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CURRENT REALITY AND THE FUTURE NEEDS OF MARITIME EDUCATION & TRAINING

G. E. Mokhtar

Arab Academy for Sciences, Tech. & Maritime Transport, Alexandria, **EGYPT**

ABSTRACT

The level of education, training and evaluation has an important role in promoting the quality of the seafarer's standard. The international shipping community hopes that the STCW Convention, together with the IMO model courses, will succeed in achieving its objective, i.e. safety at sea. However, studies of maritime accidents statistics show that the human factor is still the main originator of the problem. Hence, there is a need to improve maritime education and training.

This paper discusses the global standard of education, the barriers and challenges to be addressed, the current reality and the proposed features of the needs of the coming generation.

The paper also investigates the use of the system theory for establishing maritime learning objectives, and the application of technology- based learning in implementing and evaluating the training program.

Training institutions are required to evaluate thoroughly the application of modern technologies, and of how this might result in greater competitiveness, higher quality and lower costs.

This paper recommends focusing on the availability of a data- base about maritime institutions, human resources, institute classification, and a global accreditation body. This data- base is vital for establishing a global network

Maritime institutes have to work in close co-operation with the three international bodies interested in maritime training IMO, WMU, and IAMU.

NOMENCLATURE

AAMTI	: Association of African Maritime Training Institutes
AASTMT	: Arab Academy for Science, Technology & Maritime Transport.
CAI	: Computer Assisted Instruction
CBT	: Computer Based Training
EoD	: Education on Demand
GMDSS	: Global Maritime Distress and Safety System
IAMU	: International Association of Maritime Universities
IMO	:International Maritime Organization
ISD	: Instruction System Design
ISM	:International Safety Management
LAN	:Local Area Network
NAOE	:Naval Architecture and Offshore Engineering
PC	: Personal Computers
TBL	:Technology Based Learning
STCW	:Standard of Training, Certification & Watch-keeping
WAN	: Wide Area Network
WMU	: World Maritime University

MOTIVATION

The maritime education process conducts seafarers through specific procedures in order to provide them with the required standards of

qualification and skills. The level of education, training and evaluation has an important role in promoting the quality of the seafarer's standard, and this is a significantly major factor in marine casualties. The maritime field can be influenced by many factors: international conventions and regulations, flag state parties (the authority), companies (executing the authority's regulations), maritime training institutes (educating and training seafarers with respect to international conventions and national regulations).

Focuses on the human element when disasters occur make it necessary to have new approaches to the avoidance of risks and the control of losses. The relation between the human factor and the hardware brings new aspects and challenges into safety work, and optimum maritime safety demands a focus on people, hence increased attention to the fact that more than 80% of all undesired events can be referred back to human error.

The International Shipping Community hopes that the International Safety STCW Convention, together with the IMO model courses and Management (ISM) Code, will succeed in achieving its objectives: safety at sea, prevention of maritime accidents and avoidance of damage to the environment. But as to what extent they have succeeded in achieving these objectives, studies of marine causality statistics show no obvious improvement and the human element is still the main factor contributing to this problem. The problem can be traced and summarized in the following points:

- Time lag between convention implementation and technology development.
- Developed countries introduce advanced technology and modern ships, whereas developing countries produce the seafarers; hence, the problem of incompatibility arises and ships are not safely operated.
- The openness of the shipping industry to technology, with a consequent changing context of the seafarer's functions associated with changing work force, will set additional training requirements.
- The existing education and practical training pattern suffers from the shortcomings of person-focused objectives.

Before discussing the future needs to tackle these problems, it is worth- while to review the global standards, the barriers to be addressed and the current reality.

