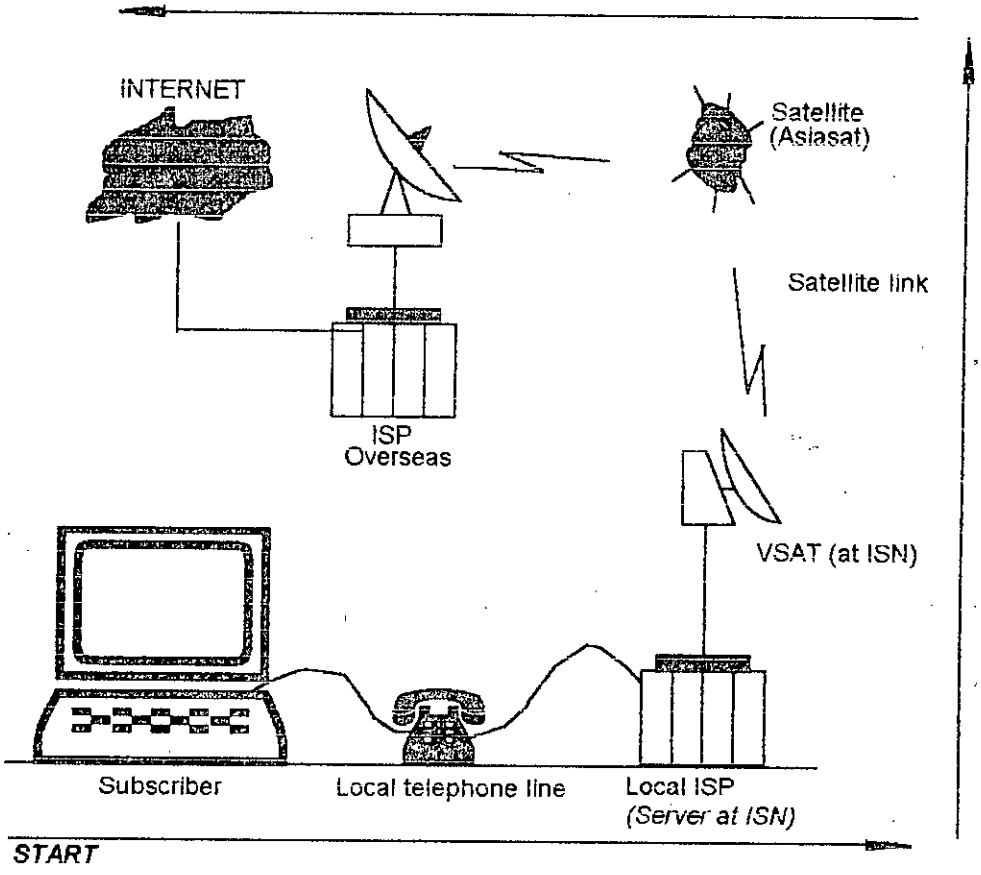

Fig. 4 : The connection of a subscriber's computer with Internet in Bangladesh

6.2 Economic aspect :

Presently the students of developing countries move to the developed countries for acquiring knowledge and skill which involves huge cost.

The objective of the following analysis is to compare the cost of the study at a foreign university, namely McGill university in Canada and the study through the proposed model using the Internet.

For an engineering undergraduate education over 4 years the total cost of study at McGill university in Canada in estimated as follows :

I. Tuition fee

Tuition fees (From university brochure)	=	C$	193.33 per credit
Course material per credit	=	C$	3.33
Total fees (including registration, laboratories, libraries, tuition) per credit	=	C$	196.66
Total credit over the UG degree	=	120	
Total fees for 120 credit (C$ 196.66 x 120)	=	**C$**	**23,599.20**

II. **Accommodation and living expenses**
(Through survey)

Expenses for food	=	C$	200.00 per montb
Expenses for room	=	C$	300.00 per month
Total living expenses	=	C$	500.00 per month
Living expenses for 4 years (C$ 500.00 x 48)	=	**C$**	**24,000.00**

III. **Plane fare**

Plane fare (once in 4 years)	=	**C$**	**2,000.00**

IV. **Cost for book**

Average cost per book	=	C$	50.00
Number of books = 80			
Total Cost of books in four years (C$ 50.00 x 80)	=	**C$**	**4,000.00**

V. **Health expenses**

Health expenses (From university brochure)	=	C$	385.00 per year
Health expenses for Four years (C$ 385.00 x 4)	=	**C$**	**1,540.00**

