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WORLD MARITIME UNIVERSITY

Malmö, Sweden

The Cyberspace Education Revolution

What Future for MET Institutions?

By

Chen Ailing

The People's Republic of China

A dissertation submitted to the World Maritime University in partial
fulfilment of the requirements for the award of degree of

MASTER OF SCIENCE

in

MARITIME AFFAIRS

(Maritime Administration)

2001

DECLARATION

I certify that all the materials in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal view, and are not necessarily endorsed by the University.

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ABSTRACT

Title of dissertation: **The Cyberspace Education Revolution
-What Future for MET Institutions?**

Degree: **MSc**

This dissertation is a study on cyberspace education, with the focus on revolutionary changes resulting from technology developments. Considering the special requirements in the marine industry field, the future of maritime education and training institutions is discussed.

The concepts of cyberspace education being discussed in this dissertation are clarified at the beginning with the focus on distance learning/education. An overview on basic principles, evolutionary process and practices of distance education is conducted, and provides a theoretical base of the study.

Educational developments and their impact on distance education are examined. Compared with traditional learning, the advantages and disadvantages of modern distance learning are identified. The concentration is put on how to organize and conduct learning in a virtual environment, including the course design, student assessment, and new roles of teachers and students. As a very important factor, how to assure the quality of distance education is suggested.

Global developments and applications of cyberspace education are investigated with brief reviews of typical education in leading countries and developing countries. China is the representative of the latter. As one of the main objectives, distance learning in MET is given more focus.

Based on the prediction of new developments and trends of technology, the future learning environment is envisioned. Challenges for future development of MET institutions are discussed with a special look at the Chinese aspect. A number of recommendations are made for MET institutions, which will be helpful for future development.

KEYWORDS: Cyberspace education, Distance learning, Educational technology, Future education, MET, Virtual learning environment.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
AMC	Australian Maritime College
BBS	Bulletin Board System
BISDN	Broadband Integrated Service Digital Network
BST	Basic Safety Training
CAI	Computer Aided Instruction
CAL	Computer Assisted Learning
CAMS	Centre for Advanced Maritime Studies
CBT	Computer Based Training
CETV	Chinese Education TV
CMC	Computer Mediated Communication
CML	Computer Managed Learning
CRENET	China Education and Research Network
CRTVU	China Central Radio and TV University
CVN	Columbia Video Network
CVU	Clyde Virtual University
DSL	Digital Subscriber Line
DUM	Dalian Maritime University
HFC	Hybrid Fibre Coax
HMD	Head Mounted Display
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
IE	Internet Explore
IMM	Interactive Multi Media
IRC	Internet Relay Chat
ISDN	Integrated Services Digital Network
LAN	Local Area Network
MET	Maritime Education and Training

METNET	Maritime Education and Training Network
MIME	Multipurpose Internet Mail Extension
MOO	Multi-User Dungeon Object Oriented
MSO	Management of Ship Operation
MUD	Multi-User Dungeon
OBT	On Board Training
PDA	Personal Digital Assistant
POT	Plain Old Telephone
PRI	Primary Rate Interface
RTM	Raymond T. Mckay
SMTP	Simple Mail Transfer Protocol
STAR	RTM Simulation Training Assessment and Research
TAFE	Technical and Further Education College
TCP/IP	Transport Control Protocol/Internet Protocol
UKOU	United Kingdom Open University
USQ	University of Southern Queensland
VR	Virtual Reality
VRML	Virtual Reality Modeling Language
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network
WWW	World Wide Web

Chapter 1

Introduction

We are all facing a new challenge of change, for the world has entered a new history of civilization, with information technology (IT), knowledge economy and learning community as its global marks. With an exponential expansion of network access world wide, coupled with the falling costs of IT products, it is a global phenomenon that governments or institutional organisations around the world are promoting the development of technology used in education in order to meet the challenges and seize the opportunities.

1.1 Purpose of the study

Cyberspace technology has enhanced the efficiency of communications and data transmission, thus renders the geographical distance obsolete. Digitisation leads to the convergence of media, which has blurred the distinction amongst different activities like sending and receiving email, browsing the Internet, videoconferencing and so on, and enabled them to be operated on the same platform. These developments are becoming the main engine to drive education to be conducted free of place and time constraints. Moreover, the increasing global competition, the higher demand on lifelong learning, and the rapid pace of change in what we need to know, pose higher needs for education operated through the cyberspace. This is why the topic of this paper, cyberspace education revolution, is chosen.

But what is cyberspace education? How is it impacted and changed by the technology development? What is the current development situation of it in the world? And along with the technology changes, what will it look like in the future?

Maritime education and training, as a special area of education, could not be immune from the impact of technology changes. The increasing use of high technology and high investment for ship operations, proposes new training demands and requirements for MET institutions. MET institutions are facing great threats more than before. What will be the future of MET institutions? Are they ready for technology changes in order to meet training challenges?

As a developing country, how will China cope with the challenges coming from these aspects? What is the situation of cyberspace education in China? For developing countries, what kind of future will there be for MET institutions?

1.2 The objectives

The above points will be the main concerns of this study, and will be achieved through the following objectives:

1. To conduct an overview of the principle developments and practices of cyberspace education systems, and to provide a theoretical base of this study.
2. To study how new technology affects education and how it is applied in education.
3. To discuss how the learning is conducted in a virtual environment. To address some quality assurance issues.
4. To compare cyberspace education with traditional education systems, and identify its advantages and disadvantages.
5. To review global developments and applications of cyberspace education, including in the MET aspect. Special concerns will be given to China.
6. To predict future trends and applications of cyberspace education.

7. To make conclusions and give some recommendations for MET institutions on future education.

1.3 Scope and limitations

As indicated in the title, this research is concentrated on the education through the cyberspace. Specifically it will focus on distance learning/education employed in higher education. Elementary and secondary education are beyond the interests of this study.

The concepts and basic principles of cyberspace education are to be made clear in chapter 2 firstly. The technology aspect will be looked after by chapter 3, together with the comprehensive understanding of cyberspace education and the relationship between them. Chapter 4 will investigate the current situation of cyberspace education in the world, while the future development will be discussed in chapter 5. The MET sector and applications in China will be integrated in these two chapters.

1.4 Research methodology

The sources of information used in this study include interviews with visiting professors of World Maritime University (WMU), interviews and observation conducted in China by the author during the vocation in December 2000, and materials from lectures that the author has attended at WMU.

A literature search was conducted with focus on technology development, cyberspace education, and maritime education and training in the world. This was done through examining the relevant books, journals, conferences proceedings, handouts and lecture notes, newspapers as well as Internet sources. Among these methods, much more weight is put on the Internet sources in considering the validity of the information.

Chapter 2

Cyberspace Education Systems

The term *cyberspace* was invented by Gibson in his novel *Neuromancer* for describing this new encompassing medium of communication and control. McFadden and others refined it in Benedikt's (1991) book in the way that "cyberspace will be an inhabitable new parallel universe created and sustained by the whole world's computers and telecommunication networks". This definition has been used until today with the implication of an integrated physical space computer and telecommunication infrastructure, plus a multi-disciplinary knowledge space (Chang, 2000).

For millions of people some of the most important parts of cyberspace are the worlds of online distance education institutions, which provide more opportunities for people to learn at work. Therefore, cyberspace education implies an interactive learning environment offering multiple disciplines of knowledge for non-linear learning. It operates without frontiers, walls, or barriers, and is globalized by technology links (Muirhead, 2000). Distance education, virtual universities, online education, all fall within the scope of cyberspace education.

2.1 Terminology

During the literature research of cyberspace education, people may be confused by over terminologies and lack of precision on what areas of education were being discussed or what was being excluded. The confusion can be highlighted by listing the term used in this field of education: *correspondence study*, *external studies*, *independent study*, *distance education*, *online learning*, *distance teaching*, *distance*

learning, open learning, and so on. In order to give readers a clear idea of cyberspace education, which will be talked about in this paper, it is necessary to make a thorough analysis of these terms firstly.

Correspondence education/Correspondence study

This kind of education is conducted by the postal services without face-to-face contact between teacher and learner. Teaching is done by written or tape recorded materials sent to the learner, whose progress is monitored through written or taped exercise to the teacher, who corrects them and returns them to learner with criticisms and advice (Keegan, 1990, P. 29). These terms have a long history and were widely used in 1960s-1980s.

Distance education

Williams et al. (1999) defined distance education as that the term refers to the teaching-learning arrangement in which the learner and teacher are separated by geography and/or time.

External studies

It is the term most widely used in Australia and has same meaning with distance education.

Independent study

This term is often used in the US for distance education programmes, which mainly include “individual study programmes containing periods of normal lectures organized on a contract basis agreed to by a student and a faculty member” (Keegan, 1990, P. 30).

Distance teaching

This term emphasises the teacher's role in the distance education system. It indicates the process of course development by which a distance institution prepares learning materials for students (COL, 2000b).

Open learning

The term emphasises giving learners choices on the "four openness" of access, curriculum and program, study organization and management, duration and flexible timetabling (Peraya, 2001). There are many institutions use the term *open* in their names: The Open University in the UK; Open Access College in Australia, Open Learning Agency in Canada and Indira Gandhi Open University in India.

Distributed learning

The Commonwealth of Learning (2000b) defined distributed learning as a term that has same meaning with distance learning, with the emphasis on "learning rather than the technology used or the separation between teacher and learner". It "makes learning possible beyond the classroom and, when combined with classroom modes, becomes flexible learning".

Flexible learning

Flexible learning is often used to emphasis the creation of learning environments that have the following characteristics (COL, 2000b):

Convergence of open and distance learning methods, media and classroom strategies; learner-centred philosophy; recognition of diversity in learning styles and in learners' needs; recognition of the importance of equity in curriculum and pedagogy; use of a variety of learning resources and media; fostering of lifelong learning habits and skills in learners and staff.

Online education

This term refers to “any form of learning/teaching that takes place via a computer network”, as Kearsley (1997) indicated, “the network could be a local bulletin board system (BBS) or it could be the global Internet and World Wide Web”, and also can be a local network (LAN) or an intranet within a particular organization.

Distance learning

Historically the term was used as only half of the process of distance education (Keegan, 1990, P. 31), but the vision is strongly influenced by the social and cognitive sciences and the developments of leaning theory. This has changed the nature of education and perception of the learner. The educational system is now focused on learning rather than on teaching, and the term of *distance education* has been more and more replaced by *distance learning* (Peraya, 2001). Though there are slight differences between them, these two terms are generally used interchangeably.

Among all these terms, which in most situations indicate the same thing as distance learning /education, *correspondence study/education* and *distance teaching* are used to refer to subsets of distance education. *Independent study* is an American equivalent of “distance education at higher education level”, with *external studies* being a term suitable for the particular Australian structures. *Online learning* mainly emphasises web-based environment, while *distributed learning* and *flexible learning* are modern substitutes of distance learning. However, the term *distance learning /distance education* will be preferred used in this paper when cyberspace education is discussed.

2.2 Basic principles of distance learning

2.2.1 Historical view - theoretical study of distance learning

The history of distance education can be traced back as far as the 1830s with the advent of commercial correspondence courses (USDE, 1999). But the advent of

advanced information technologies and, in particular, the Internet, has profoundly altered the character of distance education. Indeed, rapid changes in technology continue to challenge the traditional ways in which distance education is defined. In 1960-1970s, several important definitions of distance education given by Dohmen (1967), Peters (1973), Moore (1973) and Holmberg (1977) formulated the base of theoretical study of this field. However, these definitions were not widely accepted and used. It is Keegan (1990, P. 44) who brought a number of similar definitions together and analysed them, thus proposing a synthetic definition, which has been extensively accepted and cited until today. He defined the distance education on the basis of the following:

- The quasi-permanent separation of teacher and learner throughout the length of the learning process.
- Quasi-permanent separation a learner from a learning group throughout the length of the learning process.
- Participation in a bureaucratized form of educational provision.
- Utilization of mechanical or electronic means of communication to carry the content of the course.
- Provision of means for two-way communication so that the learner can benefit from or initiate dialogue.

But with the exception of two types of material-based learning (Keegan, 1990, P.45):

- The use of printed, audio-based, video-based, or computer-based learning materials in classroom, lecture theatres, seminars, tutorial, and laboratory sessions for on-campus programmes;
- The use of printed, audio-based, video-based learning materials and computers in private study.