1- GLOBAL STANDARDS OF MARITIME HUMAN RESOURCES

The International Convention on Standards of Training, Certification and Watch- keeping for Seafarers (STCW), 1978, was adopted by the International Conference on Training and Certification of Seafarers on July 7, 1978. The 1978 STCW Convention entered into force on April 28, 1984. Since then, three amendments thereto were adopted in 1991, 1994 and 1995. The 1991 amendments relating to the Global Maritime Distress and Safety System (GMDSS) entered into force in December 1992. The 1994 amendments to special training requirements for personnel on tankers entered into force in January 1996. The 1995 amendments consist of three resolutions (Attachment 1 to the Final Act of the STCW Conference, Amended Annex to 1978 STCW Convention, and STCW Code) entered into force in August 1997 and will be completely implemented in 2002.

Through the IMO procedures the approved international conventions have to be followed by the flag state parties (countries) through companies, maritime training institutes and seafarers. **The STCW 78 needed approximately 17 years to be revised and 7 more years for complete implementation**. So, the IMO mechanism, as the apex of international legislation in the maritime field, needs to be accelerated in order to take the proper action at the proper time, since any deficiency which might arise in the internal processing system of the IMO will have its serious impact on the maritime field world-wide.

The STCW 95 was adopted in order to establish minimum global professional standards for seafarers. These professional standards include skills, knowledge, understanding and the abilities needed to ensure that individuals are capable of fulfilling the role expected from them at sea. Around 3 years have passed now since the Convention entered into force (1st August 1997), and it is obvious that the revised STCW may need more revision - for example in the area of lack of standardization, as in the case of referring in general to simulators without specifying the procedures and how each institute will implement the utilization of simulators. The IMO model courses, too, need to be revised with respect to changing the objectives of education from theory to competence (produced and published late in 99). The revised STCW only encourages countries to help each other to co-operate in the field of examinations, but as education and examination are both sides of the same coin, there is a need to establish a global standard assessment system.

2- CURRENT REALITY

The approach to the analysis of current reality will highlight the non-availability of maritime databases. This gives a clear picture of the maritime field current reality situation. The needed worldwide maritime database has to cover the main elements of maritime transport, (authorities, companies and institutes). Hence, the world-wide maritime database could be classified into:

- Ports and maritime authorities
- Shipping companies and seafarers
- Maritime training institutes supported by an educational and assessment databank.

Ports, maritime authorities and shipping companies' Databases are available through several bodies, but the most important databases needed for harmonizing education and training are not available. Databases needed in maritime education and training fields are:

1. The Maritime Training Institutes Database, supported with:
   -the Educational and Training Databank,
   -the Assessment and Evaluation Databank, and
2- The Maritime Human Resources Database.

Due to the fact that IMO has recently received data communicated from 82 maritime authorities throughout the world in response to regulation 1/7 (STCW 95), it is suggested that the database of the world-wide maritime training institutes should develop in close co-operation with the IMO.

Classification criteria for maritime training institutes are needed. This classification of maritime institutes can be international, inter-regional, regional and national. Hence, a global accreditation body can be configured basing on the criteria of classification and the quality of education and training. The training institutes database will help in harmonizing the system of education and training worldwide by establishing a global maritime training institutes network.

The writer of this paper has performed several activities in this area which can be summarized in the following :

1- Suggesting the establishing of a desk in IMO for the maritime training institutes responsible for developing and maintaining the related database. Positive progress was made and the IMO compendium for Maritime Training Institutes was published. Unfortunately, the Maritime Training Institutes Desk in IMO was lately closed.
2- A paper with a presentation was lately demonstrated to the Technical Co-operation Committee in July 1994 entitled "How Inter-Regional Institutes can play a more active role in promoting IMO development role within a proposed network of IMO Maritime Training Institutes". The

main elements of the presentation highlight that :

"There is a large disparity existing in the field of education and training between developing and developed countries. To tackle this problem, the IMO has introduced the Standards of Training and Watch-keeping Convention .It has also established the World Maritime University, IMO International Academy in Trieste, and the IMO Law Institute in Malta. In order to harmonize education and training, the paper proposes a network for maritime training institutes; consequently, it necessitates the classification of an institute into global, inter-regional, regional and national. The Association of African Maritime Training Institutes (AAMTI) is taken as an example of Classified Regional Co-operation Network.

