SURPASS - SHORT COURSE PROGRAMME IN AUTOMATEDSYSTEMS IN SHIPPING

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ABSTRACT
The International standards for maritime education and training (MET) currently in place were introduced in 1995 [IMO STCW-95]. Since 1995, there has been rapid revolution in design of ships and the equipment used in the navigation and propulsion systems on board these ships and yet there has been no serious attempt to revise the STCW and/or the International model courses such as IMO 7.03, 7.04, 7.01 and 7.02. One very important development has been the introduction of automation in operating a ship. The modern ships particularly container and fuel carrying vessels are becoming increasingly automated. The automation has brought with it two problems, one concerning the inadequacy of existing seafarers' education and training viz., that if any aspects of automation fails the crew often are not trained to use alternative systems and hence respond to it effectively [IMO MSC 82, 2006; Ziarati, 2007]. The second problem has arisen from the review of the arguments from recent IMO Maritime Safety Committee [reports MSC 82/15/2 and MSC 82/15/3, 2006] namely that the human operators rarely understand all the characteristics of automatic systems and these systems' weaknesses and limitations which have now been found to be the main causes of accidents.

This paper report on the development of a short course programme design, delivery and assessment on automation in order to fill the gap created as the result of emergence and application of the automated systems. The delivery and assessment will be based on the results from two recent EU funded investigations regarding the development of an online learning (developed and tested in Leonardo Pilot EGMDSS, 2006) and e-assessment (developed and tested in Leonardo MarTEL. 2009) will also be included in the paper. The internet platforms have facilities for self-learning and assessment.

This project concerns a funded EU project called SURPASS and there are seven partners from five EU countries developing the courses on automation.

Keywords: Automated ship-borne maritime systems, maritime education and training, SURPASS, ship automation

1. INTRODUCTION

A paper [Ziarati, 2006] and report to IMO [MCA, 2006] clearly identify a major source of accidents particularly in the future to be the problems with application of automated systems and failures in any aspect of automation.

STCW training standards for Engineers have not been updated to account for working with such new engines. Instrumentation and control systems including hydraulics and pneumatics need to be included in the syllabuses of the programmes for the Engineer and Deck officers. Under STCW there is no specific training requirement for electrical engineering officers on board vessels, and therefore no internationally or European agreed standard by which shipping companies can effectively assess their knowledge.

The SURPASS project's [Ziarati, 2010] main aim is to fill this gap created as the result of emergence and application of the automated systems in the education and training of seafarers by provision of a training course enabling them to have a full understanding of automated systems, and these systems' weaknesses and limitations.

2. ORIGINS OF THE PROJECT

Overall, there are two related issues/needs which need to be addressed. One can be highlighted, for example, by a recent report by the Maritime Accident Investigation Branch in the UK (MAIB) concerning the details of the heavy contact made by Savannah Express [2005] with a link-span at Southampton docks, after the ship lost astern engine power.

The report stated that the engineers on board were experienced and held appropriate STCW certificates but they were unable to correctly diagnose the reason for the engine failure. Lack of adequate training in how to operate and trouble-shoot the automated engine was a significant contributory factor in the accident. What was significant was that STCW training standards for Engineers have not been updated to account for working with such new engines.

The second issue can be highlighted by a Marine Engineers Review (MER) [Addressing Automation, IMarEST, Marine Engineers Review, 2007b] that stated that it is not impossible to bring presently serving seagoing engineers to the standards needed if a course could be devised to include synchro- and cyclo- converters, harmonics, etc. as an add-on to the existing IMO syllabuses. Ziarati [2007] reports on the need to include instrumentation and control systems including hydraulics and pneumatics in the syllabuses of the programmes for the Engineering officers. Under STCW there is no specific training requirement for electrical engineering officers on board vessels, and therefore no internationally or European agreed standard by which shipping companies can effectively assess their knowledge. Training on automation and simulating faults and learning how to rectify them cannot be done on a sea going vessel. The most appropriate method is to use simulators as is the case in the aviation industry. The proposed course, with the help of the partners, will include real life scenarios using a range of simulators.

Furthermore, to address the second problem, it is considered feasible to gather the knowledge for inclusion in the existing seafarer's education and Training in a short course format that can be easily introduced for existing seafarers and hence enabling the seamen currently working at sea and in ports to develop the competence to handle and respond to automation failures.