The present situation of distance education, where the term distance learning is often used, is applied to a great variety of programs, providers, audiences and media with a modern technology sense. According to the Commonwealth of Learning (2000a), among many approaches defining distance learning, most of them pay attention to the following characters:

- Separation of teacher and learner: in place and/or time.
- Institutional accreditation to learners' learning which make it distinct from purely self-learning without any official recognition.
- Own effort without the official recognition of a learning institution.
- Use of mixed-media courseware.
- Two-way communication between learners and tutors.
- Possibility of face-to-face meetings for tutorials or practice sessions and so on.
- Use of industrialised processes in course development teams, where various staff may be assigned with different tasks and work together.

2.2.2 Kinds of distance learning systems

Normally distance learning systems can be categorized in the following ways:

Distance learning delivery systems

There are two categories of distance education delivery systems, synchronous and asynchronous (UMUC, 1999). Synchronous distance learning requires the simultaneous participation of all students and instructors, but may from a variety of places. The interaction is done in “real time” forms of synchronous delivery including Interactive TV, audiographics, computer conferencing, Internet Relay Chat (IRC), Multi-user Dungeon (MUD) object oriented (MOO), and Internet meeting.

Asynchronous distance learning frees students from both place and time constraints. Students may choose their own instructional time frame and gather learning materials according to their schedules. It is more flexible than synchronous distance learning.

Forms of asynchronous delivery include email, listservs, audiocassette courses, videotaped courses, correspondence courses, and WWW-based courses.

Group-based and Individual-based distance learning systems

In order to evaluate the value of distance learning in the 21st century, one must identify the two modes of group-based and individual-based distance learning (Keegan, 1998).

Group-based distance education and training electronically links the teacher and the learners on various locations by simultaneous audio, video or satellite links to a network of remote classrooms (often called *virtual classroom*). It can be either for full-time students or part-time students. The former can be fully interpreted by the Chinese Dianda network system (Keegan, 1993), while the latter is a dominant mode of distance education in the United States of America (Keegan, 1998).

Individual-based distance learning can be found almost all over the world. It is characterised by the separation of teacher from learner and of the learner from the learning group, with the interpersonal communication mediated by technology. Correspondence schools, open universities are examples of individual-based distance learning, and nearly all European distance education systems have been focused on this mode of provision (Keegan, 1998). In most cases individual-based distance learning is provided with pre-prepared materials, while in some other cases, for example the external degree programme of the University of London, it is provided without pre-prepared materials.

Single-mode institution and dual-model institution

With the consideration of the type of educational provision that involves some version of distance learning approach and uses distance learning techniques to a greater or lesser extent, institutions providing distance education and training can be categorized into single-mode institutions and dual-mode institutions (COL, 2000a).

A single-mode institution is characterized by the purpose of setting up only to offer programmes of study at a distance. There may be some face-to-face interaction involved, but often optional. The teaching and learning process is “mediated” by audio, video, computer or the WWW. Many of the worlds’ *mega-universities*, such as United Kingdom Open University (UKOU), Indira Gandhi National Open University in India, are single mode institutions.

A dual-mode institution offers two modes of study methods, one is using traditional classroom-based methods and the other is using distance methods. The two modes can be used simultaneously for the same course with common examination, with regards to distinction between two types of learners: on-campus and external. The University of Nairobi and the University of Zambia fall within this group.

Besides these two types of distance learning institutions, more and more institutions are starting to have a combined characteristic of study modes provision, which can be called *mixed-mode* institutions. They offer learners a wide choice of modes of study including independent, group-based or some combination and face-to-face, mediated or some combination. Typical examples of *mixed mode* institutions are Deakin University and Murdoch Universities in Australia.

2.2.3 Nature and characteristics of distance learning

Distance learning occurs free of place and, often, time constraints. Materials and methods of delivery are maximized so that students learn independently under guidance from faculty. So in broad conceptual terms the nature of distance learning can be described in a simple way of teaching and learning, which involves two elements. The first is pre-prepared course materials having the act of teaching embedded within them, while the second is non-contiguous (asynchronous) communication between teachers and learners (Muirhead, 2001). Thus distance learning programmes are often provided with professionally developed and

instructionally designed learning units with built-in teaching and learning mechanisms, which significantly increase the use of interaction, feedback, evaluation, activities and tasks that lead the learner toward specific learning objectives.

Currently, distance learning delivery via the Internet and the web is heavily dependent upon digital technologies. This independence will only increase over time, as the use of digital video becomes more wide spread and integrated into online presentation. Designers of distance learning programmes need to consider carefully how to make full use of the delivery technologies and select the appropriate media. Student access to teaching staff and learning resources must also be considered and planned. Preparation time for teachers is much greater than that for traditional internal classes. Student support is a central pre-condition for a good “learner centred” distance learning programme, this is also the critical point where distance learning differs from traditional classroom-based learning.

One of the key components implied in distance learning is communication, which bridges the gap between teacher and learner caused by the separation of time and/or geographic distance. The development of better distance learning systems, as to connection options, relies on communications becoming faster, more reliable, and more flexible. Short turn-round times are very important to both students and teachers for receipt of materials, contacts, assignment feedback and so on. Although communication is still time-consuming for everyone for the time being, with the rapid technology changes, all kinds of communications, including voice, video, and fax, will be done simultaneously, fast and securely in an enjoyable way in the near future.

There is no doubt that the characteristics of distance learning can be described as enhanced access to resources, program delivery, outreach, and student interactivity. Outreach means that “learning can take place anywhere at anytime, interactivity

means you do not learn in a vacuum.” (Muirhead, 2001) Distance learning courses in higher education are self-contained learning environments where students can engage in all the forms of learning: they use the Internet as a resource as well as a main delivery vehicle; communicate via e-mail with teachers and classmates; communicate in chat rooms, in threaded conferences or in teleconferences. Physical and psychologic distance can be minimized by the enhanced interactions.

As well freedom from the scheduling of classes has always been considered as one of the salient characteristics of distance learning. This is often named by *non-linear learning*, which means learning process can be re-structured by the learner, allowing for self-paced learning. The student can have great latitude in directing their own learning in a manner compatible with their learning styles. For example, they can pursue information by using the interactive hypertext-based systems, which enable newly discovered concepts to be thoroughly explored, instead of only following the traditional start-to-finish style.

Some other characteristics, which make distance learning the world’s first choice for lifelong learning, are inherent in the nature of distance systems. Keegan (1998) identified these characteristics of distance systems when he lectured in Hebei Radio and TV University of China in 1998. Among these characteristics, freedom from space/time constraints, freedom from joining learning groups in order to learn, education for taxpayer, education for homemakers, and education for the hospitalised, shift workers and travellers are especially suitable for lifelong learning.

2.3 Development and practices of cyberspace education

Throughout the process of technology development in history, distance learning/education has always been the leading edge of change with technology, During the long history starting from the middle of the 19th century, the evolution of distance education can be divided into four stages, namely four generations of

distance education (Taylor, 2001), which are Correspondence Model, Multi-media Model, Telelearning Model, and Flexible Learning Model.

The Correspondence Model is widely regarded as the first generation of distance education, which is the oldest form of distance education involving the use of print materials distributed through the mail or the use of radio and video. This model has been practiced worldwide and in the United States the term correspondence study was substituted by independent study.

The second generation Multi-media Model subsumed the first one by entailing the use of highly-developed and refined teaching-learning resources, including printed study guides, videotapes, audiotapes, and computer-based courseware, such as computer managed learning (CML), computer assisted learning (CAL), and interactive video. Open Universities are typical examples of the second generation. The UK Open University (established in 1969) was the first institution putting this form of distance education into practice (Moore and Kearsley, 2001).

With the widespread availability of new information technologies, several new forms of technology became viable for distance education purposes, such as two-way interactive audio-teleconferencing, audiographic communication systems, video conferencing and broadcast television/radio with attendant audio teleconferencing. This stage of distance education was named as Telelearning Model (Taylor, 2001), starting in the 90s of the 20th century.

The emerging fourth generation of distance education, the Flexible Learning Model, as put forward by Taylor (2001), has combined the benefits of high quality interactive multimedia, with access to an increasingly extensive range of teaching-learning resources and enhanced interactivity through computer mediated communication (CMC) offered by connection to the Internet. Currently many educational offerings use a flexible learning approach on the Internet.

Table 2.1 Models of Distance Education and Associated Delivery Technologies

	1st Generation	2nd Generation	3rd Generation	4th Generation
Models of distance education	The Correspondence Model	The Multi-Media Model	The Telelearning Model	The Flexible Learning Model
Timeframe	1850-1960	1960-1990	1990-	1990-
Primary Feature	One technology	Multiple technologies	Multiple technologies – Tele-communications	Multiple technologies-Internet
Types of Media	Print, Radio, TV	Print, TV, Fax, Audio-Visual tapes, Computers, CDs.	A/V Teleconferencing Broadcast TV/Radio Satcoms, Digital TV, VOD.	Live video, E-mail, Internet, WWW, High bandwidth transmission, Interactive Multimedia (IMM)
Communication Features (IT)	One-way: Mail, Telephone	One-way: Mail, Telephone, Fax, Computer Assisted Learning (CAL),	Two-way: Interactive A/V conferencing (Audio/Video)	Two-way: Realtime, Synchronous/Asynchronous, Internet-based access to WWW, Computer mediated communication
Student Characteristics and Goals	Isolated mature, Highly motivated	Primarily isolated, Highly motivated	Contact through A/V-network system	Contact through computer network system
Educational Philosophy and Curriculum Design	High structured materials, Information dissemination	95%prepackageed structured materials for independent learning, Passive learner	Materials instructionally designed, More faculty support, Active learner	Incorporated interactive technologies, Active learner, participant and contributor
Infrastructure Components	Postal service, Radio, TV	TV, A/V, Tutors, Upfront investment	A/V conferencing network	Online services, PC Multi-media, Complex design
Practices and Applications	External Degree of London University	The UK Open University, some Mega-Universities	Live Tele-classroom Japan Open university	Virtual reality, Virtual universities, Virtual library/laboratory, e.g. French National Distance Education Centre

Sources: Nipper (1989), Pelton (1991), Taylor (1997), Ding (2001), Muirhead (2001).

Based on the analysis of research of Nipper (1989), Pelton (1991) and Taylor (1997), connecting with the work of Ding (2001) and Muirhead (2001), the author proposes the foregoing table (Table 2.1) to summarise the characteristics of various models of distance education that are relevant to the technology used and the quality of teaching and learning.

Chapter 3

Technology and Education: Potential and limitation

Technology has always been the indispensable driver of educational development. This can be proved by the four generations of distance education, which have been discussed in chapter 2. The nature of the differences among the four generations is development and changes of technology. The faster technology develops, the faster education changes. There is no doubt that the potential of technology development is unlimited, however, can education always keep up with the steps of technology innovation? Are there any existing limitations? This will be the main theme penetrating all the discussions in this chapter. Discussions will be focused on the impact of technology changes on distance learning, how the learning is conducted in a virtual environment and what are the pros and cons of learning at distance.

3.1 Technology in education

Technology is assuming an increasingly prominent role in education; thus, it is important to know something about its evolution, characteristics and main applications in education. The technology being talked about here is technology in education or educational technology, as Roblyer & Edwards (2000, P. 6) said, which is “involved in addressing educational needs and problems, with an emphasis on applying the most current tools: computers and their related technologies”; it is “a combination of the processes and tools”.

3.1.1 Evolution of technology

Historically speaking there are four perspectives that shaped educational technology, which are characterized separately by technology in education as media and

audiovisual communications, as instructional systems, as vocational training tools and as computers and computer based systems (Roblyer & Edwards, 2000, P. 6). No matter which perspective is concerned, the evolution of technology can be categorized into one-way communication and two-way communication two stages (Muirhead, 2001).

One-way communication is the first stage, including radio broadcasting, television broadcasting, audio and video recordings. Although it is not an interactive one-way delivery when used for distance education, being cheap and easy to access, make it widely used and still attractive for some people today.

While education is interactive in nature, two-way communication technology has been prevalent only in the educational field through recent years. From interactive audio-video, teleconferencing, video conferencing and synchronous/asynchronous computer mediated communication (CMC), to Local Area Network (LAN)/Wide Area (WAN) Networks, the Internet and the World Wide Web (WWW), and Broadband (fibre-optic and VSAT satellite) networks, two-way communication technology has been developed dramatically and rapidly, especially in the past five years. If it can be said that the occurrence of microcomputers is a major turning point in the history of technology, then the emergence of the Internet can be linked to the invention of fire "...more important than the invention of movable type" (Remnick, 1997, P. 214). Now most computer-based distance learning applications involve some Internet resource or activity, and many of them rely exclusively on Internet materials. The information superhighway becomes an expressway for education.