Due to lack of information and data of maritime training institutes, the writer and his working group have accessed the Internet and retrieved the available information from selected institutes:

- Arab Academy for Science, Technology & Maritime Transport
- Cardiff University;
- Denmark NAOE;
- Hong Kong Polytechnic;
- Kobe University;
- Korea Maritime University;
- Newcastle University, UK;
- Norwegian Shipping Academy;
- Singapore Maritime Academy;
- Singapore Polytechnic;
- Tokyo University;
- U.S. Merchant Maritime Academy;
- U.S. Naval Academy (King's Point);
- University of Plymouth; and
- Warsash Maritime Centre.

Although, US Naval Academy (King's Point) shows full information about its curricula and training courses, unfortunately, the information and data retrieved as a whole from all the selected institutions do not provide a consistent focus on the current reality situation.

The maritime institutes have to work in close co-operation with the three international bodies interested in maritime training performance IMO, WMU, and IAMU in developing the world-wide maritime database and databank as an important step towards the harmonisation of maritime education and training system globally.

3- BARRIERS AND CHALLENGES TO BE ADDRESSED

Maritime institutions involved in development of maritime education face a number of barriers and challenges that limit the effectiveness of their efforts. The most salient are:

3-1 Lack of self-development. Choice and opportunities for self-development are constrained by circumstances. The lifestyle and working conditions of seafarers are not conductive to the realization of potential in terms of self-development and, to be successful, the seafarer has to surmount many obstacles not experienced by his shore-side counterparts. Such barriers to development can be described as structured in that they are inherent in the occupation of seafaring. Among the most obvious are unremitting noise and perpetual motion, intense and often unsocial work schedules, limited privacy, restricted access to learning materials, and lack of motivation compounded by feelings of isolation.

3-2 Lack of adequate training. Regarding the regional and country levels, there is a lack of personnel trained in the broad spectrum of disciplines and perspectives needed to successfully implement maritime training requirements. In addition, there is a lack of accurate and effective data on manpower requirements and training needs to meet anticipated developments and to respond to new and emerging training areas.

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3-2 Lack of adequate training. Regarding the regional and country levels, there is a lack of personnel trained in the broad spectrum of disciplines and perspectives needed to successfully implement maritime training requirements. In addition, there is a lack of accurate and effective data on manpower requirements and training needs to meet anticipated developments and to respond to new and emerging training areas.

3-3 Limited sharing of training materials. There is rarely any sharing of training materials and experience even though many training institutions and individuals are attempting to address similar issues. At the regional level, training courses may not be accessible to all target groups in need of acquiring skills and knowledge. This is due, among other things, to the fact that in most cases training courses are instructor-dependent and are not adequately documented, a fact that inhibits their adaptation to other institutions or countries .

3-4 Lack of coordination between training institutes. Despite major advances in the maritime practice and the valuable capacities that have been built as a result of long experience in maritime training and education, up to now there have been limited opportunities for cross-exchange of experience among the training institutes. This is due to the isolated approach to training that has prevailed and the lack of a mechanism to steer the training efforts in order to optimize human resources development and provide sustainability to any capacity-building effort.

3-5 Lack of job-focused objective. In most countries, training has been undertaken solely by educational/training institutions that supply mandatory courses not necessarily oriented to the operational needs of the job (***job-focused objectives***). Unfortunately; training is rarely designed and delivered in such a way that trainees can apply the knowledge and skills acquired when they return to the workplace.

3-6 Lack of fund for new training Technology. High quality training is a costly effort involving considerable investments in course preparation as well as the training time itself. In future, training courses, based on high quality materials, geared to specific training needs and coupled with flexible schedules outside working hours, are likely to be in high demand. The introduction of new technologies for training, which allows, for example, the organization of distance learning, or computer assisted teaching, may be considered as an alternative to traditional classroom courses at a scheduled time.