3. PROJECT AIMS AND OBJECTIVES

The main aim of the project is to fill the gap created as the result of emergence and application of the automated systems in the education and training and further training of seafarers by provision of a training course enabling them to have a full understanding of automated systems, and these systems' weaknesses and limitations. It is for this reason that this project primarily is fully in line with Programme General Objectives as it will support participants in training and further training activities in the acquisition and the use of knowledge, skills and qualifications to facilitate personal development.

The second aim is to make this course also available to industry to ensure companies in the sector are aware of the support these systems require and operational features as well as their management. It will enhance the governance and attractiveness of Vocational Education and Training (VET) systems through increased cooperation with social partners and all relevant stakeholders by facilitating the participation of companies and Small to Medium Enterprises (SMEs). It is in this respect that the proposal also addresses to improve the quality and to increase the volume of co-operation between institutions, enterprises, social partners and other relevant bodies. Furthermore, many employees and individuals will be able to enhance their skills and competence and hence become more employable and participate in the European labour market. This will improve the transparency and recognition of qualifications and competences as well.

The third aim is to adapt e-learning and e-assessment systems and use Internet as a means of communication to support the development of innovative Information and Communication Technology (ICT) based content of lifelong learning.

Since the developed courses will be given in English as well as the partners' own languages, it will also contribute to Vocationally Oriented Language Learning (VOLL) and Content integrated language learning (CLIL) priorities that will encourage the learning of modern foreign languages.

4. TRANSFER OF INNOVATION

The main aim is to transfer the innovation already developed in the design, delivery and assessment of short courses in the Maritime Sector in order to fill the gap created as the result of the emergence and application of the automated systems in the education and training of seafarers by the provision of a training course enabling them to have a full understanding of automated systems and these systems' weaknesses and limitations. The automation knowledge is already known, however applying it to ships provides an excellent opportunity for transferring innovation. The innovation in this case is transferred from the novel internet based design as well as from the existing automated system in industry.

Centre for factories of the future has been involved with automation in manufacturing and their experience is invaluable in this project. It is also worth noting that one of the partners, TUDEV, led a recent and successful Leonardo project led by Turkey [Safety On Sea – SOS, 2005-2007] which transferred the most up-to-date maritime education and Training (MET) in the EU and in the process harmonised the practice in several EU countries and in Turkey. The partner has the knowledge of how to incorporate the proposed short course programme in the existing curricula and how to obtain European-wide recognition for it.

SPIN is a high technology maritime company in Slovenia and developed together with C4FF an e-learning and assessment platform as a result of the Leonardo EGMDSS project. Both partners, SPIN and C4FF are partners of SURPASS and have agreed to adapt the platform for SURPASS.

In summary European members of the IMO MSC committee and partners in this project are aware that automation is a topical issue throughout the shipping industry in Europe. They all agree automation failures to be a problem that requires urgent attention and a partnership that is presented in this proposal would be able to make significant contribution in resolving it at source.

Analysis of accidents at sea and in ports, as reported for instance by IMO [sub-committee minutes, 2005 and 2006], clearly point the finger at problems with automated systems and subsequent manning levels which are often kept at a minimum on vessels with such systems.

These reports indicate that countries which take safety seriously and provide necessary resources for personnel training and development in the sector are among the safest maritime nations.

This proposal intends to use benchmarking and promote good practice throughout the partnership and beyond. The majority of accidents and incidents on automated vessels are due to automation and in over 80% of the cases studied these are due to human error or lack of adequate standards. In recent years the number of accidents and incidents relating to automation systems and their failure has been sharply increasing and this trend is expected to increase [IMarEST, 2006].

In summary what is innovative is getting the knowledge that already exists but not transferred for the training of crews working on board automated ships (automation systems and components) from C4FF (instigators of many projects on automation, for instance, Factory of the Futures programmes (supported by EU such as Force and Eurotecnet and EUREKA and so forth) and use of already developed laboratories at TUDEV as a result of SOS [2005] project (new electronic interfacing, electric motors and devices, hydraulics and pneumatics, instrumentation and control) and an existing e-learning and assessment platform [SPIN and C4FF Leonardo EGMDSS, 2006] together with existing software (C4FF and TUDEV, EU funded Clean Diesel project and Clean Diesel II MPhil/PhD project – a joint project between C4FF TUDEV and Coventry University as precursor for a major Framework proposal) and by bringing three major maritime institutions and MET providers to support TUDEV to create a set of training modules on automation. Therefore, this is not a business as usual project but a novel proposal based on an identified and real need with a well thought plan and for implementation by real and competent partners with worldwide reputation.

By the end of this project there will be a novel training programme as a standalone short course training for industrial updating. The Course will receive acceptance due to its importance at international and European levels and will be included in the existing MET programmes.

