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Perceptions of demanding work in maritime operations

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ABSTRACT

Demanding work might have properties that increase the risk of incidents and accidents. The purpose of this study is to understand such perceived demands through sharp end experiences. A better understanding of demanding work can support safety oriented training agendas and facilities, and evidence-based component frameworks can contribute to accident prevention and intervention as situated needs and requirements in the industry are incorporated. Emerging demands can accordingly either be adapted to framed components, or give rise to new components.

A sample of maritime operating crew partaking in maritime simulator training courses answered a questionnaire developed by a reference group consisting of people responsible for maritime training. An exploratory analysis of the 42 items generated seven distinguishable components of demanding work: Elemental forces and technological strain, incidents and accidents, reporting and assessment, pressure and interruption, team shortcomings and cultural differences, interaction obstacles, and own individual shortcomings. The structural components weighs unevenly in how demanding they appear, and in their influence on each other.

We discuss some methodological issues, like the context of the study, and order and wording effects on the component structure. These may hamper the validity of conclusions, but the tentative model is still important to raise consciousness for future maritime operations. Further research is encouraged, especially in other cultures, other types of operations, and with regard to resources available for mitigation.

1. Introduction

1.1. The human element

Human element issues have been assigned high priority in the work programme of the International Maritime Organization (IMO) because of the prominent role of the human element in the prevention of maritime casualties. IMO Resolution A.947(23) – Human Element Vision, Principles and Goals for the Organization – acknowledges “the need for increased focus on human-related activities in the safe operation of ships, and the need to achieve and maintain high standards of safety, security and environmental protection for the purpose of significantly reducing maritime casualties”. The 23rd assembly adopted the resolution in November 2003. The human element is of importance as multilayered influence on maritime work, all the way from initial intentions to act in this global market, to regulations of activities in all aspects of the industrial chain, and into the sharp end performances, where execution conveys the implemented safety of all actuating parties. El Ashmawy (2012) states that “the human element in the maritime/shipping industry, and in particular seafarers, should be treated as human capital who can add worth to the business with preferable protection, indemnity and deliberate investment”. Understanding human performance and human errors can thus have tremendous impact on the industry. Improvement and implementation of safety management systems (SMS) and proper maritime education and training (MET) directly impacts the practical safety of ships (El Ashmawy, 2009). However, as Schröder-Hinrichs et al. (2013) argue when analyzing maritime human factors and IMO policy, instead of reactively responding by awaiting accidents and incidents to happen, it now seems to be enhanced conditions for acknowledging complexity and identifying proactively issues that IMO member states must act upon.

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1.2. The maritime operations safety context

One of the principles in IMO's resolution (principle b) explicitly states that when developing regulations, the Organization "should honour the seafarer by seeking and respecting the opinions of those that do the work at sea". Exploring the context of demanding operations, and mediating and processing the experiences of "those that do the work at sea" can thereby raise awareness of the causal powers that may evolve in maritime operations, and further contribute to MET developments and SMS refinement.

Recent requirements from the Norwegian Maritime Authority, also based on IMO by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), includes courses in Bridge resource management (BRM) and Engine room resource management (ERM) adding to the Crew resource management (CRM) contributions. The certification process involves substantial safety awareness. Maritime operations, however, have an additional layer of demanding work to the ordinary seafarer work. Maritime operations may be serving the oil and gas industry through functions like demanding anchor-handling operations (AHO) and rig-moves; by installation, maintenance and repair work (IMR); or specific types of operations like towing of icebergs to avoid collisions with such petro-structures, for instance. Lately, maritime work in other energy industries have expanded, such as in offshore windfarms. Subsea activities also involve for example explorations and mining of mineral resources beneath seabed. Ocean explorations are driven in new directions by national policies and by the industries both at the seas and onshore, and preparation for safe operations may seem difficult when the work expands to increased depth, harsher climates, more complex interactions, extremely advanced vessels and technologies, and equipment increasing in size and cost. The risk thus seems to intensify, calling for similarly more advanced preparation to maintain safety.

Emad and Roth (2008) discuss the contradictions in practices of training for, and assessment of, competencies, where certification may correspond less to the real competence needs than mariners themselves are comfortable with, and on-the-job training (on-board) and more cumulative records of competencies may be advantageous. However, for demanding operations, maritime simulators have the advantage of enabling training of operations without the immense consequences that may occur from real life experimentation. There is a need to understand where the risks develop, and the situated experience of performing crew is of great value in developing safety-oriented preparation. The research and innovation strategy for the maritime industry in Norway, Maritim21, requests further efforts to meet the challenges in the sharp end of the industry and develop effective models for decision support and training. Situated knowledge from the maritime industry is therefore crucial to enable better customization of safety-oriented interventions like simulator training.