4- PROPOSED FEATURES OF THE NEEDS OF THE COMING GENERATION

The infusion of technology into the maritime field and the changing structure of modern maritime transport are facts of life for a growing number of today's maritime professionals. Neither shows any sign of being a passing trend. Rather, it is the maritime institutes that cannot adapt to changing demands that seem to be fated for non-existence. Adaptation is required at all levels of the system. Seafarers at every stage of their career are being required to expand their skills and knowledge, to develop computer literacy, and to deal with a multitude of tasks that do not fall within the scope of traditional job descriptions.

It follows that, with all the changes occurring in the workplace, training must also change if it is to remain a relevant and contributing activity of the business. In this context, the traditional paradigm of training-program development must be reassessed to determine whether it is still truly relevant. The following will review the systematic approach to training development in order to identify its strengths and limitations within the modern maritime training systems.

4-1 ISD Model. The traditional IMO model courses are based upon the system theory. In its training manifestation, the system theory provides a methodology for defining, developing, applying and evaluating instructional programs. In this approach, as illustrated in Fig. (1), training systems development begins with a system analysis phase , basically, an assessment of training requirements and an *analysis of job data.*

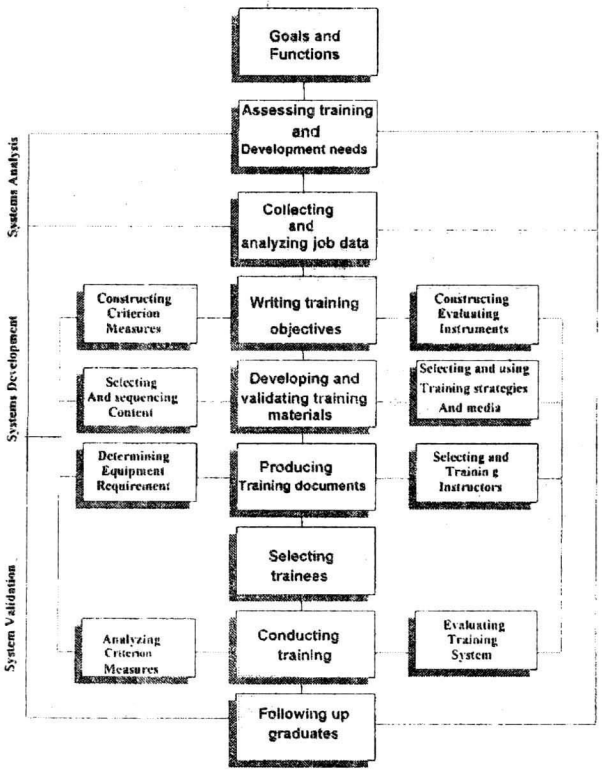

Fig. (1) Instructional System Design (ISD) Flowchart

The purposes of system analysis are to identify where training is needed, what skills and knowledge must be taught, and how work is currently being performed. At its best, the system analysis phase is undertaken proactively: focusing on training in skill and knowledge areas that will support future needs derived from job goals, objectives, and direction. The relevant job data has been collected; ***job-focused training objectives*** are developed. Objectives are stated in terms of performance, defining exactly what the trainee will be able to do by the conclusion of training. Together with this statement of a task, the training objective typically sets forth conditions for performing the task and criteria for measuring task completion.

Objectives stated in this manner may be readily converted into test items, called criteria-referenced-test-item specifications, which are used to evaluate the trainees' knowledge and skills before and after the introduction of the training course. Test items are commonly developed and included in a pre-test, which is introduced prior to training. Then, for consistency, the same question in a different order or with randomised multiple-choice answers – are placed in a post-test, introduced after training. These pre-tests and post-tests are among the evaluative instruments that may be developed at the start of the system development phase.

The remainder of the system *development phase* is concerned with the practical stuff of training development; content is identified and teaching points are organized for presentation. Subject-matter experts are called upon to validate that the material is complete, accurate, and aimed at the appropriate knowledge and learning level of the trainee. A senior trainer or training manager may also review the lesson design for its adherence to the general concepts and standards of training endorsed by the training organization.

