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Human Factors

International Conference on Human Factors

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08.30-09.00 COFFEE & REGISTRATION

09.00-09.35 SAFETY BARRIER INTEGRITY IN SHIP OPERATIONS, *Simon Mockler, Tore Relling, Tobias King, DNV GL.* Maritime safety regulations and inspection regimes have principally developed reactively in response to accidents and incidents in the industry. For the majority of the world's fleet the assurance of safety continues to be driven by reacting to what we are able to measure i.e. principally and predominantly occupational incidents and accidents, after the event. Broadly speaking, system safety is influenced by three measures: Personnel, Technical and Organizational. The system approach to safety has developed over a number of decades, but it has proven difficult to implement practically in the Maritime industry. DNV GL is currently pursuing methodologies which it believes would facilitate just this implementation. Proactive owners and operators have invested significant time and effort into a better appreciation of the critical barriers controlling occupational safety and major accident risks and are moving towards dynamic barrier management. The Maritime industry has lagged behind comparable industries in our understanding of the importance of the human element but in recent years has developed a greater appreciation of the importance of a strong safety culture within the organization as a contributor to safety management and barrier integrity. Recognizing the potential value of a holistic and dynamic approach to safety management, DNV GL is developing a methodology for the assessment of safety culture as an influence on barrier integrity, uniting two of the principal measures of safety performance.

09.35-10.10 THE HUMAN ELEMENT OF MODULAR CAPABILITY, *Rob Crabbe, BMT Defence Services Ltd, UK, Georgina Fletcher, Frazer Nash Consultancy, UK, Chris Kelly, K Sharp, UK, M Wood, BMT Reliability Consultants Ltd, UK, D Collins, Grey Matters Performance Ltd, UK.* The aim of this paper is to highlight the human factors (HF) issues surrounding naval ships designed with modular capabilities i.e. ships with modular systems that can be added or changed to allow a ship to perform a different role. Modularity is not a new concept and much work has been done to understand the technical aspects. However, the training and personnel implications of modularity on a ship's core company are not well understood. Moreover, the ability to maintain the non-embarked elements of a ship's company with a sufficient level of training and motivation has seen little study. This initial phase of the study included a literature review and interviews with Royal Navy (RN) stakeholders. A new definition for modularity was developed, encapsulating both equipment and HF issues and established a framework identifying levels of modular systems. The team quickly realised that, particularly with vessels such as the Type 26 frigate, the detrimental impact on the core crew could be significant and the infrastructure that would be needed to maintain the training and experience of modular system crews would be extensive. In particular, the proposed UK Way Ahead on Modularity highlights an equipment-based description that, although useful from an industrial procurement perspective, does not adequately articulate the whole concept of modularity.

10.10-10.45 RISK ASSESSMENT MODEL FOR SHIP COLLISIONS IN CONSIDERATION OF HUMAN FACTORS, *Professor Takeshi Shinoda, Kyushu University, JAPAN.* Most marine accidents related to vessels are the result of human factors, such as missed timely detection, judgment errors and incorrect operation of functional systems for safe navigation. In recent years, collision accidents are occurring frequently in the seas off the coast of Japan, which have been reported widely in the media. These accidents convey a negative image of marine transportation and needs to be addressed for improvements. In this paper, we examine the application of the Bayesian network for accident occurrence modeling, which can reveal the causal relationships between human factors in maneuvering vessels and ship collisions. Then we create risk analysis models for the collision accidents using the Bayesian network. This model consists of three major components which are; (a) the model of ship maneuvering, (b) the model of collision factors and, (c) the model of effective factors for Risk Control Options (RCOs) as safety measures to reduce collision risks. Collision Risks are analyzed by using the conditional probability table calculated using the constructed collision database. Evaluation of RCOs for collision is calculated using the effective dominance index. Finally, a trial cost-benefit analysis for RCOs is considered through gross cost of averting fatality index in the guidelines for Formal Safety Assessment (FSA) approved by IMO in 2002. These are applied by analyzing the records of adjudication of marine accident inquiries of vessel collisions, ship traffic surveys and a questionnaire survey for fishing vessel operators.

