

**Modern Teaching and Research Training within the Maritime &  
Transport Section of  
Liverpool John Moores University**

**Dr. Steve Bonsall, Co-ordinator of Maritime Programmes  
Professor Jin Wang, Head of Marine, Offshore and Transport Research  
Group  
Liverpool John Moores University, Liverpool, L3 3AF, UK**

**Abstract**

This article outlines both modern teaching and research training activities in maritime and marine related fields at Liverpool John Moores University. The taught programmes and current modes of teaching deliveries at both the undergraduate and postgraduate levels are described. Maritime research activities are described in detail using seven on going and seven completed research projects selected.

**1. Introduction**

The Maritime and Transport (M&T) group at Liverpool John Moores University (LJMU) in the UK traces its history back to the foundation of the Liverpool Nautical College in 1892. At that time the senior “Deck Officer” Certificates of Competency were taught. This area of teaching continued at the Nautical College until the 1950’s and 60’s when cadets and junior officers were also taught. In 1970 Second Mates (STCW OOW) and lower grades of teaching were passed to Liverpool City Council at the Riverdale campus and the Nautical College, which had become the Department of Maritime Studies within the new Liverpool Polytechnic continued with Master and First Mates, Chief and Second Engineer Certificates of Competency.

The undergraduate BSc Nautical Science was taught from the late 1960’s and an MSc in Maritime Studies from the mid 1970’s. Since 1990 the consolidation of professional seagoing teaching in the UK to the four main Further Education Nautical Colleges has meant that the UK Maritime Universities have concentrated on undergraduate and postgraduate programmes. The LJMU M&T group relinquished professional Deck Officer teaching in June 2005 but has extended its academic teaching to doctoral and postdoctoral programmes within the Marine, Offshore and Transport Research Group (MORG). The M&T group has adopted some distinct and novel teaching methods and has extended its teaching internationally in Greece and Iran. Marine Engineering teaching consolidated in a BEng Mechanical and Marine Engineering in 1995.

**2. Maritime Teaching within LJMU**

The M&T group, which encompasses maritime business and law, navigation, ship technology, ports and transport and logistics disciplines, has a relatively small number of full and part-time lecturers and around 150 students registered to its courses. The M&T group works with the Marine Engineers at LJMU who, under a professor, set up the MORG (MORG 2006) some eight years ago. This has developed over the last five or six years into an internationally recognised centre of excellence in marine safety and risk assessment and much of the PhD and post-doctoral research of wider marine and maritime studies is carried out under its auspices.

The portfolio of courses offered by the M&T group is quite large and extends from Certificates of Professional Development (CPDs) at the lower end to a PhD or postdoctoral level at the upper end. The main emphasis is on the undergraduate teaching and a suite of six BSc programmes is available. These programmes lie alongside the marine engineering BEng degree in Mechanical and Marine Engineering and the postgraduate MScs of Maritime Operations, Marine and Offshore Engineering and International Transport, Trade and Logistics. This latter programme is offered for the first time in September 2006.

All of the M&T group programmes together with teaching in general in the wider university at LJMU have evolved with innovative teaching in mind. The University, along with others in the UK, has been at pains to provide a framework of support and facilities to allow lecturers to encompass new technology as well as develop teaching methods that allow wider access by students to education at the undergraduate and postgraduate levels.

### **3. Electronic Notes and Lecture Material**

There are several ways of using computers and the INTERNET for storing and disseminating lecture material. LJMU has kept pace with developments in this area and two aspects are widely used now within the M&T group and the wider University.

#### **3.1 The Blackboard System**

LJMU has for several years had a web-based system (Blackboard 2006) that allows lecturers to place lecture notes, assignments, notices and instructions for access by registered students. These elements are held under the module name heading and thus all students registered for a particular module are able to access this information. The University is particularly keen that as many lecturers as possible utilise the facility and indeed some lecturers have moved totally over to the system. Students are slightly ambivalent to Blackboard, recognising its obvious benefits but fearful of the cost of printing hard copy notes. If a tutor lodges great tracts of text on Blackboard students feel obliged to "print this off" and this may cost several pounds sterling. This is contrasted with the production of "free" handouts available to students in earlier years.