A *feedback loop* is illustrated In Figure (1), that provides stimulus for the acceptance or modification of the training system based on trainee pre-test and post-test results The whole instruction system design methodology flows from training objectives, which are derived from careful analysis of job tasks. Fig. (2) shows a view of the structure of work as it is directed by ISD methods. Occupational fields are subdivided into jobs, which are subdivided into duties, which are subdivided into tasks, which are subdivided into elements.

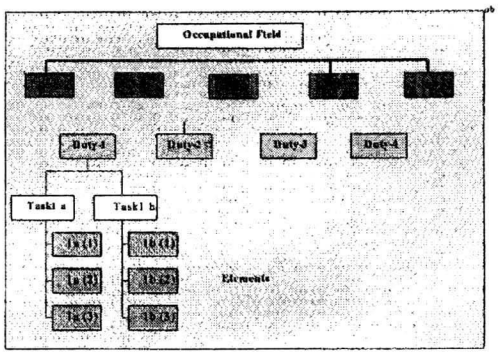

Fig (2) Task Analysis

Hence, from every ***job description***, a complicated taxonomy of subtasks is defined. The analyst then seeks to define the prerequisite skills and knowledge associated with each subtask and developed training objectives designed to provide instruction in the skills and

knowledge areas required for task performance. In the absence of strict job descriptions, the insights into maritime training requirements yielded by system analysis are no more objective or scientific than the vague feelings. In the light of this fact, trainers and training managers in maritime universities have every reason to be concerned about the solvency of their formal education in Instructional Systems Design (ISD). The final step is *the evaluation* that generates the feedback that supports the dynamics of adaptability, which ISD advocates regard as its chief advantage over other methodologies. Feedback, in the form of observable improvements provides both an important input for adapting the training-systems development effort to make it more effective and a basis for justifying training.

4.2 Technology-Based Learning. It is the use of technology to help people learn. The technology involved is a computer of some kind. But the computer is undergoing considerable transformation in its function. That is why word technology is in preference to computer. Already the advanced communications technology and technology-based learning (TBL) enable the maritime field to develop interactive learning programs. Trainees will be able to log into web sites and learn anywhere at any time (a global open university). This will become common within maritime industry. Maritime professionals and trainers will have to learn new skills both in developing and performance monitoring. It is even possible to see technology-based learning courseware supplementing the role of the lecturer. Technology-delivered applications could be considered for the following reasons:

1-to reduce training costs,
2-to shorten training programs,
3-to improve staff to student ratios,
4-to make training timelier,
5-to eliminate over- and under-training,
6-to provide more and better training,
7-to increase the total delivery of training in the same time period,
8-to manage training better, and
9-to interact with the student in a meaningful way.

Today, however, there is a changing view of adult education and of motivation. "To motivate" is no longer regarded as a verb. Trainees cannot be motivated to learn. They learn because they want to, and fail to learn when they do not want to. Of course, there are incentives for learning that may help to sustain motivation when it is already present. These incentives are *self-interest* , *need for respect* , *trainee segregation* , *varied media,* and *organisation of training content* .

4.3 Person-focus Training These incentives are by no means exhaustive, but they do point out that training effectiveness is a product of more than the relevance of specific training objectives to the immediate day-to-day work of the trainee. Most adults have innate curiosity and are motivated to learn. These features are automatic products of *person-focus objectives,* which are achieved when adapting the TBL system. What is a ***person-focused objective***? Person-focused objectives focus on self-understanding and self-management. They are not job-task-focused in the strictest sense, though they may be used in conjunction with job and subject-focused objectives.

