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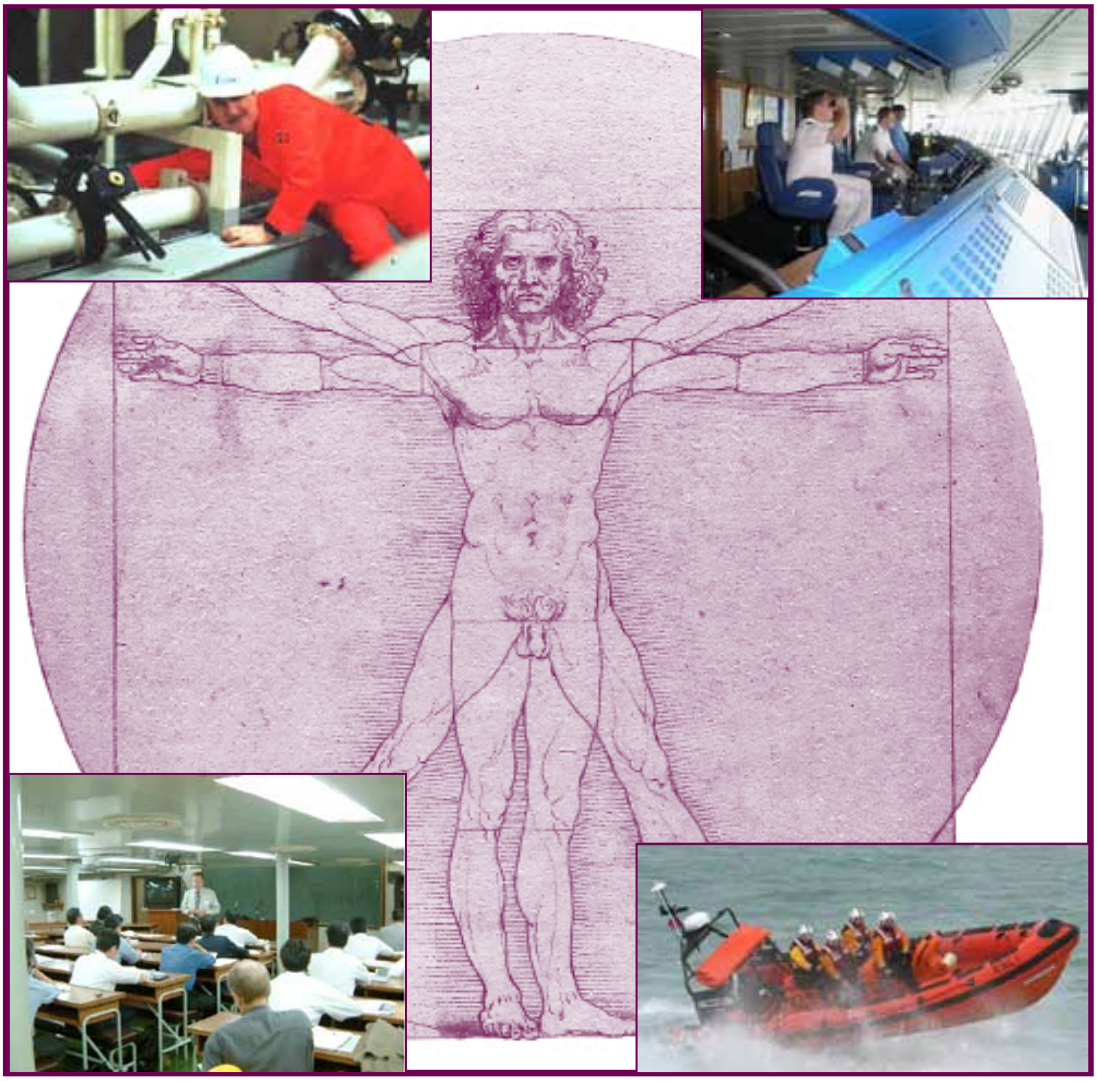