VI. **Student service fee**

Student service (From university brochure)	=	C$	150.00 per year
Student service for Four years (C$ 150.00 x 4)	=	**C$**	**600.00**

VII. **Admission fee**

Admission fees (From university brochure)	=	C$	25.00 per year
Admission fees for Four years (C$ 25.00 x 4)	=	C$	**100.00**

VIII. **Miscellaneous fee**

Miscellaneous fees (From university brochure)	=	C$	100.00 per year
Misc. fees for Four years (C$ 100.00 x 4)	=	C$	400.00

IX. **Student society fee**

Student society fees for Four years (From university brochure)	=	C$	**100.00**

TOTAL EXPENSES FOR FOUR YEARS	=	**C$56,339.20**
	=	**US$42,925.10**

(1.00 US$ = Tk.42.00 and 1.00 C$ = Tk.32.00)

For an engineering undergraduate education of 120 credit through Internet the total cost can be estimated as follows :

I. **Communication equipment cost**
(Source : Information Service Network leaflet)

i. 80386DX or more powerful computer (A 486 DX PC with 66 MHz is likely to cost) = Tk. 45,000.00

ii. One modem with 14.4 Kbps capacity

It will cost about = Tk. 10,000.00

iii. Membership fee (one time) = Tk. 10,000.00

Total equipment cost = Tk. 92,000.00

II. **Charges due to communication media**

i. Total credit = 120

Class time in one semester for one credit = 14 hours

(It is assumed that there will be communication using the Internet for the total 14 hours)

The cost of communication for 1 minute = Tk.3.00
(i.e. Tk.180/hr.)

Total credit hour communication cost = Tk.3,02,400.00
(Tk.180 x 14 x 120)

ii. Examination time = 45 x 3 = 135 hours

Number of courses in 4 years = 45

and

It is assumed that a total of 3 hours is needed for student assessment for every course.

Communication cost due to the examination = **Tk. 24,300.00**
(Tk.180 x 135)

iii. Tutorial time = 14 hours for 3 credits

Communication cost for tutorial = **Tk.1,00,800.00**

$\left(\text{Tk.180} \times \frac{120}{3} \times 14\right)$

iv. Library work time = $\left(14 \times \frac{20}{100} \times 120\right)$ = 336 hours

It is assumed that the library log in through the Internet will be 20% of the total class contact hours.

Communication cost for library work = **Tk. 60,480.00**
(Tk.180 x 336)

Total charges due to communication media = **Tk.4,87,980.00**

III. Tuition fee

For each credit the tuition fees charged by the uniersity = C$ 193.33
(From university brochure)

The course material charge = C$ 3.33

Total fees for each credit charged by the university which includes registration, laboratories, tuition, libraries etc. = C$ 196.66

Total fees for 120 credit = **C$ 23,599.20**
(C$ 196.66 x 120) = **Tk.7,55,174.40**
(1.00 C$ = 32.00 Tk.)

IV. **Living expenses**

Living expenses *per month* (Through survey)	=	Tk. 1,500.00
Total living cost for 4 years	=	**Tk. 72,000.00**

V. **Medical expenses**

Medical expenses (Through survey)	=	Tk. 659.59/year
Medical expenses for 4 years (Tk.569.59 x 4)	=	**Tk. 2,638.32**
Total cost for education through Internet	=	**Tk.14,09,792.72**
	=	**US$ 33,566.49**

(1.00 US$ = Tk.42.00)

Assuming the cost of education materials such as paper, pen, pencil etc. will be the same in both system.

Though proshika net offers less cost for student but the services, they give are not satisfactory. If they improve their services and then by using the proshika net system the cost will be much much cheaper.

McGill University is a Canadian University. Most of the Canadian Universities are state supported universities which are subsidized. But for an American private university the university fees is about US$ 20,000.00 per year, which includes lodging and food and for 4 years it will be US$ 80,000.00.

There is no subsidy in the educational model in Internet. Thus, the proposed system is much cheaper than an US University even cheaper than a subsidized university.

A comparative table of the cost of the study at a foreign university, say, McGill University and the study through the proposed model using Internet.