The system has several drawbacks. One is that if a lecturer requires students to follow printed notes it is then either incumbent on the students to obtain these prior to the lecture or for the lecturer to provide them at the lecture. If the latter course is taken then a dual system is operating with notes being provided electronically as well as physically. Also if the notes are not provided then students may find difficulty in following the lecture and thus fail to gain full benefit from the teaching. Another drawback is that if the lecture notes are available electronically then some students may feel that it is not necessary to attend the lectures. This has many effects. Firstly the students who do not attend miss out on the particular emphasis a lecturer may give to elements of the topic. This is not always evident in a written set of lecture notes. Secondly the non-attending student misses the important peer observations made by students in the questioning of the lecturer. The question and answer period at a lecture is often the time when students gain the most effective learning. Sometimes it is when someone else asks a question that one's own misunderstanding is realised. Thirdly lecture notes are only one source of information at a lecture. Lecture notes are used as a foundation for a lecture, not the whole topic. If students do not attend they risk missing the important additional information and comment.

Taking these drawbacks into account the advent of an electronic database of lecture notes holds great opportunities for development of teaching to wider audiences particularly with regard to distance learning. The UK government's target of 50% of school leavers entering higher education together with the withdrawal of funding for college and university fees plus the removal of the any maintenance grant has meant that many students have to work whilst attending University or College. The lecturers in UK post 18 educational establishments can no longer expect 100% attendance from students and have to adopt methods to develop the whole of a subject cohort through other means than lecturing. The use of a web-based database of lecture and learning material specific to a particular module is one way of ensuring that non-attending students can access appropriate learning material.

### 3.2 E-mail

This communication method can be used for individual or group contact. On an individual level students can be tutored at times convenient to both parties. This is particularly important when considering the vagaries of student part-time work patterns as well as the various tasks required by tutors in the present university climate. E-mail takes no account of distance thus it has become an essential part of distant learning control.

On the group level e-mail has an advantage over the static electronic database in that it is high profile and goes direct to the student. Provided that they use their e-mail system they will get the module information along with other communications. It does not require the application to seek out the information on their part that is needed with the electronic database. This has beneficial and detrimental effects. On the beneficial side the tutor has more confidence that the student has received the information. Detrimentially students can become lazy and assume that it is unnecessary to seek out the required information and that it will arrive when required without any input from themselves. E-mail is however a good way of getting important announcements rapidly to a group.

## 4. Overseas Teaching

The M&T group sits within the School of Engineering (SoE), which itself is one of three schools in the Faculty of Technology and Environment. The SoE has long been active in developing overseas links and to this end has good contacts in Malaysia where LJMU hold degree ceremonies. The M&T group and SoE have developed ways of delivering postgraduate programmes in a distant learning form, which gives LJMU absolute control of the quality and standard of delivery and examination integrity.

### 4.1 MSc Maritime Operations in Greece

In 1998 the M&T group established in Piraeus, Greece a distance learning form of its successful MSc Maritime Operations. The MSc in its full time form at LJMU consists of seven maritime taught modules of which five must be studied to achieve a postgraduate diploma (PgDip). A further research and communication methods module is taught as a core module in line with the University's requirements for postgraduate masters programmes. The successful submission of a research dissertation then allows the PgDip holder to achieve the MSc. In its fulltime format the modules are taught simultaneously with examinations held annually in May.

The part-time distance learning format adopted for the Greek version of the degree uses a block teaching mode where each of the modules is taught over a two-week period four times per year. One major advantage of the LJMU format is that the LJMU lecturer delivers the material at the overseas location and thus essentially the overseas distant-learning part-time student receives the same level and quality of delivery as the Liverpool based full-time student.

Each two-week block starts with the examination for the module previously taught and is invigilated by the lecturer who then delivers the next module. The lecture material and tutorial sessions can be delivered as required by the student cohort in the overseas location. For the Greek programme the students are generally all employed and thus lectures and tutorials are given in the evenings and during the weekend of the two-week block. Each module has 48 hours of student contact including the 3-hour examination. Evening teaching is in 4-hour sessions from 6 to 10pm for 9 weekdays and 9 hours at the weekend, often 5 hours Saturday and 4 hours Sunday.

This system has been running for 6 years now and has worked successfully with several student cohorts completing the programme. Entry to the programme can be made in general whenever a module is taught and this provides great admissions flexibility for students. In line with the University requirements for postgraduate programmes a research and communication methods module is included in both the full and part-time programmes. In Greece this is taught in June and programme entry is not allowed at that time.