3.1.2 Technologies used in distance learning

These may involve one or more of the following: e-mail among teachers and students, class chat room, links to resources on the WWW, live two-way interactive audio and video, virtual reality, and even the older technologies, like teleconferencing.

This part will give an overview of these technologies used in distance learning, and also take a look at some infrastructure technologies behind the Internet and information transmission.

Teleconferencing

Teleconferencing generally employs two-way audio and sometimes one-way video, which enable two-way interaction via the telephone among all participants with video broadcast. Like radio broadcasting or television broadcasting, teleconferencing is delivered live (in real time), but also can be taped for later use. It works best when the flow of information is one-way, and is not suitable for programs requiring high levels of response or interaction.

Interactive Videoconferencing

Interactive videoconferencing is an effective distance learning tool designed to support interactive two-way video and audio interaction between multiple locations. Based on broadcast and land-line technologies, videoconferencing is a point-to-point closed communication system connected by CODECs (coder-decoder)(CEUI, 2000) that are each equipped with video. The CODEC is an electronic device that transmits and receives the video signals that the participants will see on their television monitors. Interactive videoconferences are often transmitted on expensive dedicated lines.

Computer Mediated Communication (CMC)

Based on computers and networks, communications can be conducted in synchronous manner as well as asynchronous manner. Desktop videoconferencing is typical synchronous CMC, while asynchronous communication is represented by e-mail, newsgroups, whiteboard, bulletin board system (BBS) and mailing lists.

Desktop videoconferencing system utilizes a personal computer equipped with a video camera and microphone, and videoconferencing software; speakers at each learning station allow learners to be seen and heard by the teacher or learner at the remote site. Signals are transmitted using modems and telephone lines. These systems are less expensive than conventional videoconferencing system, but offer limited resolution (CEUI, 2000).

Electronic mail (e-mail) makes it possible for quick delivery of messages or other information and is a good asynchronous method to accomplish person-to-person communication. Normally it is written in accordance with Simple Mail Transfer Protocol (SMTP), and users can also attach text using Multipurpose Internet Mail Extension (MIME), which enables multimedia e-mail containing picture, video, or audio by attachment (Yamasaki, 1996).

A shared whiteboard allows many people to write in the same cyberspace, while Usenet News (Netnews), a bulletin board system on the Internet, provides discussion forums on a variety of topics broken out by topic or area of special interest. Mailing lists, usually used for announcement and discussion, allow the broadcasting of e-mail to many subscribers.

Internet

The Internet is a worldwide system of computer networks, which has often been called the ultimate network or “the mother of all networks” (Roblyer & Edwards, 2000, P. 208) because it is a network of networks. Various types of networks can connect to the Internet, people at different network sites can communicate with each other as if they were on the same local area network (LAN).

Figure 3.1 illustrates the interconnection of networks on the Internet, which is mainly based on the Transport Control Protocol/Internet Protocol (TCP/IP). The high

connectivity with other networks can be achieved as long as gateways interpret between TCP/IP and protocols of various networks.

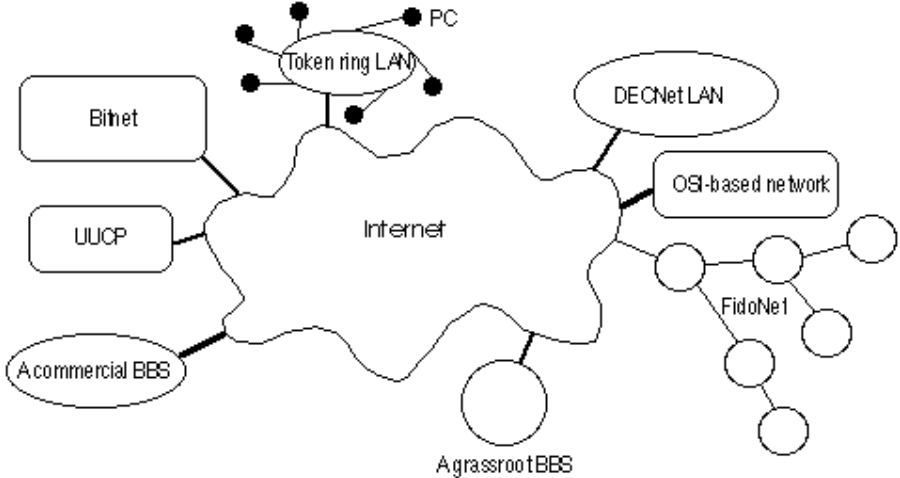


Figure 3.1 Structure of Internet as connections of networks
(Source: Yamasaki, 1996, P.23)

The typical dial-up connection of a personal computer to the Internet is shown in Figure 3.2. There is also a variety of academic communications or commercial

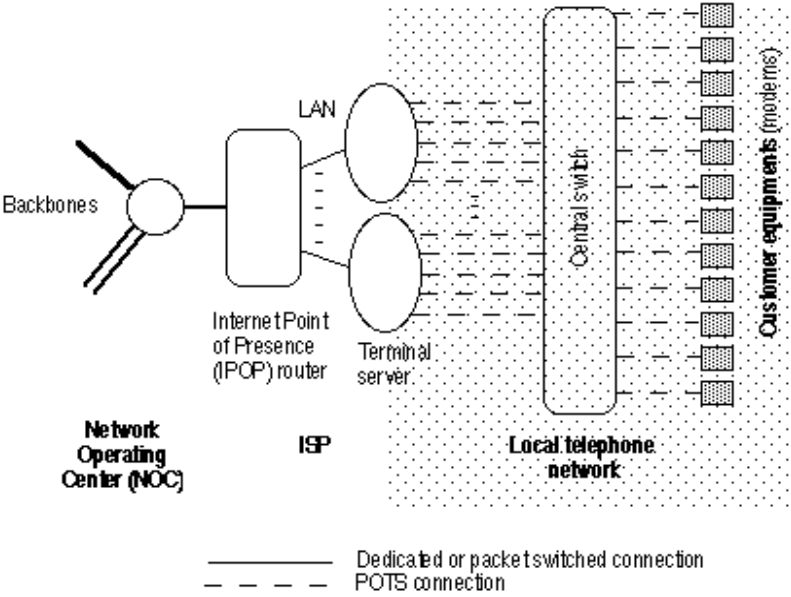


Figure 3.2 Structure of Internet.
(Source: Gillet, 1995, p. 69)

service providers who have direct connections to the Internet and allow people to use these connections.

World Wide Web

Though most people think of World Wide Web (WWW) is synonymous with the Internet, the WWW really is a subset of the Internet system. While the Internet is the world's largest, most powerful computer network connecting personal computers, sophisticated mainframes and high speed supercomputers around the globe, the WWW is an Internet service that links all the sites through hypertext documents and provides users with a uniform and convenient means of accessing the vast resources of the Internet. Some popular software tools, that are now referred to as "web browsers", such as Mosaic, Netscape and Internet Explore (IE), permit text, graphics, sound and video to be hyperlinked to other pages in other sites, thus facilitate navigation and use of the WWW.

The Hypertext Markup Language (HTML) used by the WWW solves the incompatibility problems among different computer architectures. Anybody with a web browser can easily access all kinds of "home pages" to get information on what they need. Some extensions of HTML, such as Java, Virtual Reality Modeling Language (VRML), Acrobat and Shockwave plug-in for Netscape, enhance the WWW more advanced functions with 3-dimensional (3D) manipulation, animation of hypertext and so forth. If applied in distance education, the WWW provides exciting new opportunities to distance educators.

Virtual Reality

As an advanced computer technology, virtual reality (VR) attracts increasing amounts of attention of distance educationalists because it enables non-verbal communication like touching, shaking hands and moving. VR is defined by Chou et al. (2001) as a "computer-technology-based artificial world filled with computer-generated images that respond to users' movements and inputs"; it "allows users to

experience a mediated sense of presence”. VR is a collection of advanced computer technology components and equipment, including high-speed computers, head-mounted displays (HMD), and motion-sensing data gloves. Through the dynamic display of computer-generated graphics, users can interact with virtual objects and information in the virtual 3D environment.

When used for educational purposes, virtual-reality environments fall into three categories according to Johnson’s (1998) proposal: networked text-based virtual environments, desktop virtual reality, and immersible virtual environment. Networked text-based virtual environments are well known as Multi-User Dungeons (MUDs) and MUD Object Oriented (MOOs), with support to real-time interactive use among distributed users. Desktop virtual reality provides 3D multimedia simulations, which enable users to share the same virtual world through computer networks. Immersible virtual environments can provide the greatest degree of immersion through employing high-end laboratory equipment, such as workstation computers, head-mounted display, and data gloves (Chou et al. 2001). However, the high cost to implement VR limits its application.

Streaming Video

This term is specially used for “movies that have been compressed and transmitted in the form of real time video via the Internet” (Roblyer & Edwards, 2000, P.212). An online video player software, Real Video, can help people to see streamed video. Normally the streamed video starts to play almost immediately after the download of the video beginning. However the quality of playing could not always be guaranteed because of heavy reliance on the speed and quality of the connecting line of the computer to the Internet.

Transmission Media

Transmission media takes decisive functions for the quality and speed of telecommunication networks. Normally interconnections for networks can take many

forms: telephone lines, Integrated Services Digital Network (ISDN), coaxial cable, fibre optics, microwave links, VSAT (Very Small Aperture Terminal) links and Broadband ISDN.

- ***Telephone Lines-Twisted Pair (copper)***

Today's telecommunication networks are still using twisted pair cables and coaxial cables, although high bandwidth is in high demand.

Twisted pairs are pairs of insulated copper wires, often used to transfer signals between modems on microcomputers. Although the frequency transmitted is normally less than 4 KHz in analogue model of telephone networks, for purely digital communications the transmitting frequency is up to 1.54 Mbps over short distances (Muirhead, 2001). The drawback of using twisted pair is the noise caused by electrical interference, which decreases the quality of digital transmissions.

- ***Coaxial Cable***

The construction of a coaxial cable with inner and outer conductors separated by insulated material, makes its transmitting capacity up to 50 Mbps for baseband transmission and a few hundred Mbps for broadband transmission (Williams et al., 1999, P. 44). Coaxial Cables have been used primarily on cable TV and certain types of networks. They can transfer signals with minimal interference.

- ***ISDN: Integrated Services Digital Network***

Integrated services digital network (ISDN) provides end-to-end digital connectivity with integrating data, fax, voice, video, and data simultaneously over one line. It runs over plain old telephone (POT) lines using existing twisted pairs, however, it can provide clear channel capabilities and bring significantly more bandwidth to the desktop.

The transmission capability of ISDN is dependent upon different service interfaces used today. Among three basic interfaces, 2B+D “S” Interface uses two twisted-wire pairs to deliver two 64 Kbps B channels and one 16 Kbps data channel. 2B+D “T” Interface is the same as 2B+D “S” Interface except only one twisted pair is used here. The third interface is normally called primary rate interface (PRI) with 23B+D or 30B+D, which operates on two twisted pairs. In the United States, 23B+D is used as the standard T1 line with the delivery capability of 1.54 Mbps, while in Europe 30B+D provides 2.05 Mbps as standard E1 line (Williams et al., 1999, P. 42).

With the advantage of running over existing telecommunications networks and not requiring more expensive fibre optics, ISDN is the best interim technology to be used for distance education until networks having broader bandwidth are fully deployed.

An alternative for broadband implementation is broadband integrated services digital network (BISDN), which provides services at a rate over 2 megabytes per second with a single optical fibre (Williams et al., 1999, P. 48). The biggest advantage of BISDN is provision of bandwidth on demand, thus it has wide applications such as transfer of broadband video, high-speed unrestricted digital information and high-speed, high-resolution facsimile and so on.

- ***Cable Modem***

A cable modem is a device that allows high-speed connection to the Internet via a cable TV network. A cable modem fulfils the functions of a modem, router, bridge and Ethernet hub. Connection to the Internet using coaxial cable services is promising, because a much faster connection speed is possible. With a modified cable system, the download speed ranges from 3 to 10 Mbps, and upload speed is 128 Kbps-10 Mbps. The transmission speed can achieve 1.5 Mbps (Krungrt & Gilroy, 2001). This is much more than most widely used connection speed via telephone line, which is only at 28.8 Kbps or 56Kbps now.

Internet connection via a cable modem will have a promising potential if the Internet has enough bandwidth to carry full-motion video to a screen size as a TV. This will be a feasible way for distance education.

- ***Fibre Optics***

Fibre optics is cables made of glass strands with plastic coating, plus plastic covering. In spite of the high cost involved in installation of fibre system, fibre optics are increasingly attractive to be used as a transmission medium in telecommunication networks, especially suitable to meet the high demand of broad bandwidth.