Item	McGrill University US$	Proposed model using Internet US$
1. Tuition fees for 120 credit (including registration, laboratories, libraries, tuition, etc.)	17,980.34	17,980.34
2. Accommodation and living expenses	18,288.71	1,714.29
3. Plane fare	1,523.81	000.00
4. Cost of books	3,047.62	000.00
5. Health expenses	1,173.33	62.82
6. Student service, admission, miscellaneous	914.28	000.00
7. Communication equipment cost (PC modem, etc.)	000.00	2,190.48
8. Charges due to the communication media (for class, examination & library work)	000.00	11,618.57
Total	US$ 42,925.10	US$ 33,566.49

The proposed model will be cheaper than it has been shown above. The reasons are :

1. Charges due to the communication media US$11,618.57

   Bangladesh is not yet a member of INTERNET. When Bangladesh becomes a member and the technology is developed and easily approachable, the cost will be less. Presently Prodigy, America Online serves the clients at a much cheaper rate.

2. Tuition fees US$ 17,980.34

   In reality with the introducton of INTERNET knowledge, the fees will be less.

Chapter Seven

CONCLUSION

The comparison shows that for an undergraduate engineering education through Internet is cheaper. It is also more flexible and avoids the language and cultural barrier.

The model will have its conseqeuntial effect on the conventional education system. The classroom teaching will loose its significance to a great extent. Being cheaper and more flexible, the proposed system will attract more and more undergraduate student from the developing countries.

Such a development will create colossal turmoil in the education system of the developing countries. The demand for the local university education may fall drastically, questioning the viability of the universities. If so be the situation, the total employment scenerio in and around the universities, the infrastructure facilities and the resource mobilization by the developing countries will signiicantly change.

The educators, the education planner and administrators and the governments in devleloped as well as developing countries will have to foresee the impact of information technology on the education system.

Because of acute resource limitations in the developing countries, of the influence of the market oriented economy and because, the generation of teaching manpower needs a long time, it would be apprigte to think about the restructuring of the education system in all earnestness.

It must be made clear that the model in based on the assumption that the Internet will develope fast and in all dimension and it will be easily approacheable by the students of the developing countries.

Thesis contribution :

The proposed model in the thesis will help to open a new window to transfer knowledge and skill, specially for the people of the developing world.

Chapter Eight

FURTHER RESEARCH

The proposed model is only a theoritical study. If the model is practically implemented then it faces lots of problem. So one first and major topic of research would have to address the course design of the proposed education model. If the model is practically implemented then the course design would be different from the conventional courses.

Multi-media traffic has one distinguishing characteristic: it's time sensitive. Different data types, especially voice, must arrive at their destination at the right time otherwise the multi-media application will lose its effectiveness. For example, if the audio portion of a video conference of a teacher and a student is out of synchronization with the video components, there we get "dubs disease". So a second major topic of research should then focus at the voice tranmission.

A third topic of research would address the language barrier of a teacher and a student, because the pronunciation of people varies from country to country. During transferring the knowledge and skill, there may arise a problem of pronunciation between teacher and student.

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Appendix - I [9]

Multi-media presentation

The principal objective or aspiration of the multi-media representatin of the negative frequency model is the conceptual clarification of the model. The following dialogue would detail an animated multimedia display of sinusoidal waveform generation. Educationally the strategy is to restate existing knowledge setting a conceptual foundation on which to build the abstract negative frequency model.

To validate this multi-media teaching objective, students will be exposed to this example and their responses compared with previous student results.

Generation of circular functions

Figure 5 shows the cyclic motion of a point P at the tip of a radial arm R of unit length is mapped to a sinusoidal and consinusoidal motion. This type of function is called harmonic motion Harmonic functions were known to the ancients and the name sine appears to be due to the mistranslation of the original Hindu term jibr, meaning chord.

The following equations map the cyclic motion to the sin and cos functions, since R is equal to one in this example:

$\sin \theta$ = vertical component of R

$\cos \theta$ = horizontal component of R

The quantity ω is the angular velocity of the point P of the cyclic motion, it is also defined as the circular frequency of harmonic motion, expressed in the unit of radians per second. A sinusoid is periodic where the period, T seconds, is the time taken to compete one revolution or cycle of the point p.

Therefore $T = 2\pi/\omega$ given that $\omega = 2\pi f$, where f = number of cycles per second or freuqncy (Hz) and the angle (θ) is the arc swept out by the anti-clockwise rotation of R(ωt).

R can have an initial, angle (ϕ) known as the phase angle also, R may have a length A modifying the amptitude of a resultant waveform. Giving Asin ($\theta+\phi$) where the three variable. A θ and ϕ define any point on the sinewave.