The part-time research project is studied in a similar way to that on the full time programme. The aim, objectives and study plan are agreed with the programme leader and a supervisor. The student then works independently using the supervisor for assistance within the problem areas. E-mail is indispensable for this element as the students will only be able to meet with the supervisors when they are in overseas teaching. The face to face contact whilst desirable on occasions is not necessary for the bulk of the work. Postgraduate students should be able to work independently and being at a distance from the University should not be a handicap.

#### 4.2 Other Engineering and LJMU Master's Programmes

The success of the distance learning MSc Maritime Operations prompted the development of other MSc programmes within SoE and also an MA in Tourism and Leisure Management Development (SBE 2004). One of the MScs is the MSc in Marine and Offshore Engineering offered by the marine engineers from SoE and also working within MORG. These distance learning programmes have been developed over the past four years and all run in a similar manner to the distance learning MSc Maritime Operations.

There is also an MSc Technology Management and from September 2006 an MSc International Transport, Trade and Logistics. Combining modules from the MSc Maritime Operations and the MSc Technology Management programmes may provide an MSc Maritime Operational Management.

##### 4.2.1 Bespoke Programmes

From time to time the M&T group is approached to set up programmes for a specific market. Over the past few years this has seen the development of specific MSc and short CPD (Certificate of Professional Development) programmes with a modular

credit base from 12 to 60 hours. The latter credit base becomes a semester long programme.

#### 4.2.2 Postgraduate Teaching in Iran

The success of a Master Mariner from an Iranian Shipping Company on the Liverpool based MSc Maritime Operations spurred bespoke versions of both that programme and the MSc Marine and Offshore Engineering programme in Iran. The two programmes entitled MSc Maritime Operations and MSc Maritime Technical Operations have been running for 3 years now with some students from the first cohort having graduated.

The novel delivery of the programmes lends itself to adaption to a variety of markets and situations. The built in quality assurance of the programme which is controllable by LJMU staff mixes well with the desire for non UK students to study shipping at a postgraduate level in their own country. Costs are therefore kept to a minimum for the students who can continue to earn whilst they study.

#### 4.2.3 CPD Study

At the undergraduate level there has been a demand for short programmes to cover specific topics and student requirements. In Hydrographic Surveying a CPD was validated to allow certification of Hydrographic learning for local company personnel. There is a growing demand for students from European Universities to study part of their programmes at another University. Thus European Maritime Universities seek cooperation with UK Universities for semester long study of maritime subjects which can be included in their own degree study. Two CPDs have so far been validated; CPD Maritime Business for semester one (September to December) and CPD Marine Insurance, Maritime Project and International Trade (January to May). Student cohorts have successfully studied both CPDs.

### **5. Work Based Learning**

This form of teaching is not new but is desired by the UK government and encouraged by the central management of LJMU. It is however difficult to implant into programmes and usually requires company cooperation.

#### 5.1 Case Studies

This is a traditional way of introducing work-orientated learning into academic programmes. Within M&T this is achieved in a number of ways. Individual modules will, where possible include module content directed towards the use of case study material. Thus students are able to work independently or in groups to achieve a learning outcome. This has been used to effect at level 1 on the undergraduate programmes with an Integrated Activities module where the syllabus is deliberately flexible to allow fundamental concepts to be brought together. An example of this is a paper exercise concerning the loading of a containership bay where the operations technique of container sorting in a container stack within a container terminal can be combined with the stability concepts needed to provide a proper tier weight regime on the ship.

The Integrated Activities module also allows flexibility of teaching at the introductory level. Thus problems encountered elsewhere on the programme can be tackled in an integrated manner. Often key skill modules are offered to a variety of programmes

and thus may lack focus. The focus for one group will be developed to involve specific topics in the Integrated Activities module.

## 5.2 Industrial Visits

Another traditional way of exposing students to the workplace is by visits to an industrial complex. This concept can be utilised in the Integrated Activities module to real advantage to achieve specific learning outcomes. Thus a ship visit can be developed into the basis for a report, which is then written to specific standards and referenced in the required fashion. The report style is then used later in the programme notably in the final year project. The style and referencing system so important to that final year programme will thus have been introduced at the student's first contact with the course and should therefore be well established by the time the major project is studied. The confidence promoted by early initiation to specific detail thus leaves the student to devote time to the more important research task.

The industrial visit has the important aspect of bringing the students close to the working environment into which they will graduate on completion of the programme. Thus providing a variety of such visits throughout the course has the effect of allowing students to sample first hand areas into which they may wish to move at a later date.