Williams et al. (1999, P. 44) identified the following characteristics of fibre optics that make it so popular:

- Very high bandwidth (more than 2.5Gbps) (Muirhead, 2001) and very low error rate (1bit in 1 trillion)(Williams et al., 1999, P. 44).
- Immune to electromagnetic and radio frequency interference.
- High security with very little radiation.
- Thin, light, easier to install than copper.
- Safe in hazardous environment.
- Wide networking applications.

- ***VSAT Links - Very Small Aperture Terminal***

Very small aperture terminals (VSATs) are receive/transmit terminals installed at dispersed locations connecting to remote data centres via satellite. VSAT networks can provide two-way transmission of high-quality data, voice and video, with acceptable cost compared with other high-quality transmission medias.

Though the bandwidth of VSATs is not so high with the receiving rate up to 512 Kbps, and transmitting rate at 63 Kbps (Williams et al., 1999, P. 48), VSATs have wide applications in LANs, mainframes, asynchronous terminals and for transmitting compressed video.

3.1.3 Issues in application

The development of technology is always to meet the needs of humankind, it is by no means an exception for educational technology. From postal mail to electronic delivery, from text content to multi-media content, from one-way communication to two-way communication, from low transfer speed to high transfer speed, educational technology has continuously satisfied distance learning needs. Throughout the development and application process of educational technology, there have always been two key issues causing wide concern, namely information transmission speed and cost.

Transmission speed of information is always the bottleneck problem of today's distance education, when it needs to achieve high quality transfer of audio, and video, especially of real time video. Connection to the Internet via traditional telephone line is incapable of transferring high quality videoconferences, virtual reality and real time stream video.

Broadband technology is engaged to increase network transmission speed and capacity with the alternative name of high-speed Internet access. Broadband is "provided by a series of technologies that give users the ability to send and receive data at volumes and speeds far greater than current Internet access over traditional telephone lines" (Kruger & Gilroy, 2001), while the latter is often called "narrowband". Broadband high-speed Internet connection, not only offers high data transmission rate, but also provides "always on" connection and a "two-way" capability, which means high speed download and upload ability.

There are various transmission media or technologies to achieve broadband access. Cable, fibre optics and BISDN are currently used examples. Among these alternatives twisted pairs (cable) can provide 1.54 Mbps for pure data transmission but only within short distance; coaxial cable with a larger capacity at a hundred

Mbps is based on today's cable TV network, but sometimes is combined with fibre optic, known as hybrid fibre coax (HFC).

Primary rate interface (PRI) of ISDN is separately used in the U.S. and Europe with the capacity of 1.54 Mbps and 2.05 Mbps, but the cost is relatively high. BISDN with fibre optics can provide high quality services at a rate of 2 Mbps, mainly deployed in the U.S. Fibre optics is the best choice of broad bandwidth provision, with 2.5 Gbps transmission speed and a lot of other attractive advantages, but the high cost of installation limits its wide application today.

Each technology has its respective advantages and disadvantages, and will compete with each other based on performance, price, quality of service, even geographical locations. To determine which technologies are to be used, distance education program designers need to consider the following questions:

- What is the nature of material? Is it audio, video, data, picture or graphics?
- Who will be the intended audience of the program?
- What is the volume and frequency of exchange?
- Is the speed of transmission of the technology available?
- What will be the cost of transmission of the technology?
How about the budget?
- Is the type of connectivity available?

The final choice of technologies will be a balance of the above factors, especially based on the transmission speed availability and the cost.

3.2 The impact of technology changes on distance learning

Distance learning can always take advantages of technology development. Through incorporating new technologies into education courses and learning environment, distance learning has been reshaped by technology changes through the years. As discussed in chapter2, the foundations for dividing the four generations of distance learning is based on the revolution of educational technologies. As a result of new

technologies, distance education programs are offering a more interactive experience that more closely parallels face-to-face teaching in effect creating a virtual classroom. In this virtual environment of distance learning, the following aspects can be identified in reflection of the impacts of technology changes on distance learning:

- **Levels of interactivity**

One of the most significant ways in which distance education has evolved is its shift from one-way technologies to interactive technologies. As indicated in Figure 3.3, the development of two-way interactive video delivery environments is highlighted, the way that distance learning has evolved through the years is also represented .

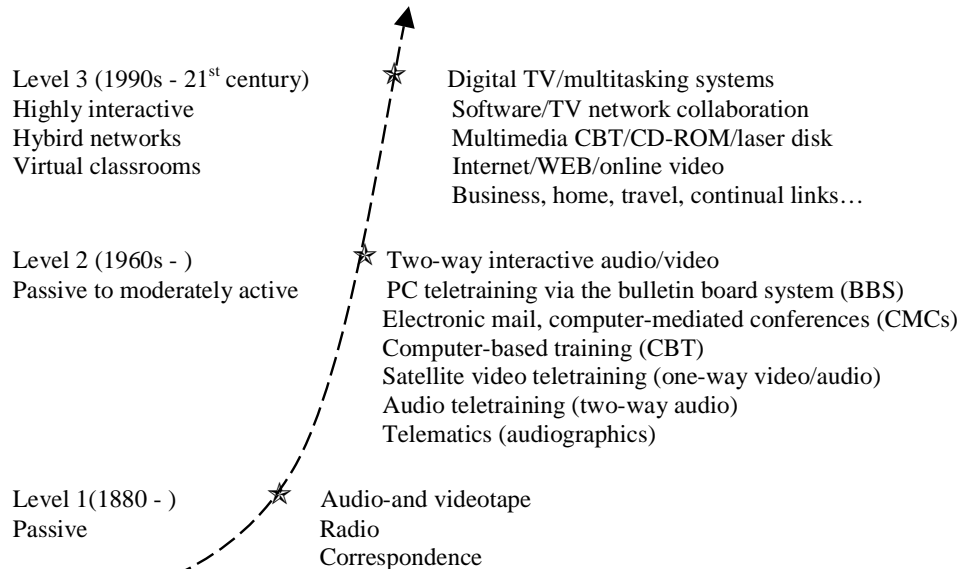


Figure 3.3 Distance education continuum

(Source: Williams et al., 1999, P. 4)

Level 1 indicates typical asynchronous distance learning and shows one-way communication between the learner and the instructor. The learner could not interact with the instructor in real time and transmission of messages between them normally has a lengthy delay, so distance learning at this level is considered as passive distance learning.

Level 2 mainly consists of synchronous means of communication. For audio teletraining, computer-mediated conferencing, bulletin board system, and other distance learning environments listed in this level, messages can be transmitted simultaneously between sender and receiver, and can get immediate feedback and interaction among distance sites. Two-way interactive communications are achieved at this level and level 2 is considered as passive to moderately active distance learning.

Level 3 is a hybrid learning environment which combines all the previously described synchronous and asynchronous distance learning methods, that can be used in one virtual classroom with powerful supplement of the Internet and the WWW. The learner can benefit from both asynchronous tools, such as e-mail, threaded discussion and self-paced testing, and synchronous elements such as chat rooms and online streaming video and/or audio. All the means can be used flexibly, and high interactivity can be achieved at this level.

- **More student-centred learning**

Putting focus on students is a central pre-condition of good education at a distance, many distance educators tried to enhance this but they were limited by the technologies available to them. The traditional model for distance education, only one-way transmission of instruction from teacher to student, could not get in-time feedback from students. Students were “less of a voice” and passive.

The advent of digital technologies enables more teacher-to-student and student-to-student interaction, which lead distance learning to a higher level of interactivity. This makes student-centred learning possible. Through two-way, synchronous or asynchronous interaction with the teacher, the student can play a more active role in distance learning. Prompt feedback and immediate communication will help to build student-needed course materials, while high interactivity can let students get more support from the teacher. Access to the Internet can provide large resources for study

needs, and communications with other students will be helpful for co-learning. All of these form the base of student-centred learning.

Asynchronous technologies particularly promote self-paced learning and make distance learning more individualized. In the early stages of distance learning, through radio broadcasting or television broadcasting, students were constrained from studying at their own pace and at their own time. While today's technologies, among which both synchronous and asynchronous means can be combined together as needed, students can choose any of them for study and communication. Thus self-paced, self-determined study is becoming the main feature of current distance learning.

- **Information delivery**

Course contents are enriched. Course material contents of distance education have been enriched dramatically along with the growing capacity and ability of delivery technology. The emergence of radio and TV added audio and video materials to the text-based course contents. The advent of computers enriched the types of delivery materials to a multi-media level, which consisted of computer based audio, video, and animations. While the Internet and the WWW not only permit course designers to add 3D images and animations, they also make the transfer of interactive videoconferencing, streaming video and virtual reality possible.

Delivery speed is faster. To deliver one book of 850 pages for instance may need one week by postal mail, but through the Internet with a high-speed cable modem it can be finished in 2 seconds. And with broadband technology, 5 million such kinds of books can be transferred in less than 1 minute through fibre optics (Muirhead, 2001)!

Information quantity is enlarged. Interactive videoconferences, online real time video and other high-volume, high-compressed contents can only be transferred with high-quality through modern broadband technology.

Accessible resources are increasing. Reference materials were very limited in the past, but are amazing today in the Internet. As long as the copyright is permitted, one can almost get all kinds of materials needed for study.

- **Relationship development**

Technology development has improved relationships of students with teachers, and students with students in distance learning.

Distance learning has the nature of geographical or time separation between the student and the teacher or other students. Nobody knows each other among them. In early correspondence learning, the one-way communication between the teacher and the student was far from enough to establish a good relationship and to reduce the psychologic distance between them, not to mention the relationship between distance learning students.

The Internet and the WWW is a powerful tool for improving the situation and enhancing the relationship among teachers and students. Multi-means communication, high interactivity during study, especially interactive videoconferencing, where teachers and students can see, can hear from and can talk with each other, makes study seem to occur in a real classroom. Thus psychologic distance among them is shorted and even disappears.

Group collaboration for study can be managed through the Internet. Students can learn together online, through discussion and analysis, a virtual study community is built to shorten the distance. Therefore students can still develop a good relationship in a virtual collaborative learning environment.

3.3 Learning in a virtual environment

The core of distance education is to provide a virtual learning environment, which includes a delivery mechanism, student tracking, assessment and access to resources. This section will discuss how distance learning is organized and conducted in this virtual environment, what kind of roles teachers and students take and how to assess students. With the consideration almost all the distance learning being conducted through the Internet and the WWW today, the discussions will be based on online distance learning.

- **What is a virtual learning environment?**

There is no simple definition of what constitutes a virtual learning environment. Generally speaking when used in learning at a distance, it may consist of “any attempt to create a unified environment for learning” (Milligan, 1999), which aims to mirror a face-to-face learning environment. This environment cannot only present structured information, but also provides the communication medium for the necessary interaction. Within it the students will be able to establish some form of human relationship with the teacher.

A virtual learning environment should have a core set of features, as proposed by Milligan (1999), which can be listed as the following:

- Delivery and management of course materials
- Access control: usually password based
- Administration: student tracking, collation of marks, record of progress
- Time-tabling facilities: some explicit means of pacing materials
- Assessment: usually formative (e.g. for self assessment)
- Communication: on various levels, one to one, one to many, synchronous and asynchronous
- Personal space for participant to exchange and store materials
- A resource base: less formal than learning materials, perhaps an FAQ (Frequently Asked Questions) or database accessed by keyword search

- Support facilities: for instance, online help about the environment, and
- Maintenance tools for creating and updating the learning materials.

Besides these elements, the course delivery mode (fully online or part online), the level of tutor support, ways of the class being structured, length of the course and cost are vital external factors, which will greatly influence the format of a virtual learning environment.

Currently increasing attention is put on a student centred model of virtual learning environment. This model adopts a student centred approach, which provides a set of tools to help the student to construct an environment for effective learning, and also adopts constructive and collaborative methods in the learning process (Pulkkinen & Niemi, 1997), which can foster the development of critical thinking, clarification of ideas, and evaluation of others' ideas.

- **Learning course design**

To design and organize distance education courses in a virtual environment, an important challenge is how to build the relation between the contents and the method of study. Since the constructive and collaborative learning method can help the student to study effectively, guiding principles of designing distance education courses should be focused on student centred instruction and learning needs assessment, nurturing reflexivity and awareness of one's own thinking and learning process, and providing the mechanism for encouraging interaction and social negotiation.