5. EUROPEAN DIMENSION

The SURPASS short course on automated vessels will be of interest to a wide global audience as many fleets increasingly are opting for vessels with automated and integrated navigation and propulsion systems.
The dissemination strategy is divided into two approaches. One concerning strengthening the existing links with European and National agencies responsible for implementation of IMO standards (STCW) as well as awarding, accrediting and licensing authorities who have direct links and representation with main bodies of IMO and European Maritime Safety Agency. The second approach is to disseminate information about the project its aim and content as well as the rationale for its instigation to local and regional authorities including social partners, local governments and their agencies. To implement this strategy a master dissemination plan is developed based on the Hoshin Kanri road map.

The partnership considers dissemination of the projects results as an integrated part of the project development and will be carried out throughout the project life and beyond.

There will be two experimental training sessions and the analysis of the results and the resulting feedback for the information of partners and the target groups involved. This includes reports to awarding, accrediting and licensing bodies who are silent partners in this project. In addition to having two strategic approaches for dissemination, the intention is to identify the most appropriate format for each dissemination activity.
The automation system will be a continuous programme of training and no doubt will evolve as the time passes by, and new technologies and practices come into play. Maritime courses are generally very profitable. A record of profits made in running maritime short courses such as Bridge Team Management , Ship Handling, STCW Refresher courses and so forth have generated huge financial gains for the institutions. The success of the course would help to disseminate its evolution even faster. One of the partners has suggested that the e-learning and e-assessment platform would be an excellent tool for dissemination of the project.

6. RECENT RESEARCH

Recent review of accidents and incidents as sea [Ziarati, 2009; Rowley, 2006 and accident investigation report such as MAIB, 2007 and resulting MCA MIN 261 (M)] has shown many

vessels, particularly automated and hence newer vessels, are having machinery failures – engine stops in particular .These failures have remained high despite the market downturn in recent months due to the recent economic crisis [SAS, 2010]. In the same article SAS reports that five years ago and in the decade before that, the vast majority of hull and machinery incidents were structural and now there are much fewer of these and more machinery-related incidents. Intertanko reported that ships are stopping regularly, and in the case of their tankers there are now one or more a week with main engine failure. MCA [2007] states that given the increasing prevalence of automated systems on board ships, it is important that the human element is considered throughout their design, implementation and operational use. Automation can be beneficial to operators of complex systems in terms of a reduction in workload or the release of resources to perform other onboard duties. However, it can also potentially be detrimental to system control through increasing the risk of inadvertent human error leading to accidents and incidents at sea. The Maritime and Coastguard Agency (MCA) research identified particular issues in design, selection, installation, use, maintenance, and updating or modification of automated systems which can present problems. MCA produced a range of guidance points were for those involved in selecting or using automated systems, throughout the lifecycle of a vessel. In particular these include the following:

- Shore-based company management
- Shipboard management
- Seafarers using automated systems
- Training providers.

While SURPASS project partners will focus on training issues and points raised for seafarers using automation , the course content will touch upon the points identified in the MCA report for shore-based company management and shipboard management.

6.1 MCA FINDINGS

MCA is of the view that automated systems are increasingly prevalent on ships, in particular on the bridge and in the engine control room. While they bring benefits to both seafarers and ship owners or operators, they have also been identified as a potentially significant contributory factor in accidents and incidents at sea. Particular problems result from difficult or poor integration of new systems and from the move towards an increasingly passive monitoring role for seafarers working with some systems on the bridge and in the engine room. These and other problems present an increased risk of inadvertent human error leading to accidents and incidents at sea. SOLAS Chapter V Regulation 15 is concerned with ergonomic principles and procedures for bridges. It places significant responsibility on a range of stakeholders to ensure the safe and efficient use of bridge resources. This includes, amongst others, masters and watch-keepers, but there is a need for further guidance for them about the practices necessary to achieve these aims. Potential solutions are also of benefit regarding other ship-borne automated systems such as those in the engine room.