## 5.3 Commercial Project

One problem with the industrial visits is that they tend to be passive with respect to the students. They are very much spectators during the visit and learning is clearly enhanced when exposure to new concepts is interactive with the student taking part in the learning process. To take this forward within M&T students are put into the workplace of consenting companies to work in groups on a project devised in conjunction with the company management. The projects can be long and take many months or short and take just a few hours. They can also be something the company wants examined and investigated or devised to allow the students to learn and sample the workplace. The latter is novel to companies and brings them close to the learning environment and gives them a stake in the learning process.

For a small commercial project to be successful the programme leader needs to have good contacts with the industry that the programme serves. Commercial companies are in business to make money and being involved in education usually means spending money rather than making it. Thus it is necessary to take the initiation process slowly and allow the company to progress at a gentle pace. When the idea of having a student group in the company becomes normal then the process has really succeeded and should be fruitful in the long term for the companies, students and programmes.

## 5.4 Placements

These are standard options on most undergraduate degree programmes. They are sometimes difficult to arrange as the student needs to be on the pay role and thus the company needs to feel that they are gaining a benefit from their outlay. Traditionally placement students are merged into the workplace and become another employee. This however is incorrect as the student should be learning all the various aspects of the company profile and not just one particular job. The commercial project can be a lead into the full placement and allows companies to consider how students can usefully be integrated into the company for mutual benefit.

## 6. Foundation Degrees

A new development in the UK higher education system is the introduction of foundation degrees. These are generally taught outside the higher education system at the further education level but must be validated by a University and lead to level 3 of an appropriate University degree. Maritime education in the UK has seized this opportunity to bring the current maritime seagoing training which is taught at the further education level into a degree based scheme. There has been a degree route into UK seagoing for many years however it has had limited support from both students and shipping companies. The foundation degree concept however has been adopted at the Chamber of Shipping level and will become by September 2006 (Chamber of Shipping 2006) the preferred route for entry for UK Merchant Navy Officers.

At LJMU the Nautical Science foundation degree will feed directly to level 3 of the BSc (Hons.) Nautical Science. Students on the foundation degrees will achieve the underpinning knowledge for the STCW OOW and Chief Mates Certificates of Competency. Acquiring the appropriate sea-time and passing an oral examination will achieve the Masters certificate.

## 7. Research Activity

MORG within SoE was set up in 1998 and has since been actively engaged in research. It currently consists of 8 academic members and 14 doctoral and postdoctoral members of whom three are doing a PhD through a part-time distance learning mode. MORG has attracted external funding of more than £1m from the UK EPSRC (Engineering and Physical Sciences Research Council), EU, HSE, industry, etc., and completed a number of doctoral and postdoctoral research projects supported by both internal and external funding. MORG is equipped with a wide range of risk modelling and decision making software tools including *ITEM* and *IDS* (intelligent decision system). Several research projects have been conducted closely with the Lairdside Maritime Centre (LMC), which is an autonomous centre within the Faculty of Technology and Environment at LJMU. LMC has the UK's only 360° ship simulator for research and advanced ship-handling/bridge teamwork training (LMC 2006).

MORG has the following research interests at both the doctoral and postdoctoral levels:

- Electronic charts.
- Formal ship safety assessment.
- Human error studies.
- Marine and offshore system design.
- Navigation studies.
- Offshore safety analysis.
- Offshore structural assessment.
- Port safety assessment.
- Port studies.
- Safety based design/operation decision-making.
- Safety-critical software assessment.
- Simulator-based research.

Many industrial organisations and government agencies have collaborated with MORG in research. These include AMEC Process and Energy Ltd, Vectra

Technologies Ltd, NNC Ltd, Shell Global Solutions, UK Offshore Operators Association (UKOOA), American Bureau of Shipping, Maritime and Coastguard Agency, Lloyds Register and HSE Offshore Safety Division. MORG has also collaborated in research with many universities world-wide including Dalian Maritime University, India Institute of Technology, Loughborough University of Technology, Shanghai Maritime University, Salford University, Staffordshire University, Technical University of Lisbon, Technical University of Gdansk and the University of Manchester.