Exponential series and the j operator

1 Terms used to describe the action of the j operator can mislead and confuse students. In particular the use of the word imaginary to describe the vertical axis of the Argand diagram. To clarify the operation performed by j and especially $e^{j\theta}$, an animated multi-media description is given of the power series of e^x with x replaced by $j\theta$.

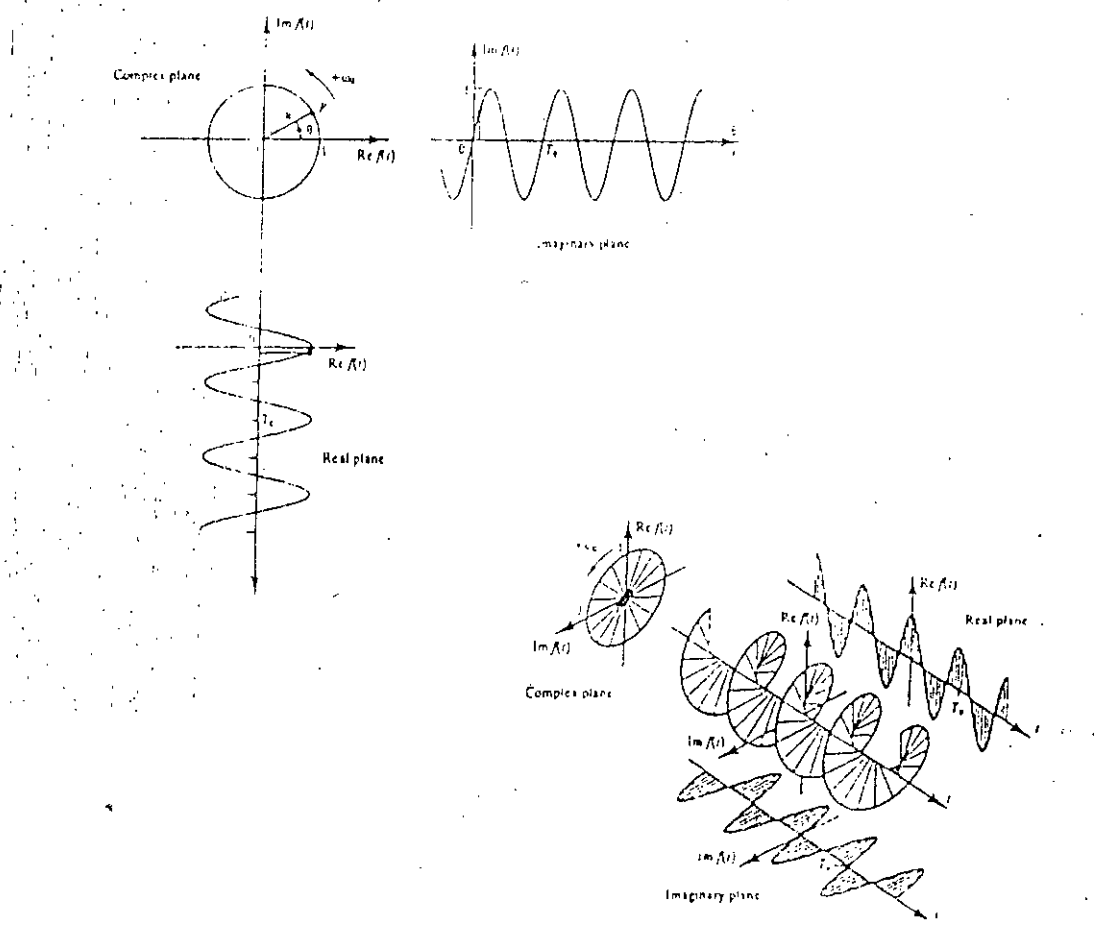

Fig. 5 : Sine and cosine components of rotating phasor R

$$e^x = 1 + \frac{x^2}{2!} + \frac{x^3}{3!} \ldots\ldots + \frac{x^n}{n!}$$

Replacing the x in e^x by $j\theta$ and substituting j^2 for -1 and j^3 for -j gives ...

$$e^{j\theta} = 1 - \frac{\theta^2}{2} - j\frac{\theta^3}{6} \ldots\ldots + \frac{(j\theta)^n}{n!}$$

Ploting each vector of the first few terms of the series $e^{j\theta}$ with θ =1 on the Argand diagram, via multi-media animation, shows that a point P is

reached at unit radius making an angle θ radians with the horizontal (real) axis.

Significantly θ is then replaced by ωt showing that $Re^{j\omega t}$ is simply a radial arm of leanth R rotated anticlockwise by a distance θ (ωt) radians.