International Conference

HUMAN FACTORS IN SHIP DESIGN AND OPERATION

16 - 17 NOVEMBER 2011

RINA HQ, LONDON

HUMAN FACTORS IN SHIP

16 - 17 NOV

day 1

09.00 - 09.30 **COFFEE AND REGISTRATION**

09.30 - 10.05 **THE HUMAN ELEMENT COMPETENCY REQUIRED FOR DESIGN APPRAISAL**

O.Walker, Lloyd's Register, UK

One way for the human element to make an impact on a large scale is through inclusion of ergonomic requirements in Class Rules. This can be achieved by two means; by introducing specific human element requirements into the Rules and by making current rule requirements with human element implications more explicit. Any attempt to address the human element in the Rules requires that the competence of surveyors is increased at the same time as the Rules are revised. Raising awareness of the subject is an essential first step if the benefits of improved design are to be realised. This paper outlines how Lloyd's Register is striving to address the Human Element in the Rules whilst at the same time putting in place mechanisms to ensure surveyor competency is met. The paper discusses the development of internal Human Element awareness training, the first step towards achieving a competent workforce in this area.

10.05 - 10.40 **THE HUMAN FACTOR IN THE INVESTIGATION OF MARINE CASUALTIES, AMENDMENTS TO MANILA STCW78 2010**

J Alvite Castro, A Coruña University, Spain

Due to the rebound experienced maritime accidents in 2010, the investigation of marine casualties in requires information on the human factor, particularly in the organizational factors and ergonomics.This study was carried out to develop a systematic series of actions to implement the method ILO / IMO, based on amendments to STCW78 Manila 2010.The result serves to facilitate the identification and sequencing of the acts or dangerous decisions that have been involved in the development of maritime casualty as well as the underlying factors behind them. The aim is to finally determine the existing security problems and to develop appropriate corrective measures and their inclusion in the "European Maritime Casualty Information Platform" (EMCIP)

10.40 - 11.10 **COFFEE**

11.10 - 11.45 **EFFECT OF ENVIRONMENTAL FACTORS ON HUMAN PERFORMANCE ON BOARD SHIPS - DOES INCREASING NOISE LEVELS BRING CREW PERFORMANCE DOWN?**

R. Emek Kurt and O. Turan, University of Strathclyde, UK

More than 80% of shipping accidents can be attributed to human factors and a main influence on this are the environmental conditions which the human inhabits. These conditions have a high degree of interdependence between the different factors (motion, vibration, noise etc.) on board ships, which has prevented researchers from modelling all the factors together to effectively estimate human performance and comfort on board. However, investigating each factor independently is the first step towards modelling the effect of all the environmental factors. This paper investigates and analyses the effects the different factors have on human performance. It also studies in-depth one of the main environmental factors: noise from the engines and machinery. The case study will focus on the effects that noise exposure has on human performance and reliability deduced from the results of experiments carried out by the authors of this paper on crew members in ship simulators.

11.45 - 12.20 **MARITIME PLATFORM HABITABILITY ASSESSMENT**

A. Woolley, M. Riding, V.Pit and R. Mead, DSTO, Australia

The Defence Science and Technology Organisation (DSTO) has embarked on a research program to deliver to the Royal Australian Navy (RAN) a capability to assess the conformance of maritime platform designs against habitability requirements. For this research, habitability has been defined to encompass volumetric compartment space requirements, victualling and platform environment. The primary deliverable will be a platform habitability assessment software tool, which will output a measure of habitability conformance, known as the Platform Habitability Index. The Platform Habitability Index will amalgamate assessments relating to the platform's space configuration, victualling and environment. Subsequently, it will allow for identification of habitability deficiencies within a proposed design and therefore enable risk identification and the development of risk mitigation strategies. This paper presents an overview of the research program and how it may be utilised to provide holistic platform assessment during mission scenario simulation. Rules for platform habitability will be defined and assessment utilising the Platform Habitability Index will be exemplified.