The maritime training professional with person- focus training would analyse not jobs, but specific individuals so as to tailor training to their specific needs. Individualised training represents an enormous development effort, particularly in institutions with numerous personnel of different cultures. How can separate training programs be developed economically to accommodate the needs of each individual in the institution? In a sense, this has always been done. Good trainers in the classroom individualise their approach to presenting lesson subject-matter by observing trainee feedback and restating material in another way when confronted by a blank, no understanding from trainees. The same is true in a well-written Technology-Based Learning (TBL) Program. If quizzes placed in the program result in below-acceptable performance, content may be presented in another way in the hope of better accommodating the learning style of the trainee.

Of course, there is a world of difference between individualised presentation and using the individual as the basis for training-system development.

Training success is reflected in the seafarers' improved self-awareness, which can make them better seafarers or, at least, more contributing participants in the work of the shipping company. Thus, the evaluation of the success of a training system may need to be an intuitive one where person-focused objectives are considered in training. It can be argued that this has always been the case, even in job-specific training. The ultimate productivity of trained individuals can be diminished by a host of factors unrelated to how trainees perform their assigned tasks. Intuition – or vague feelings – is almost always used to separate seafarer performance improvements from the environment that translates performance into productivity. Still, the concept of making training-systems development a mixture of job-focused objectives and subject- and person-focused objectives may be a necessity.

4-4 Automated Training. Designing an automated training development capability is quite similar to the procedure for designing an instructional course. Most computer systems development methodologies are based on the same basic principles as in ISD methodology. The procedure begins with an analysis phase, then proceeds to an implementation phase, and concludes with an evaluative phase.

Automation needs are identified in the analysis phase of systems development. Based on these needs, functional requirements are defined and the analysis of system requirements is based on a close examination of current manual methods. From this standpoint, excellent trainers should make excellent system analysts! To perform automation needs analysis, many of the same techniques used in ISD job analysis may be applied. To understand how manual methods of training development produce training programs, training department personnel need to be interviewed, their work observed, and procedural steps carefully documented. Few training departments adhere to the standardization training development methods. Fewer still document these standards and procedures where they do exist.

In fact many of the current efforts to integrate artificial intelligence into TBL products- called Intelligent Tutoring Systems (ITS)- are aimed at making TBL courseware more adaptable to trainee or student status in order to better diagnose his misconceptions and buggy behaviours and to provide the appropriate feedback and remedy. ITS can tailor their contents, knowledge and methods to meet the needs of individual student without being limited to predefined responses. Researchers reported that students and trainees working with ITS could learn the presented materials four times faster than students in classical classroom. Typical ITS should contains domain model, teaching strategy model, student model, and intelligent student interface.

The goals of automated systems development are stated in terms of performance: the system will be able to perform certain functions when it is finally implemented. These functional requirements are manifested as outputs generated by the system. The outputs of an automated training development system are the materials used in the conduct of training. Thus, training managers who are planning to automate training program development functions must begin by exploring the learning objectives previously produced by the updated IMO model courses to identify common outputs.

4.5 Forms of Delivery Systems. Remember that the Problem Solving Mode of Computer Assisted Instruction (CAI) comes into play when a person uses computer as a tool to learn something. Any of the computers could be used in that way. IBM has long offered CAI on their mainframe systems. The PCs are the mainstay of today's TBL. Historically, computer-based instruction has been delivered on Large Local, Area networks (LAN), and on desktop PCs. Today the big main frame-based central

systems have all but disappeared. However, the increasing availability of Wide Area Networks (WAN) and growth of the Internet are replacing them in concept. Today, despite the brand or model, instructional computer systems can be classified into two general group: Network System, and Stand-alone System.

a) Network System: Recently the entire network-computing paradigm has shifted from local-area, or campus-wide, networks to the Internet. The exponential growth of the Internet has provided a large and growing number of people with Internet access to information and services.

This convergence on the Internet as a standard vehicle for delivering information and the global nature of the Internet makes it a very attractive medium for publishing. Instant access to globally distributed information has popularised hypermedia for online publishing, and it is likely that various forms of Internet-mediated hypermedia will become a dominant form of publishing. Although transmission over the Internet is slow, it offers tremendous possibilities for distributing training. Taking advantage of these trends to deliver distance education remains one of the most exciting challenges for existing educational institutions, Education-on-Demand (EoD). Many people have limited access to traditional classroom settings due to various constraints, such as time, distance, physical disabilities, transportation limitations and expenses, or non-school commitments. Based on a network system, Education-on-demand (EoD) provides distance-learning opportunities for continuing education. Even for traditional full-time students, distance learning can provide attractive options with great flexibility.