Some typical doctoral and postdoctoral research projects within MORG are briefly described as follows:

### 7.1 A Selected List of Some Current Projects

#### 1. An advanced tool for safety-based offshore operations (2004-2007)

Safety is of paramount importance in offshore operations. Human and organisational factors (HOFs) play a critical role in offshore operations and are often at the root of many major failures with disastrous consequences. Research in this area poses a significant challenge and is so far very limited. This may be due to the unique characteristics of offshore operations in harsh environments and with many innovative features, the high level of uncertainty in failure data, and the difficulties of integrating HOFs into overall risk assessment together with other failure events as well as factors in finance, the environment, etc. This project deals with such problems in a rational and integral manner.

This postdoctoral research project funded by the UK EPSRC is aimed to develop a novel decision support tool for offshore operations. The project includes an initial investigation into the generation of best operation strategies, development of an advanced risk-based framework for modelling HOFs, formulation of Bayesian networks and a linguistic approach, and development of a novel group decision analysis methodology for supporting overall multiple criteria assessment of offshore operational strategies. The collaborators of the project are Shell and HSE.

#### 2. Port safety assessment (2001-2006)

Throughout this doctoral research project, formal safety assessment on cargo handling systems is investigated in detail in a large port. The primary aim of this project is to develop a novel formal safety assessment approach to be applied to different types of ports. The work-packages of this project include:

- Development of a modified version of the variables transformation in the FORM/SORM method for the estimation of the Most Likely Failure Point.
- Development of a novel risk-based decision-making approach in port operations.
- Application of Bayesian networks in risk assessment of vessels carrying liquefied petroleum gases.
- Use of multiple criteria decision-making techniques for port safety assessment.

The collaborators of this project include several British and Greek port companies.

#### 3. Logistics performance of liner shipping (2003-2006)

An appropriate liner shipping performance measurement can only be achieved by closely integrating the internal functions within carriers' companies with the external operations of shippers' and consignees' companies. In this regard liner shipping performance measurements will encompass not only internal operation efficiency parameters, but also measures of customer-facing services effectiveness. This doctoral study will develop a conceptual assessment framework of the logistics performances of liner shipping and provide suggestions for using validated measures in substantive research and practice in the context of both British and Chinese marine industries with particular reference to safety assessment.

The collaborators of this project include Shanghai Maritime University and Mersey Docks and Harbour Company.

#### 4. The impact of automation on cargo handling terminals (2003-2006)

Since the industrial revolution methods of cargo handling have undergone major changes, human power has been replaced by mechanical powered equipment and instead of being labour intensive the handling of cargo has become capital intensive. Maritime trade has been increased rapidly and there has been a general increase in vessel size. Such a development has had a great impact on ports and their employees.

The latest development in cargo handling methods is automation of terminals. The information flow as well as the physical flow of cargo through the terminal is being automated. An effective and efficient communications network and cargo tracking system are of crucial importance when automating terminals. The full automation of the terminal is at this stage not yet realised. A limited number of terminals have automated large aspects of their operations but most terminals have some automation and are looking for the opportunity to automate other areas. The automation of terminal operations has considerable impact on the design and layout of the terminal, the workforce and the management.

The work-packages of this project include:

- Modelling of cargo flow in terms of costs, risks, uncertainty, etc.
- Information flow modelling.
- Reliability based maintenance and formal safety assessment of cargo handling systems.
- Cost-benefit analysis.
- Ship-port interface modelling.
- Comparison of different ports in terms of safety and efficiency.

The collaborators of this project are the Mersey Docks and Harbour Company and Bandar Abbas Port Authority.

#### 5. Marine security study (2003-2006)

For many years regional cooperation of Port State Control (PSC) has taken place especially in Europe. Its implementation has just recently started in Taiwan. Therefore, in order to attain PSC regime efficiency in Taiwan traditional maritime countries' experience of the important issues in the organization of such a safety regime may be exploited. The work-packages of this project include:

- Modelling of Port Facility Security (PFS)/PSC system in traditional maritime countries and identification of the relationship between marine safety and PSC system.
- Investigation of PFS/PSC system.
- Modelling of impacts of the implementation of PFS/PSC system.
- Study of the role of cost and benefit analysis in the Taiwanese shipping industry.
- Use of quality control techniques such as the Six Sigma concept for improving port operations.