To make the student the centre of the learning environment, it is necessary to construct a set of tasks, link resources, submissions, communications routes of each individual student. Through assessment of their own learning needs, the students are allowed to construct their own knowledge of teaching and learning. Course designers need to consider carefully how to 'individualise' the learning approach, and the

course structure should be focused on 'Interaction', which can motivate the students to think creatively and communicate with each other easily.

Interaction in a virtual learning environment consists of three aspects: teachers, learners and course materials. To foster interaction through course material design, the core part will be to select appropriate resource materials that are activity based and incorporated with implicit dialogue, and to integrate and apply appropriate technology as needed.

Good online learning materials should not only provide the knowledge, information, and communication opportunities, but also implicate the reinforcement of learning through reflection, thus be an inviting environment for collaborative activities. In general, at the best, online course materials should extend beyond being a virtual coursebook, to being a virtual classroom.

Collaborative learning can help to reach deeper levels of learning. This is often achieved through learning groups within which good collaboration is required. Collaboration may be synchronous (through the use of video conferencing, audio communication or white boards) or it may be asynchronous (through the provision of shared workspace). On one hand, the group collaboration can reflect individuals' experiences and ideas, and feedback from other group members. On the other hand, group collaboration can help individuals to conquer difficulties encountered in the learning process. Of course in a virtual distance learning environment, a collaborative learning group may be separated physically, but can be connected by all kinds of interaction tools. Teleconferencing, video conferencing, telephone, e-mail, Internet netmeeting are popular technologies with high interactivity used in online learning.

Based on the above analysis, a typical distance learning course unit should include the following elements (Muirhead, 2001):

- Study guides: instructionally designed print
- Printed resource materials: textbook, selected readings, online lecture notes
- Electronic medium: Library online files and databases, CD-ROM, audio-visual tapes, the WWW
- Interactions: Telephone, Tele/video-conferencing, E-mail, Internet netchat, netmeeting, residential schools
- Group workshops: individualised print based.

- **Roles of teachers and students in a virtual learning environment**

The roles of teachers and students in a virtual learning environment are very different from those in a traditional face-to-face class. Traditional education is often based on teacher-centred instruction, where teachers have total autonomy in the design and delivery of their courses. While in computer supported collaborative learning, the traditional roles of teachers as information deliverers are changed to roles of facilitators, mentors and co-learners. Students are also undergoing a transformation from passive recipients of information to active participants in the learning process.

In the online distance learning environment, new types of interaction are at the heart of the relationship revolution between teachers and students, as new methodologies are created for online virtual classroom. In a traditional classroom, teachers and students interact directly, the teacher has direct control of instructional content, and information delivery, gives immediate corrections and adjustments according to students' responses to the content and the learning process. Lecture and discussion are the main forms of communication between them. In an online learning environment, being separated physically, teachers and students are connected by various synchronous or asynchronous electronic means such as videoconferencing, e-mail and so on. Teachers choose appropriate electronic media, such as audio and video resources, multimedia presentations and simulations, put course materials on line, design the learning environment; students conduct learning in this virtual

environment, interact with these course media, and interact with teachers when needed.

Thus the core of a teachers' role in a virtual learning environment is to "think students, think students' support" (Muirhead, 2001). As designer of an effective learning environment, the teacher needs to select and use digital media, to think of distance education provision as support for distance students. As mediators, facilitators of learning, the distance educators should think how to make their roles more accessible, more involving and more supportive. As mentors and co-learners, they should make sure their support is provided "in the right place, at the right time".

Students, learning in a virtual environment, do not have to take notes as in the traditional classroom, since the materials are organized and presented in electronic format. Through interaction with teachers and other students, the student plays an active role in the learning environment, not a receiver of information, but a participant in learning, an active collaborator with other students and teachers.

- **Assessing distance learners**

Assessment is an inevitable component of distance education. How to assess a student's learning in a virtual environment is a big challenge for online education.

Since assessment is a process that "uses information gathered through measurement to analyse or judge a learner's performance on some relevant work task" (Hill, 1997), there is no big difference between assessment of distance learning and of traditional learning. The assessing purposes of both learning environments are the same and to achieve pedagogical improvements for teaching and promoting learning, by applying assessment tools to monitor students' progress.

In order to get an effective assessment in an online learning environment, instructors should make the assessing criteria accessible and understandable to students, and link assessment to the learning and focus on validity.

There are various assessment methods, among which the assignment is one of the favourite assessing tools used by distance educators, while sometimes online examination also functions well. Since it is difficult to monitor the process of how the distance students respond to the assessment, good assignments are often designed to measure students' observation, interpretations, analyses, critiques, and applications of a particular issue. This will force students to develop critical thinking skills, writing skills and independent thinking skills, and encourage demonstration of understanding.

Assignments should help to reduce the perceived distance and lessen the anxiety caused by assessment, by giving clear expectations on assignment requirements. Responses to students' assignments should foster "risk taking" to encourage self-directed confident learners. Pointing out strengths, finding something positive, acknowledging important issues, indicating when more depth was expected, and offering answers to confusion (Muirhead, 2001), are good practices of responding to assignments.

Assessing students' learning can be used for formative purposes to track students' progress in an online learning environment, and can also be used as summative assessment to measure what and how students have learned at the end of a block of instruction (Dedeke, 1999). But in general, distance educators should assure the effectiveness of the assessment and make it be a continuous process in the virtual learning environment.

3.4 Learning at distance: advantages and disadvantages

Compared with traditional classroom education, learning at distance has some advantages as well as disadvantages. Typical advantages of distance learning are as follows:

Flexibility of learning

- Distance learning occurs free from place and time constraints, offers a “no walls, no frontiers or barriers” (Muirhead, 2001) learning environment. Students can learn at any place and at any time, this is the biggest advantage of distance learning compared with traditional classroom learning.
- Solving time or scheduling problems, make it the best choice for on-job learning, lifelong learning. Distance learning will be more prevalent since the lifelong learning is becoming the mainstream of education in modern society.
- Distance learning permits students to learn at their own pace. The student-centred approach can let students create individually tailored paths and move at their own speed, thus make self-directed, self-paced individualized learning possible .

More opportunities for sharing resources

- Through using the Internet and the WWW, distance learning offers more opportunities for students to access vast resources from all over the world.
- Students have equal opportunity to access experts and share the same expertise. Through learning online students can easily acquire valuable information contributed from experts or professional organisations.
- Distance learning providers can share materials and expertise in order to improve course quality, even provide materials from other schools for life-long education, if they do not have enough teachers or facilities themselves. This can help to improve distance learning quality and students will get more benefits.

High technology supported

- Multimedia presentation of content. Distance learning courses are often well-designed and tailored beyond the traditional classroom-teaching materials. Multimedia contents (texts, images, audio, video and animation) can accommodate different learning styles and make learning itself attractive.
- Multi-accessibility and reinforce of the content. In traditional classroom learning students have to keep up with the teacher's instruction pace, while in distance learning environment it is very easy for students to study the same materials as many times as they like. If learning through the web, students only need to "click" the mouse and get what they need.
- Up to date information. Distance online learning always provides the newest materials and information, since the web is "dynamic and allows for easy updating and fast dissemination" (Hui & Cheung, 2000). This can keep distance learning from being out of date and obsolete.
- Experiential learning. High integration of technology in distance education, can help to create a simulated and virtualised learning environment. Simulation of experiments can be carried out in virtual labs on line, through interacting with graphics, voice and music. This is especially suitable for those experiments that could not be conducted in a real classroom. The learning process is thus to be enriched and expanded to a level that traditional learning could not reach.

Collaborative and constructive learning

- Distance learning offers an environment to foster the development of critical thinking and encourage students to construct their own knowledge of teaching and learning.
- Through all kind of connections and interactions, students can learn collaboratively in a distance learning environment. They can change information and help each other, even complete a group task. Through cooperation and collaboration the student learns as an active participant, not a passive information receiver.

More capacity and releases teachers from classroom

- For distance learning providers, there are fewer classroom limitations compared with traditional classroom education.
- Teachers do not need to give lectures repeatedly as in a traditional classroom. They are released from classroom, and can spend more time to keep up with technology changes, shift their effort to improve course design quality and coach students' self-paced learning.

The following disadvantages are still barriers to further development of distance learning:

Psychologic distance still exists

When learning at distance, students are separated from teachers and other students physically. Although distance education can provide all kinds of communication and interaction tools such as e-mail, chat room, videoconferencing and netmeeting, which can help to reduce the distance, psychologic distance still exists and is difficult to totally eliminate.

Compared with classroom live lectures, distance learning has a lack of non-verbal communication such as eye contact, gestures and handshakes, which is very important for personal interaction and eliminate distance. Virtual Reality technology has integrated non-verbal communication into learning (Chou et al., 2001), and it may be helpful for solving this problem.

Too much dependence on technology

Distance education delivery system relies heavily on technology. Streaming videoconferencing and virtual reality are very effective tools for distance learning, but low transmission speed of the delivery system today undermines the quality of

their playing. Broadband technology such as fibre optic can solve the transmission speed problem, but it needs time for wide application of fibre optic.

The stability and reliability of the delivery system is also a big problem facing distance learning today. Once some trouble occurs somewhere in the system, the ongoing distance learning will be interrupted.

Also communication through the computer system is complicated and time-consuming. Students and teachers may feel bored on spending too much time on computer operating.

Higher requirements for both teachers and students

The more technology is integrated with a distance learning system, the more skills of grasping the technology are required for teachers and students. They both face the concurrent changes of learning computer skills, new software, and appropriate online communication skills. This may be a big burden for some of them. Having a lack of familiarity with communication skills and necessary trouble-shooting skills, students may fall into technological pitfalls and the distance learning process consequently could not be continued normally.

Costs involved are high

Investment of distance learning equipment and course materials are costly. Also course designers need to be trained, technical management and support system need to be maintained. Broadband technology for increasing the transmission speed is especially expensive. For instance the cost is still the main barrier for wide application of fibre optics. For the student the cost is also a problem in owning a computer system and accessing the Internet. Fortunately along with the development of technology, the costs will be reduced markedly and will not be a problem for distance learning.

Lack of competitive pressures

When learning at distance, student study at home or work places individually and at their own pace, they take greater responsibility for their own learning than on-campus students. Because of lack of competitive pressure associated with a traditional classroom environment, students' focus and concentration may decrease with time. It needs high self-disciplinary ability and high motivation to keep their activity.

3.5 Quality Assurance Issues

Distance learning frees the students from time and place constraints, also makes itself grow rapidly and increasingly becomes international and globalized. The distance learning providers are put into a more competitive market than ever before, since learners have a choice to select institutions which they would like to learn from. From the institutions point of view, key questions are how to attract more students and make themselves secure in the market, and how to assure the quality of the service and courses offered by them? What kind of strategies should be taken? These questions fall within the scope of quality assurance of distance learning, which is a key component that is increasingly used to give a competitive edge to a distance learning programme.

Quality assurance

Quality is defined as the “degree of excellence” by the Pocket Oxford Dictionary (1992). Regarding distance learning, it is associated with “fitness for purpose” by Reid and Robertshaw (1991), where the purpose means the successful learning by means of distance education methods. Quality assurance is just the means adopted by institutions to maintain the standards of practices and to achieve higher standards of excellence. The success of the quality assurance process of distance education can be measured by the following attributes listed by Reid and Robertshaw (1991):

- An assessment and examination system which measures accurately the extent to which knowledge has been acquired by the students;

- A higher retention rate or lower dropout rate;
- A higher pass rate than that achieved by equivalent courses of lower quality.

Therefore the practice of quality assurance in distance education should be used to maintain standards of services for purposes of competition and reliability. The necessity of adoption of quality assurance will be more evident as the business of distance education becomes bigger and bigger.

Quality assurance strategies

To assure quality in distance education involves a variety of factors such as basic foundations of technological infrastructure and market infrastructure, outcomes-based assessment, interaction in the learning process, academic and student services, and external oversight (Broad, 1998). But basically the quality assurance strategies should be integrated into the process of distance learning programme design and their delivery. Distance learning unique features should be taken into account, such as to focus on student-centred learning, less control by faculty over curriculum and less emphasis on process but more assessment-driven. Thus Phipps et al. (1998) believe that quality assurance strategies should focus on four key aspects:

- **Faculty credentials, selection and training**

This is to assure the faculty to be competent with distance teaching. In addition to possessing an appropriate degree in the relevant field of instruction, they also need to have appropriate training in designing the course content to fit the delivery method proposed for the course, have basic understanding of technology used in a virtual learning environment and possess necessary assessment techniques.