The initial review and detailed consideration of selected case studies by MCA [2007] identified the following issues which could contribute to unsafe practices or an accident or incident:

6.2 GENERAL

1. There is sometimes an over-reliance on automation by crews, leading to a false sense of security that the automation will always handle the situation safely;

2. Ships' crews are often overconfident in the data presented to them by automated control systems and this leads to a lack of crosschecking of data;

3. There is often a lack of understanding by ships' crews of automated control systems and any inherent weaknesses they may have;

4. Automated ship-borne maritime systems do not always have optimal ergonomic design considerations;

5. On some screen-based automatic control systems, the human-computer interface can be very confusing to the user;

6. Control methods for systems designed to run automatically are sometimes not immediately obvious, so it may not always be possible to recover an error, even if it is very quickly realised;

7. Serious consequences can arise if ships' crews are unaware of the fail-safe actions that a control system can take automatically following an operator error;

8. Maintenance and calibration errors when setting up automatic control systems can lead to catastrophic consequences;

9. Some current automated systems do not adequately support the system operators in developing and maintaining situation awareness;

10. A typical modern bridge arrangement can overload the crew with information;

11. Poor bridge design and ergonomics can have

detrimental effects on human performance and increase the incidence of human error;

12. Inconsistencies exist in the display formats of navigational information between manufacturers. Greater standardisation is required;

13. Human operators rarely understand all the characteristics of automated systems;

14. System weaknesses and limitations can remain hidden from the operator;

15. The design of automated systems is not always appropriate to the range of competence of the automation operator community.

16. The list above is not intended as a complete list of factors by which may lead to an automation related incident, but describes those issues which their research identified as presenting a particularly high risk to safety.

6.3 TRAINING

The MCA in their research [Rowley, 2006; MCA, 2007] identified a list of suggestions as to how training could help to mitigate some of the accidents and incidents due to automation. The following are the main points raised:

1. This study concluded that, with regards to using training in mitigation, it would be artificial to consider errors related to automation separately from errors related to general maritime resource management (MRM). However, training developers should consider how effectively automation issues such as those identified by this research are incorporated into existing MRM courses, perhaps within the exercises or scenarios used.

2. When revising MRM training, it may be useful for courses to have a specific objective leading to an understanding of human errors related to automated ship-borne systems and how these may be mitigated. An individually tailored training needs analysis will show the specific syllabus content required to achieve this objective. Criteria including the following should be considered in developing the most appropriate training:

- Target group of trainees (e.g. experience, qualifications, role);
- Duration of training period and budget;
- Degree of sophistication of automation on the company's vessels;
- Training facilities available (e.g. availability of simulators);
- Experience and quality of instructors;
- Assessment of competence requirements.

7. CONCLUSIONS

The MCA research has identified a range of problems which could result from inappropriate or incorrect specification, design, selection, installation and use of automated systems, and suggested some methods of mitigation. Much of the guidance for mitigation is implied in the provisions and goals of the International Safety Management (ISM) Code. While no sections specifically mention ship-borne automated systems, their use relates to sections including those on resources and personnel, emergency preparedness and maintenance of the ship and equipment.

The findings of the MCA's research should be considered by designers, shipbuilders, trainers, shore-based company management, ship-based management, and seafarers themselves, to assist in the safe, effective and efficient use of automation on board ships. Applying the guidance where appropriate should support risk mitigation as part of proactive safety management procedures, and avoid inadvertently reducing safety margins or introducing new opportunities for error.

Furthermore, it is an obvious fact that safety at sea is a very important topic. It has been proved on a large number of occasions that human errors have been to blame for accidents at sea and this is mainly due to a lack of education and training for merchant navy officers. MCA research together with the SURPASS project intended automation training course is expected to reduce the number of accidents and incidents substantially.

Automated systems can be difficult to understand even for a well educated individual and it is important that all merchant navy officers understand them, but it is also important that they are able to understand them using a suitable learning platform.

Today we live in a world where almost every household has access or can have easy access to the World Wide Web, what better and easier way to train these officers by using an e-learning platform. This will give officers a structured training course for them to have easy access to across the globe and more importantly it will regularly keep them updated with understanding automated systems. The e-platform systems developed by some of the partners such as the e-learning platform for EGMDSS (www.egmdss.com) and e- assessment platforms for MarTEL (www.martel.pro) are novel systems for the development and assessment of skills intended in the SURPASS training course.

The impact of the project is expected to be substantial because it responds directly and internationally to an acknowledged problem which SURPASS is confident of resolving and the impact

is expected to include widespread use of the course in many EU countries and worldwide.

It is pertinent to note that the SURPASS training programme will consider how effectively automation issues identified by MCA research and our own research are incorporated into existing MET particularly MRM courses through the development of additional exercises or scenarios. However, the intention of the SURPASS project is to give a series of basic information on aspects of automation including hydraulic, pneumatic, electric systems and components and some general information on aspects of control and instrumentation. Having stated this the partnership intends to fully take advantage of the training objectives identified in the MCA report when finalising the syllabus content required to achieve the objectives of the SURPASS project.

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