Figure 6 is a typical illustration of the real function cosωt shown by the complex exponentials.

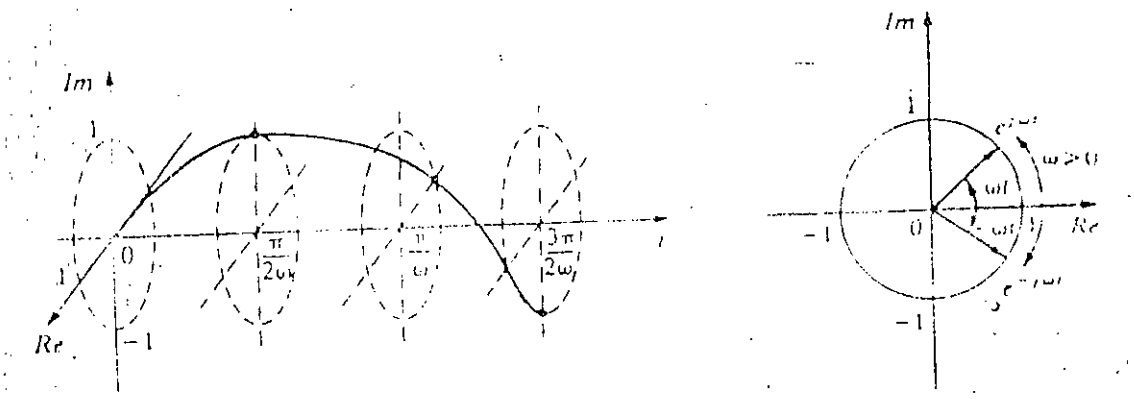

Fig. 6 : Complex exponentials

The plot (a) of $e^{j\omega t}$. With time as the horizontal coordinate the plot becomes three dimensional and is difficult to visualise. Therefore, it is customary to plot $e^{j\omega t}$ on the Argand diagram, as shown by (b) above. Representations of sinusoidal signals may take the form of line spectra where the time domain function is shown in the frequency domain.

A typical approach is to make use of Euler's theorem, which states that similarly