Producing and integrating course materials prove a core problem in providing distance-learning services. This process is very time-consuming. Even if publishers do the routine work, such as creating Web pages or encoding video, instructors still need to make decisions regarding the arrangement and integration of course content. Moreover, instructors usually do not have time to, nor are they interested in, learning complicated authoring tools to design and arrange lectures. To motivate the instructors, publishers need easy-to-use authoring tools that help them produce digital courseware quickly. A simple tool to help instructors combine their class lectures and Internet resources has to be developed so that these materials can be delivered to distance learners through an EoD service.

b) Stand-alone System: This hardly needs a description. Almost any PC can serve as a stand-alone learning station. It is a self-contained unit. Each unit is totally independent from others, providing maximum flexibility of curriculum. The training software may be conveniently packaged and introduced on media of various types. The most common general use media for current microcomputers are CD-ROMs. They are optical disks that offer speed, downsizing, accuracy, lower costs and are easy to use. Normally, Stand-alone Systems are the least expensive systems to buy. Since there is no network, a breakdown of one PC will not affect all the students, and one student's PC cannot affect others. Response time may be faster than with network systems. Network versions of software and courseware are not needed.The AASTMT is in the process of developing TBL courseware on maritime training and one of the completed models is going to be presented in CAORF/JSACC 2000, **INTERNATIONAL MULTI-CONFERENCE on INSTRUCTIONAL TECHNOLOGY** at the United States Merchant Marine Academy, Kings Point, New York (July 3-7,2000)

5- CONCLUSION

The Technology-Based Learning (TBL) system will enable maritime institutions and lecturers to enhance the quality of maritime education. TBL System will also be the cornerstone feature of open learning. Open learning seeks systematically to remove barriers to learning and co-ordination between institutions, whether they are related to time, place, or pace.

Computer assisted instruction is not just a fashionable issue but presents a unique

opportunity to take a fresh look at knowledge and learning issues and to redefine the roles of all concerned. New technology leads us to examine conventional practices in a different light. It is believed that chalk, transparencies, and paper documents will not disappear at once, but now **all teaching tools in the light of computing technology development have to be considered.**

With more basic research in human-machine cognition and discipline-applied experiments, for training mariners it is hoped that the prior discussion will provide deep insights into practical applications of technology in one of the most significant fields of human endeavour: adult education. The system described in this paper is not hypothetical. The US largest airlines and largest manufacturers of commercials aircraft have successfully used it.

6- RECOMMENDATIONS:

1- Training institutions are required to evaluate thoroughly the application of modern technologies, and how this might result in greater competitiveness, higher quality and lower costs.

2- Training managers who are planning to automate training program development functions must begin by exploring the learning objectives previously produced by the ***updated IMO model courses*** to identify common outputs.

3- To bring the trainee's performance up to par, the application of quality assurance to the instruction has to be consistent all the way.

4- Building up the permanent international capabilities for training, where the following points should be considered:
   a) transfer of experience and sharing of training resources,
   b) sustainability of efforts, and
   c) responsiveness to specific training priorities of the countries involved.

5- All the needs and constraints detailed in this paper call for a global training strategy that emphasizes the following:
   a) The availability of data about maritime institutions and maritime training is a pre-requisite to the planning stage of the proposed system.
   b) Maritime institutes are required to work in close co-operation with the three international bodies interested in maritime training performance IMO, WMU, and IAMU, in developing the world-wide database and data bank.
   c) There is need for a global accreditation body to boost the creditability of certificates issued world-wide.
   d) Institute classification will be needed for establishing the Global Maritime Training Institute Network.

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