10.45-11.15 COFFEE

11.15-11.50 CHANGING TECHNOLOGY – REDUCING RISK OR INTRODUCING NEW THREATS? *Vaughan Pomeroy, Adjunct Professor, University of Southampton.* The maritime industry is introducing new technology at an increasingly rapid pace. This is driven by a need to develop highly efficient solution to serve the demand for transport that has emerged from the financial crash of 2008. The global demand for maritime transport continues to evolve as the new order is established. It has also been necessary, and will continue to be essential, to introduce new solutions to meet regulatory changes, such as the treatment of exhaust gases and ballast water. Additionally more change will be inevitable to meet the societal expectations in relation to climate change. The maritime industry faces demands to increase safety and, in particular, to reduce pollution and so it is important that the impact of technology change on risk should be understood. Given the importance of the human element in risk mitigation, and the impact of the human element on the causes of incidents, this paper examines how the historical record gives some indication of the effect of changing technology on risk and looks forward to explore the potential for new threats to maritime safety, before considering how to ensure that new technology can be adopted without undue risk.

11.50-12.25 OPTIMIZATION OF THE ERGONOMISTS INTERVENTION INTO A SHIP DESIGN PROCESS, *Céline STALLA & Jean-Philippe FLOHIC, DCNS, France.* Mainly through major programs of surface ships and submarines for the French Navy, DCNS has experienced Human Factors and Ergonomics (HFE) integration into the design process on a large-scale. A broad spectrum of approaches could be experienced by the DCNS HF team in the way to promote the HFE point of view in the design process such as: normative approach, missions and tasks analysis, use of simulators, management of a broad participation of future users in the design process at both definition and evaluation stages. The experience is mainly about FREMM frigates project and BARRACUDA submarines project. It goes from very early stages of the design to commissioning phases. This paper will present the main lessons learned by the DCNS HF team in the field of HF integration over the past decade. These lessons will result in a number of suggestions about the best possible use of the ergonomics discipline in naval projects: tools and methods but also ergonomists themselves.

12.25-13.30 LUNCH

13.30-14.05 THE ABS APPROACH TO SELF-ASSESSING SAFETY CULTURE IN MARITIME ORGANISATIONS, *CM Tomlinson, BN Craig, and KP McSweeney, ABS, USA.* In all hazardous industries, it is now accepted good practice to have in place a safety management system, and to institutionalize safe working practices and attitudes through the development of a positive safety culture. Over the course of the last decade, ABS and Lamar University have developed a methodology for maritime organisations (with cargo-carrying commercial vessels) to self-assess their safety culture. The method is detailed in full in the ABS Guidance Notes on Safety Culture and Leading Indicators of Safety, published in 2012, and updated in 2014. The Guidance Notes are fully comprehensive with guidance on preparing for the survey; twinned questionnaires for shipboard crew and shoreside staff; statistical analysis with worked examples; and information about how to utilize the results. The completeness of the Guidance Notes enables clients to run the survey by themselves should they wish to do so, but most choose to have assistance from Lamar University where they have developed an associated software tool. The software runs the surveys, undertakes statistical analysis, and generates a report and detailed findings. Results are stored on the database, facilitating trending and benchmarking analyses. This paper details the theoretical approach to the self-assessment of safety culture that underpins the ABS methodology, results to date, lessons learnt, and the benefits of this approach.

14.05-14.40 TOWARDS FATIGUE RISK MANAGEMENT SOLUTIONS IN VESSEL AND OPERATIONAL DESIGN, *W. Uitterhoeve, G. van der Want, MARIN, Netherlands, A.P.J. van Eekelen PhD, CIRCADIAN, Netherlands.* In safety-sensitive industries like aviation or chemical industry, fatigue is one of the aspects taken into account to improve operational performance and safety. To date in the maritime domain, employee fatigue and the way to manage and reduce related risks is underexposed. This paper aims to increase the awareness of fatigue related aspects in maritime design and operations and demonstrates practical fatigue reduction solutions. This paper presents examples of fatigue contributing factors during offloading and towing operations, based on interviews with mooring masters and tug captains. Fatigue is a complex phenomenon with root causes related to the individual employee, vessel and operation design, organisational and environmental factors including staffing and scheduling. Mitigation of fatigue related risks requires an integrated approach, as applied in Fatigue Risk Management Systems (FRMS). The paper demonstrates how practical solutions contribute to the development of maritime FRMS.

14.40-15.15 EARLY HUMAN FACTORS IN COMMAND AND CONTROL SPACE DESIGN, *Claire Launchbury, James Campbell, BMT Defence Services Ltd, UK.* The aim of this paper is to highlight the value achieved by considering the Human Factors (HF) relating to command and control spaces early in the basic General Arrangement (GA) design process. Command space design is the focus of a dedicated MOD Maritime Acquisition Publication (MAP 02-001) which is concerned with guiding the significant cost investment involved during the design of command and control spaces within a GA at a mature stage of development. However, the practical reality of GA basic design, especially early in the process, involves continuous compromises and trade-offs between competing design demands. The aim of this work was to enable the Human Factors team to more effectively represent the end user and push for optimal command space functionality against competing pressures during GA trade-off discussions. Without a focus on operational needs on behalf of end users, other design pressures dominate and risk diminishing the operational effectiveness of the vessel. This work involved the creation of a cost effective, expert-led design process in order to gain an early understanding of the command and control space requirements.

