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The importance of modern technology

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TRAINING OF SEAFARING PERSONNEL

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At the conference of the German Institute of Navigation (Deutsche Gesellschaft für Ortung und Navigation, DGON) on Modern Technology in Navigation, Dusseldorf, FRG, Günther Zade, Professor and Vice Rector of the World Maritime University, WMU, Malmö, Sweden, read the following paper. By this he interpreted technology as navigation technology and seafaring personnel as navigation personnel, i. e. nautical officers and master mariners of bridge personnel.

Navigation training as a syllabus subject

Today navigation is only one of three major professional subjects in the training of nautical officers and master mariners. The other two are seamanship, a combination of subjects dealing with the safe and efficient handling of ships and their cargoes, and maritime law. The latter does not always receive as much weight as is given to navigation and to seamanship. Twenty years ago navigation was the most important subject in the training of nautical officers and master mariners and further back it as even been the subject for the training in which navigation schools have been established.

The development of navigation from **the** subject for nautical officers and master mariners to **a** subject has some reasons. Progress in technology has enabled manufacturers to produce advanced navigation equipment which, if appropriately used, contributes to safety at sea and of the marine environment and helps facilitate shipboard navigation. Most shipowners have introduced such modern technology on their ships with the objective to gain in safety and efficiency of navigation, to reduce expenditure for manpower and, if possible, to substitute members of crew by hardware and software. Moreover, the increase in carriage of dangerous and hazardous cargoes by sea and the raising of pollution prevention requirements have made seamanship and maritime law more important than before.

Adaptation of the environment to the use of modern technology in shipping

International conventions of the International Maritime Organization, IMO, have provided the basis on which maritime administrations have developed national legislation for the use of modern navigation technology on ships, to a limited extent, for the adaptation of manning requirements. Maritime training institutions have, sometimes reluctantly and with delay, adjusted their training programmes to the increased use of advanced navigation technology by attaching, on the one hand, greater importance to electronic navigation in the navigation syllabus, that traditionally consists of terrestrial, celestial and electronic navigation, and by giving, on the other hand, more attention to mathematics, physics, electronics and the use of computers as the basis for electronic navigation (and technology-influenced seamanships) in the syllabus for nautical officers and master mariners.

The use of modern tecnology in shipboard navigation and Vessel Traffic Systems, VTS, is now taken for granted. The introduction of advanced technology in ports and shipping companies as well as the growing integration of transport from manufacturer to user have established a maritime industry where modern tecnology plays a keyrole in safety and economy and where the rendering of services without the employment of such technology is no more imaginable.

The need for training in the use of modern navigation technology

There is sufficient proof that seafarers have not always been able to use modern navigation technology without endangering safety at sea and the marine environment. Lack of training and over-confidence in technology have resulted in marine casualties. The term "radar-assisted collision" and "computer-assisted collision" have been used in this context, implying that accidents have partly happened because of the use of radar and computer-supported radar or automatic radar plotting aids (ARPA).

Nearly 20 years ago, research of the Department of Maritime Studies of Liverpool Polytechnic into the use of ARPA has already shown that the application of advanced navigation equipment by insufficiently trained personnel creates a threat to safety. The recent collision of a passenger liner and another ship in the Black Sea, that resulted in the loss of many lives, has confirmed that present navigation technology can provide the basis for human decision-making but is not able to replace it. Thus, a first lesson from marine casualties, is that modern navigation equipment has to be operated by navigators who have a good understanding of the possibilities and limitations of the equipment, are able to assess its performance and to make appropriate use of the data provided.

Seafaring personnel has to be trained in the use of modern navigation technology

The navigation equipment in the use of which seafarers have to be trained, should be available in maritime training institutions. This is normally the cause with radar, ARPA and other electronic navigation equipment as e.g. Decca, Loran C, Omega and satellite receivers. Radar, when situated at the coast, allows to observe ship traffic. Position-finding receivers are confined to the reaffirmation of the positon of the training institution in which they are installated. This limitation can be overcome if a transmitter is added that offers a free choice of position and perhaps even provides for the introduction of failures.

Such simple simulation equipment, which is also available for radar in the form of target injectors, is now used in the majority of maritime training institutions. It is suited for the training in the operation of buttons, switches and other steering elements. It is sometimes referred to as "knobology", and enables the trainee to get acquainted with the operation of the devices, their potential, limitations and possible failuers.

Training in the use of modern navigation technology

It has been an on-going discussion among teaching staff of maritime training institutions in what detail nautical students should understand how electronic navigation equipment works. There are maritime lecturers who advocate a thorough comprehension of the internal operation of the equipment. On the other hand, those who

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believe that — although principles of internal operation should still be dealt with in the navigation training of nautical officers and master mariners — modern navigation devices have to be looked at as black boxes seem to gain in following. Students should receive a good understanding of input-output-relationships and should know what the pressing of a button, the turning of a switch or the operation of another steering element will produce at the output but should not be taught in detail why this is so.

Efforts for navigation calculations have drastically been reduced by electronic devices. Navigation procedures and interpretation of read-outs have gained in importance.