12.20 - 13.30 **LUNCH**

13.30 - 14.05 **MANNING CENTRED DESIGN IN THE NETHERLANDS**

W.M. Post, TNO Human Factors, The Netherlands

All navies, when taking initiative to build a new platform, have difficulties with determining in an early phase the number of people that are needed to sail the planned ship. Later on, at planning a design trajectory, new questions will arise: How do you reach a cost-effective solution? How do you identify uncertainties? How do you coordinate all the stakeholders and experts involved in this process? And when a design program has started, other typical question will arise: how can you get a quick insight in the consequences of design choices? How do you account for your design decisions? TNO have reflected on a dozen of human centered design projects for the Dutch Defence Materiel Organization (DMO). They unified knowledge, methodologies and tools in one Manning Centered Design framework, aimed at reducing the complexity of such design problems, managing the risks involved, and capturing the applied knowledge and experiences for later use. In this paper, the framework will be explained and illustrated by two DMO projects in which it is recently applied.

14.05 - 14.40 **ENHANCING SAFETY PERFORMANCE WITH A LEADING INDICATORS PROGRAM**

C. Tomlinson, ABS, B. Craig, Lamar University, M. Meehan, AP Moller-Maersk

Encouraging safe working practices to improve safety performance requires a better understanding of the social and organizational factors that foster professionalism in the seafarer. Safety culture mapping and safety performance monitoring through leading indicators are two key initiatives that may be able to improve safety performance. Leading indicators are safety metrics that are associated with, and precede, an undesirable/unexpected consequence. This paper presents the results of research undertaken by ABS and Lamar University, USA with AP Moller-Maersk. It details a method whereby marine organizations can self-assess their safety culture and/or develop their own leading indicators of safety programs. The paper will discuss the utility of different types of metrics for a leading indicators program, the safety culture questionnaires, safety performance datasheets, data analysis and how to incorporate the results into an organization's continuous improvement program.

14.40 - 15.10 **COFFEE**

15.10 - 15.45 **ASSESSING NAVIGATION PERFORMANCE OF DECK OFFICERS DURING EXTENDED NAVIGATION SIMULATIONS**

A. Kircher, Chalmers University of Technology, Sweden

"Good seamanship" is used to describe behaviour of deck officers who navigate according to a commonly accepted set of norms. These norms offer a certain flexibility, but most of them are covered by laws and regulations. The navigation performance is also of interest, and there is a connection between the terms. The scope of the paper is to analyse whether subjective and objective measures can be used to describe good seamanship and performance, and the relationship between these in different collision situations. During an extended simulator study, 50 deck officers' navigation performance was assessed. Assessment was both subjective by expert raters, and based on objective data. Of main interest was if these different navigation performance scores are comparable. Data show that the selected objective and subjective measures alone may not be enough for a comprehensive picture, but are suitable for limited scenarios for training.

15.45 - 16.20 **FATIGUE AND PERFORMANCE IN BRIDGE AND ENGINE CONTROL ROOM WATCH KEEPING ON A 6 ON/6 OFF WATCH REGIME**

P.Maurier and P.Corrignan, Bureau Veritas, M.Barnett, D.Gatfield, C.Pekcan and G.Clarke, Warsash Maritime Academy and T.Åkerstedt, SRI3

Reduced onboard ` levels and increased workloads potentially lead to a higher risk of accidents through human error. Project HORIZON is a European funded research project that seeks to investigate the problem of seafarer reliability, and to deliver measures that will help alleviate the safety hazards caused by fatigue. For this purpose, a realistic scenario was developed, in which watch keeper cognitive performance and fatigue levels were measured, using the simulator facilities at Warsash, to provide a 7 day continuous voyage. Ten simulations runs have been performed with 40 certificated seafarers of varying experience. Analysis of the results shows a significant impact of the 6 on / 6 off watch pattern on the fatigue and performance of seafarers. It is hoped these results will lead to better fatigue management systems being developed, in order to improve the safety and reliability of ship operations and the welfare of seafarers