15.15-15.45 COFFEE

15.45-16.20 COGNITIVE MODELLING OF CREW RESPONSE DURING NAVAL DAMAGE CONTROL OPERATIONS, *A Woolley, J Liu and A Travers, Defence Science and Technology Group, Australia.* Understanding crew response to damage events is critical in the analysis of Naval platform survivability. Naval Damage Control (DC) decision-making is governed by Standard Operating Procedures (SOPs), which consequently provide a simple, logical construct for analysis. Using a technique known as Hierarchy Task Analysis (HTA), the SOPs used by the Royal Australian Navy (RAN) were analysed to determine the tasks and associated goals of DC operations. HTA enabled identification of the conditions within the DC SOPs that trigger specific actions the crew need to perform. Information represented in the HTA was implemented as behaviour trees utilising the UNITY3D simulation environment. This facilitates rapid prototyping to imbue intelligent agents with the knowledge inherent in RAN DC SOPs. DC scenarios may then be developed in which these intelligent agents will be used to model containment, and recovery from, the damage event. This modelling capability will be utilised to determine the effects of changes to crew composition, such as might occur due to incapacitation from the damage event, and changes to DC SOPs on the survivability of RAN Platforms. The modelling capability could contribute to a computer simulated environment for DC training, whereby trainees would interact with the intelligent agents. Additional, longer-term analysis involving experienced DC personnel will facilitate understanding of adaptive decision-making within the bounds of DC SOPs.

16.20-16.55 PRIORITY SAFETY AS CHARACTERISTICS OF HUMAN FACTORS ON THE CAUSES OF SINKING OF VESSELS, *Dr. Haryanti Rivai, Hasanuddin University, Indonesia.* Marine accidents that have occurred could have been prevented with greater attention to safety. Those particularly true for sinking on the vessel. According to the final report of the accident investigation ship by the National Transportation Safety Commission (NTSC), found one of the most frequent contributing factor in the case of the sinking is the human factors or human failures. Method Analytic Hierarchy Process (AHP) is a simplification of a complex problem that is not structured, strategy, and dynamic to be a part as well as arrange in a hierarchy by a numerical weight or priority. The weight of each characteristic human factors with the actor of vessels that can cause the risk of sinking. An effective method is proposed for comparing characteristic of human factors such as communication and navigation; knowledge, experience and skill; management and regulation in the case of the sinking of the vessel in Indonesia.

16.55- GENERAL DISCUSSION & EVENING DRINKS RECEPTION

08.30-09.00 COFFEE & REGISTRATION

09.00-09.35 THE TRAINING SYSTEM: DEVELOPING CREW COMPETENCE WITHIN THE VIRTUAL AND REAL WORLDS, *J Hill; Trident Marine, UK, T Brand; StrongWake, Canada, T Dobbins; STResearch, UK.* Fast craft operations are high risk and push the crew to the edge of their operational capability in the full range of environmental conditions. Effective Command & Control in these conditions is essential if risk is to be effectively managed and safety maintained. This capability is founded on education, training, and experience. Defining the required competences facilitates both training and assessment, which are delivered via classroom, computer-based and on-water training. Competencies can be divided into three aspects; knowledge, skills and attitude (KSA). Classroom taught knowledge is essential, but it is the crew's demonstration of their skills and attitude, when put under pressure, on the water, that is of the ultimate competence test. To support the training and learning process, instructors use a range of tools from simple performance profiling to full mission simulation. The ability to practice Standard Operating Procedures (SOPs) prior to operations and in increasing demanding situations is vital to maintain capability. Simulation, correctly integrated into a training syllabus, is a valuable tool in the education progression of developing individual and team competence and proficiency. Simulation can also put the crews into increasingly more dangerous scenarios, gaining experience that is not available in real life without extreme dangers to life or craft. The essential aspect for the development of competence is the training curriculum that develops individual and team competence.