The division between the two schools seems partly to base on the difference in opinion on whether a nautical officer or master should be able to maintain and repair an electronic navigation device and whether a thorough knowledge of the internal functioning of the equipment is necessary for making optimum use of it. The maintenance and repair issue seems to disappear because of the reliability of modern navigation equipment and because of existing redundancy as a result of overlapping of possibilities for position-finding and doubling of equipment. Thus the school of thought that used to consider a thorough comprehension of the internal working of elecrtonic navigation equipment as essential comes closer to the originally different school that classified such understanding as nice to know.

This development is supported by the general increase in shipboard technology in addition to its use for navigation, the use of advanced communication technology aboard and ashore and of modern technology for other purposes in shipping companies, ports and transport. It has resulted in a growing awareness of the need for a better fundamental scholastic ability of future shipboard personnel in mathematics, physics, electronics and computer science without a sufficient ability in which the operation principles, potential and limitations of modern shipboard technology cannot be well enough appreciated. Moreover, adaptation of bridge personnel to new developments in technology and to the use of new equipment will be facilitated by a good education in science with its long-lasting validity.

There seems to be increased satisfaction with a black box approach to training nautical officers and master mariners in electronic navigation. Not much attention is given to maintenance and repair anymore. At the same time, it is also understood that an equivalency between shipboard equipment and training institution equipment has its limitations, even if the devices offer simulation possibilities. Such training equipment lacks the complexity of shipboard reality and can hardly be used to narrow the existing difference between training requirements and training achievements, the so-called training-job-gap.

Navigation training by the use af modern tecnology

It is of crucial importance for safety at sea and protection of marine environment to reduce the gap between training and job in subjects of the syllabus for nautical officers and master mariners which are directly related to such safety. Navigation is one of these subjects as are a.o. manoeuvring of ships, cargo operations, fire protection and fighting. It is especially risky to operate a ship in restriceld visibility, in dense traffic and in coastal approaches and fairways.

Radar simulators were the first nautical training devices which made it possible to offer a considerable degree of complexity in the training situation for nautical officers and master mariners. They provided for training in the navigation of ships in restricted visibility and allowed to train the use of radar not only as a means for the avoidance of collisions but also as a tool for navigation.

First radar simulators in he 1960ies used analog computers and analog contours of coastlines (analog coastline generators). Modern Systems are driven by digital computers, comprise digital coastline generators and electronic navigation equipment as can be found on ship bridges. Such radar navitagion simulators are now in use in maritime training institutions all over the world. In the early stages of development, technology has been the limiting factor in the use of the simulators. Today's radar navigation simulators however offer capabilities which are not always made full use of.

The International Radar Navigation Simulator Lecturers Conference (IRN SLC), a regular gathering of simulator instructors, was founded in 1980 and will hold its fifth meeting in 1988. Two main subjects for discussion will then be use of simulators for training in navigation procedures and the development of so-called effective exercises by which the potential of radar navigation simulators is better exploited for obtaining increased benefit for the trainee in a shorter time.

The advent of large ships and other ships with unusual manoeuvring characteristics has coincided with a growth in density of traffic as result of a reduction in laytimes in ports and with an increase in the amount of dangerous and hazardous cargoes carried by sea. Such "kinky" ships have supported the development of shiphandling simulators, i.e. simulators in which both navigation and manoeuvring of ships can be trained.

Present full mission simulators, in contrast to part task simulators as radar navigation simulators, do not only offer possibilities for better training in the navigation and manoeuvring of various classes of ships, for such training in certain areas and port approaches, for passage planning and training in bridge procedures but also for the training in other elements of a navigation and seamanship syllabus. They can be used for research into e.g. bridge design, operators performance and navigation procedures too.

Modern tecnology and training research

The use of modern technology for the training of seafaring personnel can be extended to purposes beyond training for technology and training by technology. Simulators offer themselves for the examining of seafaring personnel. Findings from training research in simulators can ben applied to the improvement of training for seafarers.

Considerable reservations still exist about whether training on a simulator can be used as a substitute for shipboard service and experience.

It is however accepted that modern technology in form of nautical training simulators provides for better training than can be offered in a classroom or by the use of stand-alone electronic navigation devices. A simulator is closer to shipboard reality than blackboard and chalk and single navigation devices. The use of simulators allows to narrow the training-job-gap and facilitates trasnfer of training to shipboard. Despite these mostly qualitative advantages from simalutor training, a quantification of the effect of simulator training is missing which would enable simulator instructors to design the most effective training possible.

Taken together, considerable progress has been made in the use of technology for the training of seafaring personnel. There is now a clearer understanding of what should be trained before technology, how we should train for technology and by technology. The potential of modern navigation technology enables us to give more attention than before to the training in procedures and decision-making and to reduce human efforts for navigation calculations. Modern technology has brought nautical and engineering officers closer together and has resulted in changes in the job requirements for seafarers.

Nautical officers and master mariners of today have to cope with a more engineering type of work than before.

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