16.20 - **EVENING RECEPTION**

DESIGN AND OPERATION
EMBER 2011

day 2

09.00 - 09.30 **COFFEE AND REGISTRATION**

09.30 - 10.05 **THE EFFECTS OF HUMAN FACTORS ON SHIP COLLISION FREQUENCY**
M. Hänninen, Aalto University School of Engineering, Finland
The majority of maritime traffic accidents are due to human failure. This study presents a tool for modeling the effects of various human factors on ship collision risk. With the tool it is possible to examine how various human and organizational factors affect each other and how they influence the collision frequency. In the future, the tool will also model the effects and costs of various decision alternatives. Then it can be utilized as an aid in choosing the optimal risk control options for maritime traffic. The technique applied for the modeling is Bayesian Belief Networks. The presented Bayesian network model considers the probability of two ships not making evasive maneuvers while the ships are on a collision course. The model includes various variables describing human and organizational factors such as bridge design, stress level and the following of maintenance routines. Examples of the effects when applying the model to the maritime traffic in Gulf of Finland are presented and discussed.

10.05 - 10.40 **PERCEPTION OF RISK - SOME CONSIDERATION OF THE IMPACT ON THE INCLUSION OF HUMAN FACTORS IN RISK ASSESSMENTS**
V. Pomeroy, University of Southampton, UK
It is accepted that human performance is more influenced by the individual's perception of the risks involved than by the actual risk determined from statistical analysis of historical records or by predictive evaluation. The work carried out by Bailey and Ellis in Cardiff has provided useful data on how individuals in the marine industry perceive the risks that they might face, and their assessment forms the basis of an exploration in this paper of the possible interpretation against evidence from incidents. With an increased interest in the use of formal risk assessment in the marine industry, it is important that any human contribution is properly included. The human element is seen as important in improving marine safety and any meaningful risk assessment must accommodate the contribution from people - designers, constructors, managers and operators. The paper will consider the evidence from Bailey and Ellis, place this in context and draw some inferences for the risk analyst.

10.40 - 11.10 **COFFEE**

11.10 - 11.45 **SAFETY CONSEQUENCES ONBOARD SHORTSEA SHIPS DUE TO CREW INNOVATION**
W. Post, TNO, The Netherlands
The paper investigates an alternative assignment of manning on board Dutch coasters to show that the current level of safety is maintained when monodisciplinary Chief Engineers are replaced by Maritime Officers (Marofs), combined with 24 hours shore support. A Marof has received education in navigational as well as engineering skills.This new assignment contributes in managing a serious shortage of Chief Engineers that has been forecasted. The concept was compared to the traditional assignment in a study which involved 21 modern shortsea ships in over 16,000 shifts. These measurements were provided by the Masters, Chief Mates and Chief Engineers c.q. Marofs. During their work, they answered questions about the specific conditions,the navigational and engineering process, and the safety outcome. The results indicate that sailing with a Marof combined with shore support is at least as safe as sailing with a Chief Engineer. Further,they indicate that on Marof ships, the shifts went more satisfactory and the crews were less tired compared to traditional ships, which contributes to the avoidance of fatigue.

11.45 - 12.20 **MAPPING OF WORK AREAS IN A PLATFORM SUPPLY VESSEL (PSVS): A CASE STUDY**
K.Nordby, S. Komandur, C.Lange and A.Kittlsen, Aalesund University College, Norway
When designing ship-bridges there is a need to map and mediate the structure of existing ones from a user's perspective to all participants in the process. This work reports on one such approach in the context of the initial phases of a project for creating a cutting edge ship bridge design. The data was gathered in a field study on board a ship, and an image database was created for equipment and work zones in passive and active conditions.The mapping resulted in identification and mapping of five different interest areas that were critical for co-designing.Emphasis was placed on capturing all the main features of the bridge and their use. The data served as preliminary input in the early stages of design adn for wholesome review of the workspace on a ship bridge of operation vessels for next generation bridges.