09.35-10.10 HUMAN CENTERED DESIGN FOR AN INNOVATIVE TRAINING SYSTEM USING VIRTUAL REALITY: NAVAL HELOHANDLING TRAINER, *Chantal MAÏS, Yann BOUJU DCNS, France, Lucie LEMONNIER, Alexandre BOUCHET, CLARTE, France.* This paper presents the Human Centered approach used for the development of an innovative training system using virtual reality (NHT). This system aims to train helicopter crews to flight deck operations on naval ships. Firstly, we present why NHT is so important for this crew and modern naval force and the user requirements it fulfills. In a second chapter, the system developed by CLARTE and DCNS is detailed. This paper presents the Human centered approach to design the NHT solution for the flight deck director. This solution is based on a Virtual Reality Environment using a head-mounted display and a real-time Gesture Recognition toolkit. One of the main challenges is to offer a system that is sufficiently representative of real-life conditions (ship platform movements especially) while not causing virtual reality sickness during training sessions. In a third chapter, the evaluation of this solution is presented, especially the "Virtual Sickness" aspects. This evaluation is performed with the future users (marine professionals) and also with a larger sample of peoples. Goals and protocol are described including different scenarios, sessions lengths, and tasks to be performed. Finally, the results of this evaluation are described based on SSQ questionnaire and balance observations during and after the test. The main characteristics of the simulation for helicopter and flight deck are described, relevant to the Virtual Sickness.

10.10-10.45 FROM REACTIVE IN TRAINING TO PROACTIVE IN DESIGN: APPLYING STANDARD MARITIME DESIGN, *Margareta Lutzhoft, Michelle Grech1, University of Tasmania Australian Maritime College, Australia; Min Jung, Korean Institute of Maritime and Fisheries Technology, Korea.* As technology advances are increasingly being implemented on ships, variability and complexity in design and use also increases. Traditionally, so does training requirements. With sometimes more than 30 manufacturers on just one ship's bridge this variability is evident both within and between ships. Such variations have significant impact for crew, creating the need for more mandatory training requirements, negative transfer of learning and increased error rates, overall hindering effective decision making and degrading safety of navigation. The time has come to suggest that we cannot train away the problem, but should apply a more effective countermeasure to failure – design the problem out.The standardization of navigational systems is one effective countermeasure to reducing variability and system complexity, and the IMO is now proposing guidelines on standardisation as one of its outputs for 2018. Aproposal submitted to the IMO in 2008 by the International Federation of Shipmasters' Associations (NAV 54/13/1) was to develop S-mode as a default standard display which would activate and present a standard user interface. Work on developing S-mode guidance within the IMO is now underway. This paper will provide an overview of research and development activities being undertaken to support the formulation of the S-mode guidance.

10.45-11.15 COFFEE

11.15-11.50 THE ROLE OF NAVIGATIONAL ASSISTANCE IN MANAGING UNCERTAINTY AND SAFETY AT SEA, *Linda de Vries, Chalmers University of Technology, Sweden.* Navigational assistance services aim to improve maritime safety. Traditionally these services have been provided on board the vessel, but continuous technological advancements have created new possibilities to provide additional assistance both on board and from shore. This paper explores the contribution of navigational assistance, as provided on board by maritime pilots and from shore by Vessel Traffic Services Operators, towards safety at sea. Starting from the sociotechnical perspective that safety is created through the interaction of humans, technology, organisation and the environment in which they operate, the paper investigates how uncertainties in the ship-shore system may be identified and managed to create successful outcomes. This paper considers a case study of a potential close quarters situation between three vessels, together with a model of navigational assistance developed using the Functional Resonance Analysis Method (FRAM). In the case study, a large bulk carrier finds itself in a potential close quarters situation with two other vessels near the entrance to a deep water channel. Uncertainty regarding the vessel's draught restricts its manoeuvrability, increasing the risk of collision and grounding. Analysis of this case illustrates how a potentially unsafe situation may be identified, communicated and resolved by the interaction between vessels and shore, thereby improving safety in everyday operations. Furthermore, it shows how FRAM may be used effectively both for modelling a complex work system on a generic level, and also for understanding how work is conducted safely in a specific situation.