#### 6. Risk-based inspection of large oil tankers (2003-2007)

Recent isolated and highly publicized incidents have undoubtedly cast a shadow on international maritime safety affairs. The benefits of a comprehensive regulatory system applied uniformly and controlled by an international body (IMO) need to be recognized. However, following the loss of oil tankers “Erika” in December 1999 and “Prestige” in 2002, the operations, engineering and management sectors involved in tanker safety have been subjected to intense criticisms from the media and the public. Leading figures in the classification industry have recently called for a “re-invention” of the industry’s primary self-regulation system in response to these developments. Another observer encapsulates the fundamental problems with the present system of international rule-making.. The system is to a large extent reactive, responding to accidents rather than proactively preventing them. There is a lack of transparency and the process of developing the rules is insufficiently systematic. This doctoral research via a distance learning mode looks at this important topic area. The work-packages include:

- Literature review.
- Investigation of quality/safety of oil tankers and impact of hull integrity.
- Structural hazard identification and assessment of structural risks for oil tankers.
- Formulation of the DSP (Decision Support Problem) model.
- Application of novel flexible formal safety assessment techniques.
- Development of the hull safety case for oil tankers.

#### 7. Communication and cultural human factors in maritime safety (2003-2007)

This doctoral project studies the role of human factors associated with communications and culture influences in maritime safety for analysis of situations involving a multinational crew. It examines: human and technical aspects of ship operations; linkage between human factors and maritime casualties; multicultural communications and human factors as they relate to the shipboard safety; case studies of maritime casualties caused by gaps in language and culture; comparative analysis of communication within multinational shore-based and sea-based workforces in other industries; review of national, international and industry policies on language, culture and human factors at sea. This project intends to search some possible solutions that may help balance the need for continued research on technical aspects with due consideration to human factors and those that may ease the conflict between the increasing trend of ship operations with a multinational crew and the potential of maritime accidents under these circumstances. By looking at the clash of language and culture of those at sea this research also hopes to contribute to the debate on globalisation and its effects on a highly trans-national but literally insulated working environment.

The collaborators of this project include some leading marine operators and maritime universities in Europe.

## 7.2 A Selected List of Some Recently Completed Research Projects

1. Application of approximating reasoning approaches in offshore engineering design (2002-2004)

To improve competitiveness companies must reduce cost and environmental impact whilst improving safety, quality and maintainability in design and manufacture of their products. Such multiple criteria have to be considered in design assessment at various design stages. The difficulty in conducting design assessment comes from the fact that limited reliable data is available to measure criteria at the early design stages where vague information or subjective judgement is often used. Advanced approaches that can address the above issues need to be developed.

In this postdoctoral research project funded by the UK EPSRC, several pragmatic modelling techniques, a rigorous assessment methodology and software were developed. They can be used to facilitate assessment of offshore and other made-to-order products even in situations where conventional approaches cannot be applied with confidence due to the lack of data and the high level of vagueness and subjectivity. The outcomes of this project can be used to significantly improve the design assessment processes in conceptual design, design validations and requirements definition. The collaborators included AMEC Process and Energy Ltd, Vectra Technologies Ltd., NNC Ltd, HSE Offshore Safety Division and UKOOA.

2. Integrative risk-based modelling to safety-critical assessment of marine applications (2002-2005)

In order to systematically and effectively address uncertainties such as those due to randomness and vagueness in the modelling data, Bayesian network and fuzzy logic approaches have been proposed respectively. A ship evacuation scenario and an FPSO(Floating, Production, Storage and Offloading system)-shuttle tanker collision scenario were examined within a cause-effect domain using a proposed methodology incorporating Bayesian networks while the main causes of the technical failures to FPSO-shuttle tanker collision risks were used to demonstrate the proposed fuzzy logic-based approach. By way of the theory of mass assignments, a transformation process enabled possibility values to be converted into probability ones and vice-versa. Thus, a proposed fuzzy-Bayesian network modelling was enabled as an integration of Bayesian network and fuzzy logic approaches. This fuzzy-Bayesian network method provided a practical means of integrating the possibilities of failure into a probability domain, and it was then applied to address both human factors and ballast water risk assessment.

The collaborators of this doctoral research project were Shell and Saftec.

3. Cyprus and Mediterranean cruise market: A financial and economic appraisal (2000-2004)

This doctoral research proposed a “financial and economic” methodology for a cruise product. The developed methodology consists of seven distinct sections including consolidation and globalisation; market segmentation; evaluation of consumer attitudes and competition; marketing analysis; formal safety assessment; cost and risk assessment and investment risk analysis. It was used as the basis for the

development of more scientific and objective financial and economic methods and safety modelling techniques applicable to the operation of cruise ships in the Cyprus and Mediterranean regions. A generic cruise ship and anonymous cruise companies operating in the Cyprus and Mediterranean regions were used to demonstrate the methodology developed. Finally the results of the project were summarised and the areas where further research could be focused were identified.