- **Time-on-task measures**

This is to enhance the guide and support of the teachers to distance learners. In order to ensure the learners study on the right track, the course is always accompanied by a

comprehensive study guide which sets clearly course objectives, unit guides, study tasks, assignment and time desired. Interactions with teachers are also required.

- **Students support services and consumer information**

To focus on adequate student support should be the heart of quality assurance in distance learning environments, which is characterised by student-centred learning. A good distance learning environment should be based on a comprehensive student support system, which should be put into place before the distance learning programme commences. The students should be given help on how to use the system and be monitored to get the support through the system. The core part of student support services is the tutor, who takes the function as a subject expert and interacts with students directly including assessing the students and getting feedback from the students.

- **Goals and outcomes**

Quality assurance in distance learning could not rely on the learning process as conventional education does, since distance learning is student self-paced, self-directed learning.

So the effective way of assuring quality is to put emphasis on program goals and assessment of results in achieving these goals. On the assessment process, external oversight should be highlighted with the greater use of outsider consultants and assessment “experts”, instead of the faculty.

In order to meet the above quality assurance strategies, there are also a number of other factors contributing to the quality of distance learning. For example course multimedia can be efficiently delivered with the minimum requirements of hardware and software, course materials should not violate copyright laws, assessments should consider the limitations of the delivery method, and students should have the opportunity to assess course management and delivery during the course. In general,

the success and quality of distance learning, depends on meeting the demands of the market, possessing good quality assurance strategies and implementing the quality control measures in a productive way.

Chapter 4

Global Developments of Cyberspace Education

To develop high technology-supported cyberspace education is becoming an increasingly unchangeable trend among all the institutions of the world. The rise in the availability of modern distance education, is not only seen as a revolutionary opportunity to increase access to higher education, but also as an opportunity to hasten the overall pace of reform in education. According to statistics of Chinese Computer Users (CCU, 2001) up to the year 2000, more than 100 countries have introduced modern distance education, with over 85 percent universities having their own websites and one fourth of them providing online education courses. Because of the advantages of higher developed technology, countries in the Europe and America are in the leading edge of the world in development of distance education. For example, 60% of high education institutions in US offer web-based distance education, and there are about 2,500 institutions in Germany providing online education. In developing countries, distance education has also been developed rapidly in recent years. There are more than 200 educational websites in South Korea, while the distance education market in China is growing at a rate of 150% every year, where there are already 31 higher education institutions carrying out online distance education programmes.

This chapter will give an international overview of current developments of distance education, giving some examples in leading countries such as the US, Australia, Canada and UK. Application of distance education in China as a representative perspective of developing countries will be presented accordingly. At the end, the

situation of distance education in maritime education and training (MET) will be brought into the picture.

4.1 International scenario

The United States

Distance education has been developed dramatically in recent years in the United States. According to a 1999 report of the US Department of Education, enrolments in distance education classes more than doubled in three years, increasing from 0.75 million in 1995 to 1.66 million in 1998. Last year students enrolled in online courses were already beyond 2 million (Lambert, 2000, October).

Among an estimated 54,470 distance education courses, college-level, credit-granting courses represented about 49,690 (USDE, 1999). Most of them were at the undergraduate level, except in the fields of education and engineering where more graduate distance courses were offered.

In 1999 there were around 1400 of the nation's 3000 colleges and universities offering distance education courses and programmes, one third of them offered one or more complete degree programmes at distance (Dirr, 1999). Among these institutions, most are "dual-mode" offering virtual learning degree programmes as an extension of their campus-based programmes. Columbia University, for example, has established the Columbia Video Network (CVN) to offer flexible distance education to off-campus students in several subjects, while other institutions are "single mode" and considered as "virtual universities", such as National Technological University, Western Governors University and the University of Phoenix, which mainly offer virtual learning opportunities on the principles of distance and virtual learning.

There is a big commercial trend in the US high education, especially in distance education, as more and more commercial interests are attracted and tapped into virtual learning institutions. New York University is setting up for-profit and hopes

to generate enough revenues from distance education courses. Commercial companies such as AT&T, IBM and Lotus have tapped institutions with distance education programmes to provide in-service professional development opportunities (Dirr, 1999). Distance education is becoming a large and growing business in the US.

Canada

The situation of distance education in Canada is quite different from that in the US. Increased demand for flexible learning styles and relevant programmes, decreased financial reasons and increasing competition from other providers, forced Canadian educational institutions to find all kinds of ways to improve the quality of their courses and to enrich their education delivery methods. Although the emphasis is still put on traditional teacher-directed model, learner-centred collaborative distance learning has attracted an explosion of interest and participation in recent years. The rapid growth in the availability of distance programs and the broadening of the range of information and communication technologies (ICT) used in distance education courses, has been the most significant developments in Canadian education.

In Canada, distance education programs are provided by traditional universities and colleges, newly created distance teaching and open institutions, as well as by business and industry. More and more private schools and colleges are focusing on distance training in addition to large co-operation.

The prevalent pattern for distance education in Canada is that of the “dual mode” institution with the typical example of University College of Cape Breton, which offers a graduate-level certificate programme entirely on the World Wide Web. “Single-mode” distance education systems are most notable exceptions to the traditional pattern, Athabasca University in Alberta, the Commonwealth of Learning, Tele-University in Quebec and British Columbia’s Open University are at the forefront of large-scale application of this mode, with the mixed use of technologies such as the Internet, the WWW, videoconferencing and even print (Farrell, 1999).

Most distance courses and programmes provided by universities and colleges are at undergraduate level, while some are available at graduate or postgraduate level. A large proportion of virtual learning can be found in the school (K-12) sector in Canada, with a lot of examples such as Alberea Distance Learning Centre and the Open School in British Columbia.

The new trend in distance education in Canada is the emergence of virtual organisations, which are “managed through virtual arrangements among a group of institutions with complementary services” (Farrell, 1999). These types of collaboration have developed rapidly at the level of trade and technical programmes and at university level, with the obvious advantages of providing students with high-level flexibility and reducing operating costs for institutions (Farrell, 1999). The collaboration between three of British Columbia’s “traditional” universities and the Open University is the long-standing example of this kind of virtual organisation.

The Canadian federal government has a very limited role in education, while the development of distance education has been more influenced by some national organisations such as the Canadian Association for Distance Education and the Office of Learning Technologies.

Australia

Australia has over seventy years experience in providing distance education. The geographical isolation of large parts of its population has meant that distance education is an important part of Australia’s education and training system, with nearly 20,000 students in “twinned campus” offshore, and a further 6000 enrolled by distance (Tapsall & Ryan, 1999).

Australia has no pure virtual university, while most distance education programmes are offered by dual-mode or multi-campus institutions. Corporate universities for

training worldwide employees are the new providers of learning at distance, such as Qantas College Online.

All universities in Australia have built sophisticated web-based networking systems for administrative purpose, including vocational education and training providers. Leading distance education providers are the University of Southern Queensland (USQ), Central Queensland University, Charles Sturt University and Monash University. The only online virtual institution, Technical and Further Education College (TAFE), is still in the process of realising in the state Victoria, which will represent 30 colleges. USQ also plans to launch a virtual campus providing web-based course delivery in Australia and overseas, possible enrolments in the next three years will be up to 2,500 students, according to Tapsall and Ryan's report (1999).

The technical wing of Australia is quite strong. The AsiaSpace Trials project is to provide a point-to-point multi-point satellite service for the purpose of creating distributed virtual classrooms and deliver some university courses into Asia, involving a collaboration of industry, education providers, research groups and government bodies. Besides this, the Internet has already been an integral part of the education system with the evidence that about 80% of adult Australians access the Internet as part of their study (Tapsall & Ryan, 1999). For distance course delivery, multiple media including the Internet, CD-ROM, interactive tele-conferencing and video are always used together.

The government of Australia plays a very important role in promoting development of distance education. As prime Minister John Howard proclaimed, education and training in the endeavour to "get Australia online" is a major focus of one of four sectors in the 21st century (Tapsall & Ryan, 1999). Therefore Australia will be the home of the first global or regional universities.

The United Kingdom

Generally speaking in European countries distance education systems and information technology infrastructure have been 10 to 15 years behind those of the North America, although in these five years they have got a rapid development in the UK and Scandinavian countries. Among all the European countries the UK is at the leading position by owning all forms of online and virtual education, and followed by Germany and Scandinavian countries. Though the European Union has funded several initiatives to develop distance education eastern Europe area, most are still in “awareness raising” stage (Mason, 1999). Here we just take the UK as an example of European countries to have an overview on distance education development.

The UK developed distance education as early as in 1969 with the foundation the Open University, which is the largest university of Britain today. The UK government has taken a decisive function in the progress of distance education development through these years, especially after 1995. In 1995 a national network project was launched by the government, for the purposes of computerizing all the institutions and schools, facilitating the network equipment to promote online learning throughout the whole country (Yang et al., 2000). So distance education has been changed dramatically in these five years in the UK, which can be seen from the development of following virtual education providers.

The Open University of UK (UKOU) has over 210,000 students and customers today (Changing the face of learning, 2001), with moving its longstanding education approach to large using online methods. Although it is open in accepting students with no requirements of previous qualifications, the Open University are ranking among the top of UK universities for the quality.

Distance education courses of the UKOU are available both at undergraduate level and postgraduate level, with geographical distribution throughout the Europe and many other parts of the world via the Internet. There are over 25,000 students outside

the UK, provided with study programmes of 30 two-year diplomas and over 20 degrees (Changing the face of learning, 2001).

Clyde Virtual University (CVU), built in 1996, is a collaborative project of four institutions in the Clyde region, with the purposes of delivering the Internet-based multimedia learning materials to students through the Web. There are around 1000 students in 1996-1997 school term (Mason, 1999). The National Grid for Learning is another government's recent initiative to promote distance education in school sector, with the provision of communication facilities and resources for teachers and students.

Corporate universities are a new notable feature in European countries along with the involvement of private companies in distance education provision. The British Aerospace Virtual University, which was launched in 1998 (Mason, 1999), mainly provides online delivery of learning and development research programmes across the whole company, through the cooperation with various university partners such as UKOU, by which distance education courses and training materials are provided.

4.2 Cyberspace education in China

Like in other developing countries, a huge and rapidly expanding population is the enormous challenge for education in China. With one-fourth of the population of the whole world, and only one out of 20 young people receiving higher education (Bollag, 2001), it is almost impossible to achieve mass education for China only relying upon traditional brick-and-mortar education models. The only way to cope with the problem is to seek for unconventional modes such as distance learning.

Three generations

Distance learning is not new in China. It has experienced three generations since the first attempt in 1953. The first generation used correspondence, 635 conventional universities had their correspondence education division schools in 1997. The second

generation began with the opening of China's first Radio and TV University in 1960. In 1986, the China Educational Television Service began the country's first satellite channel. In 1997, 5 million students enrolled for self-study through Radio and TV Universities system. But these programmes were mostly one-way delivery to students and the teachers could not get feedback timely (Ding, 1999). The third generation of distance learning in China started in 1987 with the establishment of Zhonghua learning project (Yang et al., 2000). It has developed rapidly in recent years with the focus on using the Internet and providing two-way interactive tele-education.

Current situations

Government policy

The Chinese government plays a decisive role in the development process of education as well as distance learning. Since developing education and science has been given a strategic priority by the government from 1997, distance education has also been put into the top of agenda for the national development. Because it specially suits the situation of China, according to Chen Zhili, Minister of Education Department, distance education will be the main component of a Chinese lifelong education system. In January 1999, a project of "Modern Distance Education" was formally launched through the approval of "The Operational Program of Promoting Education in Facing 21st Century" by the State Council (Yang et al., 2000). The aim of this project is to form an open education network and to build up a lifelong learning system.

Information infrastructure

To provide the Internet infrastructure for distance education, the Chinese government has invested in the construction of a college network. China Education and Research Network (CERNET), one of the four national computer networks approved by the State Council, was built in 1994 and now it has 36 bytes linking 700 universities and research institutes in 70 cities of the whole country. More than 200,000 servers are

available on 3 million terminals nationwide. By the end of 2000, most provinces and cities in China will open high-speed transmission networks to link up with CERNET (Yang et al., 2000), while the backbone of CERNET will be improved to 622 Mbps (Liu, 2000).

At the same time, the Chinese Educational TV network (CETV) is busily engaged in technological renovations. After the renovation, CETV will provide a satellite digital transmission platform with dozens of digital channels (Liu, 2000). Nicknamed the Airnet (the satellite TV network) and the Landnet (the computer network), CETV and CERNET thus form a basic multi-functional platform for distance education in China. This is a national unified transmission system.