1.3. Framing human elements for safety purposes

Deciding upon the constituents of relevance for risk and safety in maritime work is an extensive affair. There are amounts of conceptual arrangements, like frameworks, typologies, and taxonomies in the scientific literature that could be of relevance to demonstrate causal relationships between concepts of for instance organizational or human factors and a multitude of outcomes. The ways we theoretically structure concepts of work depend, among others, on the universal ideas we have of the concepts, the purposes and the problems, as well as the approach we choose for empirically studying those. According to Dekker (2005), our understanding of human factors and their involvement in safety has been too naïve. A notion often referred is that about 80% of accidents have root in human failures. However, as Dekker (2005) asks, "Where does mechanical failure end and human error begin? Dig just deep enough and the question is impossible to answer". Risk is associated with a multitude of factors in maritime operations. It may be manifest in the conditions, or in the human perception of such conditions, and the *perceptions* of demands can further affect the real threat, whether such perceptions are illusory or real.

To explore the human elements in demanding work, we present briefly some contributions that have influenced the interpretation of data and identification of structures in this study.

Human factors (HF) approaches have influenced especially CRM by focusing on familiar concepts like stress, fatigue, communication, leadership, workload, etc., and CRM training has proven to be successful in other high-reliability industries like aviation and medicine. In more recent safety oriented literature for the shipping industry, Hetherington et al. (2006) present an organizing framework, performing a review of different human factor related sources. In this framework, Organizational and management issues incorporate safety culture, -climate, and -training; Personnel issues contains stress, shiftwork, situation awareness, fatigue, health and wellbeing, decision making, communication, and training; and finally Design issues involves automation. Expanding this organizing framework with a fourth layer, the Environmental context (physical, economic, and regulatory), Schröder-Hinrichs et al. (2013) develop a taxonomy in purpose of coding contents of human factors-related publications as well as submitted documents to IMO. This revision of the model builds on ideas of active and latent conditions, and immediate and underlying causes leading to accidents (Schröder-Hinrichs et al., 2013). They further detail these four layers at level 1 (named Environmental context, Organizational Infrastructure, Personnel Sub-System, and Technical System) into a more fine-grained level 2 (10 elements) and even more refined level 3 (24 elements). This model thus captures a broad range of level 3-elements of importance for safety-critical work, like weather conditions, organizational culture, crew interaction and unsuitable equipment, to mention one element from each layer. Also, Chauvin et al. (2013) discuss the need to choose a relevant accident model in complex socio-technical systems, and describe HFACS-Coll (Human Factors Analysis and Classification System to analyse collisions at sea) with five main causal categories; Outside factors, Organisational influences, Unsafe leadership, Preconditions for unsafe acts, and Unsafe acts.

Flin et al. (2008) single out seven main categories of non-technical skills necessary to cope with risks and demands "at the sharp end": situation awareness, decision-making, communication, teamwork, leadership, managing stress, and coping with fatigue. However, we may argue that one of the consequential challenges of these models is that ideas of *absence* of such demand-coping resources can regress to become a demanding factor, and non-linear complex relationships emerge. The job demands-resources (JD-R) model (see for instance the state-of-art publication by Bakker and Demerouti (2007)) elaborates on a balancing assumption of stressors versus motivational elements, with the wellbeing of individuals as an idealized state. In a safety perspective, we could translate "wellbeing" to "operational safety state". However, an assumption of a balanced resource-demands-relationship may be neither met, nor normatively correct, for maritime operations. In demanding operations, redundancy, such as for instance costly latent resource systems in vessel technology, adds to safety although not necessarily effectuated. Demerouti and Bakker (2011) clarify the concept of job demands as "those physical, psychological, social, or organizational aspects of the job that require sustained physical and/or psychological (cognitive and emotional) effort or skills". They also point to the situated nature of such demands, saying, "every occupation has its own specific risk factors associated with job-related stress". Working at the seas involves some very distinct stressors, since the vessel you operate onboard is in motion at most times. Ross (2009) lists eight human stressors to attend to in vehicle design and operation: Mental workload, Airborne noise, Whole body vibration, Motion, Impact, Excessive, insufficient or inappropriate lightning, Temperature extremes, and Lack of ventilation. With the probable exception of the mental workload component, all stressors may be physically or technologically mitigated, and Ross (2009) discusses workload *transition*