12.20 - 13.30 **LUNCH**

13.30 - 14.05 **ANALYSIS AND EVALUATION OF STATIC WORKING POSTURES ON CREW, TO DETERMINE ERGONOMIC RISK ON BOARD VESSELS**
A. Lossa, Cotecmar, Colombia
COTECMAR generated a research program to integrate Human Factors into the ship design process in order to obtain a vessel with improved conditions of operability, maintainability and habitability. This program was designed to assess Ergonomic Risk on board vessels in three phases: (1) Physical environment, (2) Static working postures and (3) Mental workload. During 2010 the second phase, which consisted in analyzing and evaluating the static working postures on board the Riverine Patrol & Supply Vessel was carried out. In order to achieve this aim, protocols based on current norms and evaluation methodologies were developed to record the information. Working closely with the crew relevant information, including the feedback from the end users, was captured this way. The latter was employed to improve the usability of the furniture, devices, and spaces previously designed, as a response to the vessel's performance requirements in terms of ergonomics. The paper presents the results of this effort.

14.05 - 14.40 **ENHANCING MARINE ERGONOMIC DESIGN VIA DIGITAL HUMAN MODELING**
T.Dobbins, STResearch, J.Hill, Trident Marine, S. McCartan, Coventry University, UK
The need for enhanced ergonomics has been demonstrated, particularly for small fast craft that suffer high level of repeat shock and whole body vibration. There is still a need to support the marine sector to facilitate better ergonomic design. The ability to more effectively assess this ergonomic interaction within the 3D CAD environment would mean that physical mock-ups would be more effective. The potential to achieve this exists via the use of Digital Human Models (DHMs). DHMs are used within the design industry but have not been found to be effective design tools for marine applications. To address this issue, motion capture analysis was undertaken to quantify the space envelopes and ranges of motion in marine environment.Subsequently DHMs have been used to develop effective console, cockpit and cabin spaces with the required ergonomic features to support effective C2. This paper describes the development process of marine-specific DHMs and their use in the optimization of ergonomic aspects of marine craft design.

14.40 - 15.10 **COFFEE**

15.10 - 15.45 **DEVELOPING A STANDARD METHODOLOGY FOR DYNAMIC NAVIGATION IN THE LITTORAL ENVIRONMENT**
F.Forsman,J.Dahlman, Chalmers University, Sweden and T.Dobbins, STResearch Ltd, UK
The safe operational of fast craft within the littoral environment places a high workload on the vessels crew and specifically the navigator. In addition to avoiding natural surface and subsurface features, the navigator must also avoid other vessel traffic. This task is subsequently made more difficult by poor weather and sea conditions. Due to the high operational tempo and the dynamic nature of transiting the littoral environment, a simple methodology was developed that would be robust in high workload conditions. The Dynamic Navigation (DYNAV) model is based on three components; i) the conduct of changes in direction/course, ii) the information required by the coxswain to perform the course change effectively and safely, and iii) the information required by the navigator to plan and direct the course change. This paper will describe the methodology, the concepts behind it's development, and how standardised procedures support the enhancement of safety, operational effectiveness and interoperability.

15.45 - 16.20 **SHOCK MITIGATION SEAT TEST AND EVALUATION PROGRAMME**
J.Colwell, DRDC, Canada
Military personnel on small high speed craft experience sustained extreme motions and repeated high-g slam impacts. Shock mitigation seats reduce the negative effects of this severe environment on health and safety. To date, most shock mitigation seat technologies have concentrated on providing protection from vertical high-g shocks, but it is also important to provide protection from lateral high-g shocks. DRDC Atlantic is pursuing an R&D initiative to reduce the risk of acute and chronic injury to personnel serving in small high speed craft. This programme seeks to improve the state of the art for modeling, simulation, test, and evaluation of shock mitigation seat technologies. This will help to provide the knowledge and experience needed to specify concise statements of requirements for future acquisitions, to define practical methodologies for demonstrating compliance with such requirements, and to encourage development of novel shock mitigation solutions.

16.20 - **GENERAL DISCUSSION**

International Conference

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RINA HQ, LONDON , UK

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