Pilot projects

Up to the end of 2000, the Chinese Education Ministry had approved 31 universities and colleges to conduct distance education. Four universities, including Tsinghua University, Beijing Posts and Telecommunications University, Zhejiang University and Hunan University, were the first batch of being chosen to carry out distance education through computer networks in September 1998, with initial investment of 400 million (Ding, 2000). The pilot project has proved to be successful with the increasing enrolments. Tsinghua University even began to teach students over the Internet in 20 provinces and major cities. These 31 universities can design professional education courses by themselves, can open both undergraduate and postgraduate courses online, even accept students by various means of examinations.

A new initiative, “Construction Engineering of Network Courses in New Century”, will be launched soon by the Ministry of Education (Ding, 2000). It is planned to construct 300 fundamental network courses selectively within 2 years, together with the promotion of courseware library construction. These new century network courses can be applied to those pilot-universities, as well as other relevant universities and colleges.

China Central Radio and TV University

Since its establishment in 1979, China Central Radio and TV University (CRTVU), together with its 2600 branch campuses and 29,000 study centres (Bollag, 2001), has been the biggest distance education system of the world. Today it is still the main player of providing distance education in China, with more than 100,000 enrolments per year. The teaching methods in CRTVU have already been reshaped by the technology. A campus based LAN is opened and connected to the Internet in CRTVU, network based course delivery and multimedia compute-aided-instruction (CAI) coursewares renovated old broadcasting programs. Virtual classroom system, videoconferencing, virtual library, learning centre network, digital compression TV programme via satellite, and a new credit system form a new face of CRTVU. Radio and TV universities are the best interim for distance learning because of the high costs involved in the Internet.

Cyber populations

Distance education via the Internet needs a high availability of access to the Internet. As a developing country, China did have a very low proportion of Internet users compared with developed countries. In October 1997, there were only 620,000 people having opportunity to access the Internet (Sun and Zhang, 2001). But since then the number has increased exponentially, much faster than that in the west. By the end of 1999, the number increased to 8.9 million from 1.5 million in February 1999. By the end of the first quarter of 2000, the number had jumped to 10 million and it is expected to reach 20 million by 2003. The rapid growth rate of the Internet users indicates that distance education via the Internet has great potential in universalising education in China; online learning will play an increasingly important role in China's lifelong learning system.

4.3 Applications in Maritime Education and Training

Maritime Education and Training (MET) will have great development potential when converged with cyberspace education method. There is a great necessity for cyberspace education to be applied in the MET field since the shipping industry posed higher requirements for current seafarers. The frequent turnover of ship's crew and internationalisation of seafaring are common practices today, new incoming members have to integrate quickly and effectively; the reduction of crew members demands a broader knowledge of each new member in order to meet standards of STCW95; continuously changing operating scenarios and new technologies exploited on ships require prompt renovation and supplementation of knowledge and skills of the crew; whilst the fast turnaround of ships and reduced crews pose the problem of lack continuing study opportunities for seafarers. The best solution is to get On Board Training (OBT) through modern distance leaning methods.

Distance learning on board, what people could not imagine before, is possible today and technically realizable. The explosion of new developments of technologies in the maritime field changes the manner in which ships are managed, and also puts some threats on MET institutions.

The increasing use of Internet, e-mail and interactive data exchange software applications provides the potential to manage the fleet and crew in an entirely different way for shipping companies. Access to the Internet on board is made easy via pc and modem. Bergesen and Stolt Tankers have already installed local Area Networks (LANs) on their ships, of which a new Hub has been set up by Wallem Ship Management specifically for optimised managing of its own ships (Muirhead, 1998). Communication with company and families can be fast and easily achieved through electronic means such as e-mail, Internet voice communication and desktop based videoconferencing. The roaming satellite services provided by Inmarsat, Orbcomm (satellite telephone system), Iridium (hand-held satphones), and Teledesic

system (Internet in the sky) enhance the infrastructure dramatically, through which the ship is increasingly being the “IT office at sea”.

With the rapid development of technologies, the opportunities of training on board for seafarers are limitless. A lot of software companies seek these opportunities and provide ship-needed ready-made systems to handle the ship and shore connections, such as Marinet, GN (Comtext), Rydex and so forth. Other services are increasingly being provided through computer application packages including CrewNet, EasyInfo of Bass group, Amos Connect of Xantic, and SES in Greece (LSM, 2001), which are becoming parts of ship management systems and in consistent with the requirements of the ISM code and STCW 95 convention. Additionally, private companies such as Seagull A/S and Videotel Ltd. are involved in providing MET distance education programmes. “The Onboard Library” CBT programmes provided by Seagull are very comprehensive consisting almost all the operational aspects on board. Videotel also provides a series of onboard training packages from First Aid and Medical care, to Oil Tanker Training (Muirhead, 2001).

As the main providers of education and training, MET institutions are facing the challenges coming from all aspects. Cyberspace technology changes and pressure from non-MET providers has led many institutions to recognise that traditional educational methods could not meet the needs of modern shipping industry and they have to face up to the reality of the coming of cyberspace education time.

European institutions are in leading positions since some initiatives have already been started. METHAR, a project aiming to harmonisation of MET schemes in Europe, has made some recommendations on future MET needs and the use of advanced technology, on the basis of analysis of European MET structures and schemes. This project was under the 4th Framework Programme of European Commission and completed in 1999 (EC, 1998). Another 4th Framework (1996-1999) research programme, SEAGULL-Distance Learning, aimed to assess the

effectiveness of long distance learning technologies in maritime education and training, and the impact on costs. The optimal harmonisation in maritime long distance learning is hoped to be achieved through the co-operation of MET institutions and training establishments. After these, a new research programme, named Maritime Education and Training Network (METNET), started in 2000 with the funding provided by European Commission. The main theme of METNET is to promote competitive and sustainable growth by extending applicability of MET for ship's officers in European Union. The results of the 4th framework will be exploited in this new network. As one of three reference groups, a number of European MET institutions are involved and will benefit a lot from the findings of this three-year project.

Besides the above European institutions involved in the projects, Australian Maritime College, North West Kent College of UK, RTM simulation, Training, Assessment and Research (STAR) Centre, and the Centre for Advanced Maritime Studies (CAMS) are the active institutional players of distance education in the maritime field. The Australian Maritime College (AMC) is a leading centre of maritime knowledge, expertise, education and training. It has a relatively long history of providing distance education since 1987. In 2001 it offers a total of 19 courses through distance education by the Faculty of Maritime Transport and Engineering and the Faculty of Fisheries and Marine Environment. These distance education courses are provided at various levels, including certificate diploma, advanced diploma both at undergraduate and graduate level, Bachelor's degree and Maser's degree. External students can come from ships or ashore, and study at the time and location most convenient to them. They can get equivalent diplomas or degrees with on-campus students. According to AMC's Annual Report of 1999 (AMC, 2000), the number of external students in that year was 622, occupying 23 percent of total intake of 1999. A growing number of external master's degrees are being awarded.

The centre for Advanced Maritime Studies offers a wide range of courses tailored for maritime industry. Management of Ship Operations (MSO) and the Carriage of Dangerous Goods by sea are specifically designed for open and distance learning (CAMS, 2001). Around 10 years' high quality training makes itself approved by a number of countries' maritime authorities. The MSO programme, with a two-year scheme and being suitable both for sea staff and shore staff, covers all aspects of ship management including law, personal, operations, safety and maritime economics. In addition, the centre can offer specific training programme packages tailored for different companies. The new development in MET distance education is the new joint adventure in May 2001 between Raymond T. Mckay (RTM) STAR Centre and Lockheed Maritime Training to provide distance learning advancements to today's seafarers (RTM STAR Centre, 2001). The new programme is mainly offered through Computer Base Training (CBT), which enables mariners to access at any location of the world. The training courses will be delivered by CD-ROM or the Web, incorporated with course management services including a variety of communication links with the instructor. Basic Safety Training (BST) is the first product of several training programmes to be provided by this cooperation. RTM STAR Centre annually provides distance training to 7000 students throughout the world. Mariners benefits a lot from the programmes.

It is not difficult to see that most MET distance learning providers come from developed countries, while seldom from developing world. The lack of communication infrastructure in developing countries is the main hindrance in the delivery of distance learning. Even today the Internet is available in these countries, the expensive access limits its wide spread usage. The challenge will be much more serious if it is realized that the fact of marine manpower market has moved from traditional developed countries to developing countries. Generally speaking major seafarers supplying countries have moved from Europe to Asia. In principle the centre of maritime education and training should move in the same direction. However, with the less developed MET infrastructure and methods, how can

developing countries take the heavy burden of training seafarers for the whole shipping industry of the world? How can they assure the quality of seafarers to meet the requirements of STCW 95 or the needs of shipping companies? There is no definite answer but one point is definite, that is education revolution. On one side, traditional MET institutions have to do some determined efforts to overcome constraints to progress. On the other side, unconventional methods must be sought to solve the problem corporately and internationally. This is the best way to the future.

Chapter 5

Future Trends and Applications

Technology changes almost daily, what looks impossible today may become tomorrow's reality. Despite the rapid change, technology trends may be identified, which will influence the future of education.

The purposes of this chapter are to describe the new development of technology, and envision the possible future learning environment that is impacted by these technology trends. Discussions will be given to what the institutions will be in near future, especially in the MET field. As a developing country, the Chinese aspect will be specially concerned.

5.1 The new development of technology

Based on the research and analysis above, from the author's point of view, the following new developments of technology will represent a variety of trends that will make fundamental changes in our own personal and professional lives, and in educational environment.

- **Network technology developments**

This will be greatly enhanced by the further development and wide applications of the Internet. The transmission speed and capacity of the network will not be a problem along with the development and further usage of broadband technology. Costs of fibre optics will be stepped down. As important communication infrastructure, computers, switches and routers will be more reliable and largely

improved. The advent of handheld digital services will improve the flexibility of the Internet to a large extent.

Increased use of fibre optics

Broadband technology will be in higher demand in the near future. Though some applications can provide broadband services today, such as ISDN, Coaxial Cable and Digital Subscriber Line (DSL), only the potential use of fibre optics can revolutionarily increase the transmission speed and volume. As Muirhead (2001) investigated, Atlantic dual fibre optics cable, part of the FLAG project that will be completed in 2003, can carry 2.4 terabits (1 terabit equals to 1000 gigabits) per second. This means 200 hours video can be sent at each second! After the completion of this project, fibre optics will span the Atlantic and Pacific, thus connect Europe, Asia and America. It will be no problem to transmit large graphic, movies and 3D animations around the major parts of the world. The potential development of broadband technology will be limitless in the future since the costs will markedly fall down.

Developments in the wireless communication

Developments in wireless communication, including satellite communications will be an intensive direction in the next few years. The hand-held satellite phones, small hand-held computers and personal digital assistants (PDAs) will become true and easier to access. Future unlimited broadband technology and high capacity infrastructures will make the Internet users enjoy the “Web surfing” at anytime and anyplace, especially for “movable” users who could not access the Internet with the fixed line. There is no doubt that the application of wireless technology will change the face of distance education dramatically since students can access distance education courses in a hands-on mode.

- **Information visualization and virtual reality**

Greater bandwidth and capacity enormously enhance the ability of presenting multimedia materials through the network. Thus information visualization technologies have a great potential to be improved and widely applied for educational purposes. These technologies are increasingly sophisticated in visualizing the information into understandable pictures, images, and animations for creation of interactive virtual environments.

Such technologies as virtual reality and simulation technology will come to the personal computer interface level, while today are highly limited in military and aeronautics usages because of the lack of capacity and bandwidth. With more intuitive 3D graphic manipulation devices, the full immersive virtual reality or simulation systems will “create the illusion of interacting with people, places and things from the past, far away, or never existed” (Roblyer & Edwards, 2001, P. 231). Put in these virtual environments, people can experience a real, three-dimensional environment. Today’s video games are good examples of the application of virtual reality and simulation technology. Educational software in future will include features of them more or less.

- **Intelligent interfaces and voice recognition**

Intelligent interfaces between the user and the computer will allow users to access information more easily and flexibly. Voice recognition has been developed for several years but will get dramatic usage with the advent of hand-held systems. It allows people operate the system with voice commands.

Intelligent interfaces, through incorporating artificial intelligence (AI) technology, can learn user’s preferences and anticipate user’s needs, provide more effective, sensitive and interactive help as an expert. It cannot only custom graphic interface environments, but also can help the user to filter, block or segregate email messages according to the user’s will. Intelligent agent software can be used to perform

network searches and deliver selective information needed by the user. Some similar software packages, such as expert systems and intelligent assistants or coaches, are more or less for the same purpose to provide professional tutoring, guidance or problem solving. When used for educational purposes, the ability of students to acquire the information will be extremely enhanced; students will be highly motivated by easier access.