11.50-12.25 STANDARDISED INFORMATION ARCHITECTURE TO SUPPORT THE DYNAMIC NAVIGATION (DYNAV) STANDARD OPERATING PROCEDURE, *T Dobbins; STResearch, UK, J Hill; Trident Marine, UK, T Brand; StrongWake, Canada.* Fast craft operations are typically undertaken at high tempo and in congested littoral areas. Operating at the edge of the operational envelope puts the crew under extreme stress to deliver the required performance whilst managing the inherent risks and possible disastrous outcomes. The crew operates as part of a Joint Cognitive System (JCS), the interaction of the crew and technical components working together within the harsh environment. The adoption of the DYnamic NAVigation (DYNAV) methodology has highlighted the need for systems to support this SOP. Situation Awareness (SA) supports Command & Control (C2) / DYNAV tasks within the JCS and its requirements are described within the HSC HFE Design Guide. Information is fundamental to developing and maintaining SA, for DYNAV this requires the crew to make sense of the information provided by the systems displays. Current displays do not effectively support the crew and degrade their ability to operate safely at the edge of the operational envelope. The information must be formatted to specifically support DYNAV and the crew's ability to make safe and effective decisions. This requires the display design development to use a Human Centred Design (HCD) approach, as required by the IMO. This HCD approach also addresses the control of the information, which must be simple, intuitive and effective for operations in a harsh RS & WBV environment. Although new technology and systems are continually being developed, e.g. Head-Up Displays and automation, they must still support the decisions that the crew make.

12.25-13.30 LUNCH

13.30-14.05 NOT WITHOUT MY DOG!, *Dr. Ruillé Jonathan, University of Nantes, France.* Ferry companies like our pets. All suggest to the passengers to travel with their dogs or their cats but don't specify how they will be taken care if the captain gave the order to abandon the ship. According to the duration of the crossing, animals can stay in the car passengers in garages or have to go in a kennel. There may be up to 90 dogs crossing during summer. If abandonment is necessary, the crew may encounter some difficulties. Some passengers are very attached to their pets, "we have some passengers who go as far as sleeping in the kennel with their dogs! And they, for sure, will not leave without their dogs "(Charles, captain). Then, we can suppose that they will not leave the ship, or with difficulty, that can lead to unmanageable situations for the crew. And if they are allowed to evacuate the ship with their pets, what will the reaction of other passengers? Our original contribution will propose a reflection on the evacuation of ferries, emphasizing the importance to anticipate the reactions of the passengers and to consider pets in order not to add difficulties to the crew, who will manage an abandonment in a context of ambiguity, uncertainty and emergency.

14.05-14.40 HUMAN FACTORS IN THE DESIGN OF A PCTC VESSEL, *Nicolas Bialystocki, Antares Shipping LTD, Israel, Nicole Costa, Chalmers University of Technology, Sweden.* Based on the results of a paper by Costa and Lützhöft (2014), THE VALUES OF ERGONOMICS IN SHIP DESIGN AND OPERATION, presented at RINA in 2014, this paper elaborates on the practical implementation of Human Factors Dimensions of Ship Design using real-world examples from the design of a Pure Car and Truck Carrier (PCTC) vessel. The examples and illustrations included in this paper are from various stages of the design, such as technical specification of a new ship, detailed design drawing of the ship, and also feedback cases from the end-users, i.e. crew. The perceived benefits of applying User Centered Design (UCD) in Costa and Lützhöft (2014) are hereby verified using the case study of a PCTC vessel, and representing a success story that can be utilized by other ship designers. It is believed that demonstrating real-world Human Factors implications in the design of a vessel is essential for promoting the importance of UCD and the possibilities that having UCD as a mind-set can produce in ship design.

14.40-15.15 HUMAN FACTORS IN SHIP DESIGN; IMPLICATIONS FOR SHIP REPAIR & SHIP BUILDING WORKERS, *H.D.P.Manjula Hettiarachchie, Colombo Dockyard Plc, Sri Lanka.* Safety is a critical factor in Ship repair & Shipbuilding industry. There are many fatal accidents reports around the world in various ship yards every year and partial and total disabilities are countless. Most of these accidents are due to high risk operations that they have to involve. Due to the commercial interest of shipyard owners and also due to the pressure of ship owners, shipyards are tends to accept high risks and trying to complete the tasks in hand quickly, which ultimately leading to accidents. In designing ships, sufficient consideration for shipbuilding or ship repair activities needs to be given to overcome this situation. During normal operations of ships, they are handled by competent personal, but when it comes to a shipyard most of the employees are not competent like seafarers. The other factors should consider during the design stage is how the ship is going to repair during its life cycle. Sometimes simple changes to a ladder or to a manhole opening could save several lives of dock workers. If not given due respect to repair of ship during the design stage, there are many additional cost to be borne by ship repair companies to prevent accident, which in terns increase both repair period and cost to the company, which Dockyard are not ready to accept. Therefore ship designers should consider the repair aspects of ships to reduce the fatalities and other accidents for dock workers around the world. A simple design change can save several lives.

15.15- GENERAL DISCUSSION

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