This research was conducted via a distance learning mode. The collaborators of this research included several leading cruise operators in Cyprus such as Louis Cruise Lines and New Paradise Cruises.

#### 4. Formal safety assessment of passenger ship fires (2000-2004)

In this doctoral research project fire safety on a generic passenger ship was studied in detail to give a better view about the danger of having a fire on board. The objective of this project was to investigate fire risks of a passenger ship by using formal safety assessment techniques. The primary aim of this project was to develop a novel formal safety assessment approach for application on passenger ships. The developed novel approach integrates hazard identification, risk quantification and ranking with formal decision making techniques so that fire safety improvements made to new as well as existing vessels are effective and justified.

This research was conducted jointly with Chosun University in Korea.

#### 5. Safety assessment of offshore support vessels (1998-2001)

This doctoral research developed a philosophy aimed at facilitating the development of a formalised design and analysis environment for safe ships by adopting an integrated approach that iteratively links safety assessment and design with technological developments. This research was concerned with the formal safety analysis methods and their applications to offshore support vessels with particular reference to the incorporation of safety aspects into the design process from the initial stages.

Several novel flexible risk modelling and decision-making techniques were developed and examples were used to demonstrate their applicability to marine engineering systems. This project was jointly conducted with Staffordshire University.

#### 6. Formal safety assessment of fishing vessels (1998-2001)

This PhD project was concerned with the application of formal safety assessment to fishing vessels. Fishing vessels are generally smaller than most merchant vessels and the amount of data available to carry out an extensive safety assessment for this type of vessel is lacking. The failure and accident data available for fishing vessels are associated with a high degree of uncertainty and are considered unreliable. As such the work carried out in this research was directed to look at the development of novel safety analysis methods to address this problem.

This research developed several subjective safety analysis methods for fishing vessels within the formal safety assessment framework. A fishing vessel was used to demonstrate the methods developed. The industrial collaborators of this project were Boyd Line Ltd and UK Maritime & Coastguard Agency.

#### 7. A safety-based decision support system for the design of large offshore engineering products (1998-2001)

The primary aim of this postdoctoral research project funded by the UK EPSRC was to integrate safety assessment with formal decision making techniques so that safety aspects can be taken into account from the initial offshore product design stages. A secondary aim was to investigate how the integration of formal safety assessment and decision making techniques can support large offshore product development. The specific objectives of the project were:

- To develop novel safety assessment and decision making techniques to facilitate offshore safety analysis.
- To demonstrate how safety assessment can be used to assist in decision making when designing large offshore engineering products, in order to make the development process more controlled thereby allowing decisions regarding design and operations to be made based on safety assessment.
- To develop advanced procedures for minimising risks by improved design aspects and operation strategies based on safety assessment.
- To demonstrate that there are significant benefits to be gained.

The produced results of the project include:

- Review of current practices.
- Novel offshore safety assessment techniques.
- Models for design selection.
- Case study and advanced procedures for minimising risks.

The collaborators of the project were Shell and UMIST.

## **8. Conclusion**

The article has presented some of the work of the M&T group and a sample of the associated work of the MORG at LJMU. The article shows that maritime and marine teaching has developed from the professional seagoing to the academic and research based and as such has enhanced new and innovative teaching methods. The group has, with the assistance of the School of Engineering expanded its influence overseas and again has used innovative teaching methods to embrace student customer needs in other countries.

## **References**

Blackboard (2006) The Blackboard System. Available at <http://blackboard.livjm.ac.uk/> Accessed on 4<sup>th</sup> January.

Chamber of Shipping (2006) Merchant Navy Foundation Degree launched by Shipping Minister. Available at <http://www.british-shipping.org/news/index.htm> accessed on 2<sup>nd</sup> January.

LMC (2006) Lairdsie Maritime Centre. History of the Centre. Available at <http://www.lairdsie-maritime.com/>. Accessed on 2<sup>nd</sup> January.

MORG(2006) The Marine, Offshore & Transport Research Group (MORG) Available at <http://www.eng.livjm.ac.uk/research/groups/morg/home.html>. Accessed on 4<sup>th</sup> January.

SBE (2006) Shipping Business Education. Available at <http://www.sbe.gr/degrees.html>. Accessed on 8th January.