There are also other expected developments that will impact on future education, such as the computer hardware technology, of which the processing power, mass storage, memory, and display and output capability will be increased enormously in near future. Some “wearable” computer systems will allow users to operate in an extremely convenient manner; electronic books (e-book), which have the capacity to hold dozens of books, facilitate the user to access large amount of information.

The above technology developments will form the main stream of technology trends in future, and will continue to characterize technological advances over the next decade. Taking only one of them may not be significant; but combining them together, it will lead to revolutionary changes in education.

5.2 The future learning environment

The future learning environment is to be shaped by technologies exploited in education systems. Based on above technology trends, it is not difficult to envisage what the future learning environment will look like.

- **Learning in future**

In the future, the options for where and how you study will seem unlimited. You have a personal computer at home or workplace, connecting to the Internet with broadband, equipped with all the multi-media equipment. It will be very easy for you to access the study materials from the institution’s website, where the materials may include interactive texts, images, 3D animations, video, audio and even virtual reality

demonstrations. You can learn at your own pace, can talk with the tutor or other learners through videoconferencing or netmeeting, and even leave a voice message to them. If you are busy or lazy to use your hand, you can operate the computer by spoken commands. Intelligent agents or expert systems will give you professional guides if you encounter difficulties during the study process. Your study history will be recorded or tracked automatically, your multimedia assignments will be formatted at a professional level. You can enter the online library, search extra materials you need, and record into your own electronic books. If you want to examine some results, you can enter into virtual laboratory, conduct an experiment online, and get the results you need. Through virtual reality you can experience the “real” environment or process and get very intuitive feelings. Learning is not a dull process by purely information receiving, but an interesting experience attracting you to listen, to see, to think and to perceive.

If you are on a trip or work on a ship, the hand-held computer, personal digital assistant or wearable computer can help you. You can connect them through wireless Internet connection; broadband technology will assure you of no transmission quality or speed problem. You can access the Internet, talk with your colleagues, and access the study programme at any place and any time. The convenience is the same as you study with a fixed computer at home or at workplace.

- **Role of teachers**

Teachers’ role in future learning environment will undergo radical changes. As discussed in previous chapters, they will change from education deliverers to learning mentors, facilitators or co-learners. But not all teachers will experience this change, since specific courses may only need one or two experts to give tutoring. The majority of teachers will transform their work to other types, such as course designers, material collectors, multi-media producers, system managers and administrators. They will form a collaborative “teaching community” to provide learning services for the “learning community”.

- **Future institutions**

The future institution will not be today's model anymore. It is not a place where learning is conducted, but a learning community centre. It will be converted into a meeting facility, for face-to-face interaction that is still needed by people, also for special events and gatherings. Some laboratories in institutions will still exist, since not all experiments are suitable for being conducted virtually online. Totally immersive virtual reality systems and simulators, which need specialized equipment such as headset, digital gloves and so on, need be in place for student use.

From the education providers' point of view, the distinction between distance education and local education will be blurred. While future institutions may come into two principle types: one is purely to provide value-added learning courses, the other is responsible for certifying degrees (Dunn, 2000). Institutions that provide courses will compete globally since students can choose institutions that they are interested in, and will be more specialized in order to provide high professional level courses. Some institutions will be closed because of low quality courses and resultant lack of students. Certifying institutions will act as educational bankers for students. Students can learn anywhere and earn credits from any value-added institutions around the world, transfer the credits to the certifying institution, and are awarded the degree by the certifying institution when enough needed credits have been accumulated.

- **Quality assurance**

Quality assurance for future learning will not be a big issue. Since future learning courses are to face the worldwide students, global competition among value-added institutions will drive low-quality institutions out of the market; only high-quality course providers can survive in the competition. This is one aspect. The main aspect to assure the quality is to through national accreditation systems, which may be joined by discipline organizations, corporations, programme, testing companies and

governments (Dunn, 2000). The educational outcomes will be the main consideration of accreditation and program approval.

5.3 Future of MET institutions

Section 5.2 gives the very brilliant prospect of the cyberspace learning environment. However, to perceive is one thing, to turn it into reality is another thing. One should bear in mind that the vision is based on the full application of new technology developments in future. Unfortunately, the education development has always fallen far behind the technology development, since integrating technology into education has traditionally been a long slow process. To apply technology into education basically depends on two aspects: the relevant government policy and costs involved. These two aspects are also very important considerations for discussing the future of MET institutions.

As one branch of education, MET has great potential development in future. Higher broadband networks, improved satellite communication, development of hand-held digital equipment, all of these make the future learning environment be more favourable to MET. The enhanced ability of wireless communication and “movable” connections with the Internet, will just meet the needs of seafarers’ on job training and lifelong learning on their “floating territories”. These technology developments provide great opportunities to MET institutions. However the globalized future learning environment also puts all MET institutions into the word wide competition market, posing great challenges to each institution.

Threats coming from other aspects such as private providers of education exist as well. New development of technologies is opening up traditional MET market to non-MET players, with more and more companies providing series of MET software packages as well as training equipment. Shipping companies and seafarers have more opportunities to choose education systems between institutions and private education providers.

Combining the above factors together, MET institutions in future must be successful survivors from the competition with both other institutions and private education providers. They can get great support from the government, the policy of which is putting much effort on developing maritime education and training. Enough funding, which enables them to integrate new technologies into their education systems, can be secured by the government or other project initiatives.

The number of future MET institutions will be much less than that of today since the students may not necessarily go to institutions to conduct learning activity. But each institution will be scientifically programmed and organized, well provided with MET experts and high-tech specialised equipment. In order to meet the requirements of the STCW convention, ISM CODE, and other newly related standards the expert system will not only consist of professional staff on education and training, but also include experienced people who are familiar with everything in navigation. Highly specialized training equipment, such as sophisticated, full mission simulators and virtual reality environment, will be normally needed by the institutions. The future institutions will be more like a training centre, with most courses delivered by the Internet, and some training sessions conducted in the centre. For lifelong learning of seafarers, the institutions can even provide web-based simulator software to help learning onboard, since seafarers have already gained some basic skills on board.

For MET institutions in maritime developed countries, such as Australia, the US, and the UK, they may have advanced positions in the future MET market. Maritime institutions from less developed countries will not be so lucky, only a few of them can survive in future with provision of strong government support. Moreover, one should realize that future institutions may not be today's institutions, since some successful private education providers can fulfill institutions' functions as well. In the author's opinion these are to be the main cases in future since private companies

normally have stronger funding power. It is no doubt alarming for all MET institutions today!

The situation for institutions in developing countries will be much more severe. With the current status of a lack of enough funding, lack of high-technology integrated equipment and lack of technology-incorporated education methods, it is very difficult for them to compete with other institutions and private education providers. Maybe in the very near future they do not need to worry about their fortune, because the large seafaring market is moving towards them today. But this situation will not last for too long time because of the increasing concern of the quality of seafarers. The rapid development of educational technologies and fast emerging of private education providers will soon make the seafaring market move to the high quality MET education providers side.

As a leading member of less-developed countries, Chinese MET institutions are facing great opportunities today with the potential of being the biggest seafarers' provider in future. China does need to take some revolutionary methods to grasp the opportunity and develop maritime education and training. However, this is also a big challenge for Chinese MET institutions since they have to cultivate high-quality seafarers who meet related international standards.

The principal way for Chinese MET institutions to be more competent in future is to incorporate new technologies into educational methods and training equipment, to take full advantages of technology developments, and to provide web-based education and training. Cost issues can be solved through many ways, such as payment by student, co-operation with shipping companies, and support from the government. Fortunately the Chinese government has realized the threat facing MET in China, and has classified one of the leading maritime institutions, Dalian Maritime University (DMU) to be one of 100 key universities in 21st century. Through this way

the government gives the support to DMU, such as more funding and more opportunities to get projects at national or international level.

In order to keep up with the technology development, the best cost-effect way for Chinese MET institutions is to seek cooperation with institutions in developed countries and with private companies. Through cooperation, not only the knowledge of high-technology equipment and related software packages can be passed to MET institutions from private companies, but also advanced education and training methods can be acquired by them from well developed western institutions. This is the fastest way to train staff, to renovate equipment and to change education methods. The gap between them and developed institutions will thus be quickly reduced.

A specific way to achieve cooperation that may be considered by Chinese MET institutions is to form a “corporate university”, with western developed institutions or with private education providers. Each member of the corporate university focuses on different specialised aspects and contributes its own advantages. Disadvantages of each can be remedied by each other. Through this kind of merger or joint activity, they may have more opportunities for success in future. This is also the best way to balance the “unbalanced seafarers markets”, and to balance the “Unbalanced MET development” between the Western and the Eastern. This type of institution will be the major type of future MET institutions.

Chapter 6

Conclusions and Recommendations

6.1 Conclusions

Cyberspace education implies an interactive learning environment offering multiple disciplines of knowledge for non-linear learning. In this paper it is mainly indicated by distance learning/education. The scope and connotation of it has been changing along with the development of technology. The four stages of distance education, correspondence study, multi-media model, telelearning model and flexible learning model, represent the evolutionary course of cyberspace education.

Technology has always been the dominant driver of educational development. From traditional one-way communication to interactive two-way communication, distance education has been reshaped through the years in many ways. The interactivity among teachers and students has been highly improved, and students have been more focused and centred. Education information has been enriched in contents and enlarged in quantity, and delivered at a faster speed. The teacher's role has changed to mediator, facilitator or co-learning, while students role has transformed from passive recipients of information to active participants in a collaborative virtual learning environment. Assessments to students, both formative and summative, have focuses on encouraging critical, creative thinking more than before.

Learning at distance has both advantages and disadvantages. Distance education increases the flexibility of learning, provides more opportunities for sharing resources, and offers a collaborative and constructive learning environment. However it also poses high requirements for teachers and students on skills of using

more complicated technologies. Lack of competitive pressures, psychologic distance caused by physical distance, and high costs involved in investment may still be contraversal points of the wider application of distance learning.

Quality assurance is one of the important components to make a distance learning programme more attractive and competitive. Good quality assurance strategies should focus on four key aspects, namely faculty selection and training, time-on-task measures, student support, and goals and outcomes.

As a revolutionary method, web-based distance education is widely used around the world today. However, because of high reliance on technology in nature, distance education has been well developed in technology leading countries such as Australia, the US and the UK. Though some developing countries have made a lot of efforts, they are still constrained by the high costs of the Internet infrastructure and investments of distance education systems.

Maritime Education and Training (MET) is a special education field showing high needs for distance education. The high broadband technology and satellite communication make it technically possible for accessing to the Internet on board. A number of companies have provided some software packages for learning on board. Some European projects including METHAR, SEAGULL and METNET are also engaged in MET development and distance learning. In contrast, MET institutions have not done so much except some leading players of distance education, such as Australian Maritime College and RTM STAR centre. MET institutions do face the threats that come from private education providers.

The future development of technology will be towards a direction of being more reliable, more convenient and more intelligent. It is of no doubt that the new developments in hand-held digital systems, virtual reality, intelligent interfaces and voice recognition will bring a new revolution to the cyberspace education. The future

of the learning environment will be more brilliant if new technology is appropriately incorporated.

MET institutions will have great potential development in future. But this is based on strong support from governments, having enough funding sources and employing appropriate methods. Facing more competition pressure from other institutions and private providers of all over the world, it is time for MET institutions to seek some revolutionary and unconventional ways today in order to survive in future!

As a leading developing country, China is more aware of the revolution taking place in distance education. Some developments have been made through the effort of the government, but the gap in education level compared with developed countries is still very large. Facing the great opportunity of being the potential leading provider of seafarers for the whole world, Chinese MET institutions have a lot to do. Cooperation with leading MET institutions and private companies will be an effective way to the future.

6.2 Recommendations

Based on the foregoing study of this paper, the author strongly recommends that MET institutions need to achieve the followings:

- Obtain a strong government support as an essential pre-condition for surviving in future.
- Find all kinds of ways to incorporate new technology developments in education systems, including infrastructure, equipment, staff training, course design and delivery and so on.
- Build strong relationships with shipping companies, in order to provide needs-oriented education.
- Cooperate with private education providers, acquire advanced equipment and software packages, and renovate education methods in a cost-effective way.

- Build inter-institutional co-operation between institutions in developed countries and those in developing countries.
- As Chinese MET institutions, form a “corporate university” with western developed institutions and private education providers as the fastest way to change for the future.

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