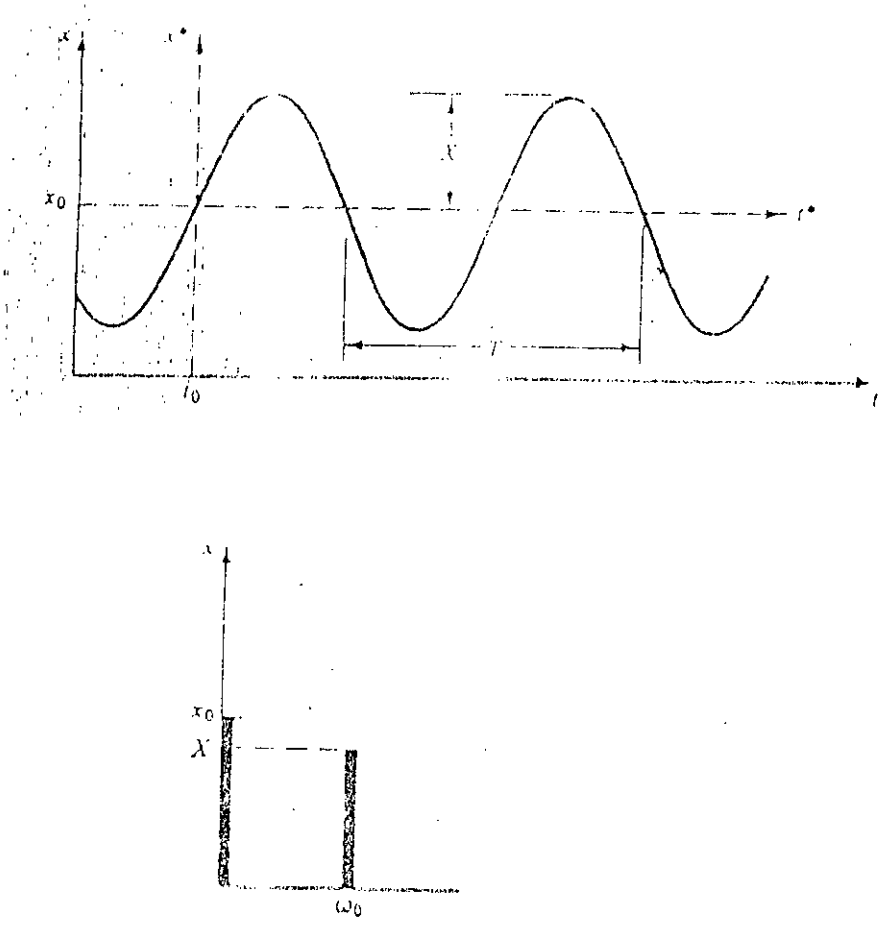

Fig. 7 : Time and frequency domain description of a sinusoidal function

$$e^{j\theta} = \cos\theta + j\sin\theta$$

$$e^{-j\theta} = \cos\theta - j\sin\theta$$

adding these two expressions and rearranging leads to

$$\cos\theta = \frac{1}{2}\left(e^{j\theta} + e^{-j\theta}\right)$$

The equation above indicates that a consinusoidal function can be modelled by two exponential terms. It is the visualisation of the complex exponential model that presents the most difficulty to a student. Of particular importance is the following form of the equation.

$$A\cos(\omega t+\phi)=\frac{A}{2}\left(e^{j(\omega t+\phi)}+e^{-j(\omega t+\phi)}\right)$$

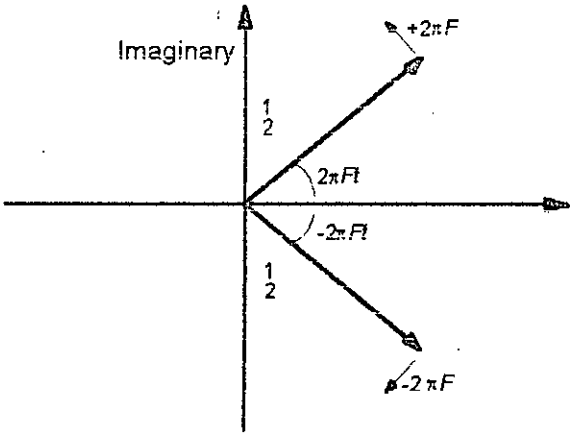

Fig.8 : A phasor diagram showing positive and negative frequency

Multi-media animation of the rotating phasors would be shown with their resultant phasor cos (2πFt) moving back and forth along the real axis. Finally, the negative frequency spectral model is given in Fig. 9.

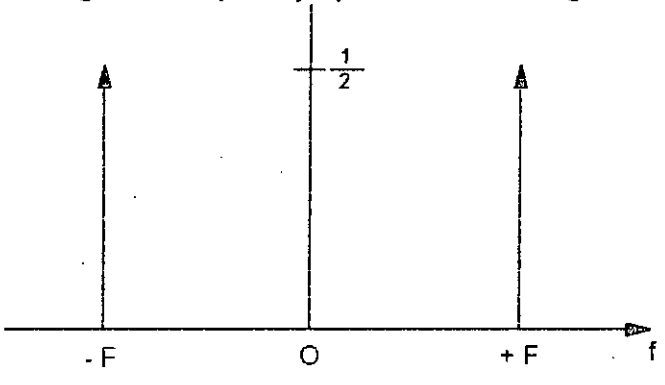

Fig. 9 : Negative frequency spectal model

Appendix - II

The cost of study at a private sector university namely the North South University in Bangladesh can be estimated as follows:

I.	**Fee**		
	Tuition fees per credit	=	Tk. 3,250.00
	Computer lab. fee *per semester*	=	Tk. 1,000.00
	Student activity fee *per semester*	=	Tk. 1,000.00
	Estimated total tuition and fees for an undergraduate degee i.e. 124 credits in 8 semesters is atleast	=	**Tk.420,000.00**
II.	**Living expenses**		
	Living expenses	=	Tk. 1,500.00 per month
	Total living cost for Four years	=	**Tk.72,000.00**
III.	**Medical expenses**		
	Medical expenses	=	Tk. 659.59 per year
	Total medical expenses for Four years	=	**Tk. 2,638.32**

IV. **Book expenses**

Total number of books = 50

Average cost per book = US$ 20.00
(assuming the cost of Asian edition is 50% of the US edition)

Total cost of books = **US$1,000.00**
= **Tk.42,000.00**
(US$ 1.00 = Taka 42.00)

V. **Transportation cost**

Transportation cost = Tk. 20.00 per day

Working day for Eight semester = 560 days

(14 weeks per semester)

Total Transportation cost = **Tk.11,200.00**

Total education cost at North South University in Bangladesh = **Tk.547,838.32**

= **US$13,043.76**