Safety culture, working conditions and personal injuries in Norwegian maritime transport

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ABSTRACT

The aim of the study is to examine the influence of safety culture and working conditions on personal injuries and risk perception on vessels sailing along the coast of Norway (mostly bulk, well and general cargo). The study employs three methods: small-scale survey (N = 180) to crewmembers, reference group meeting and qualitative interviews with sector experts (N = 10). Results indicate that organisational safety culture, manning level on board, work pressure and demanding working conditions are closely related, and that these factors influence injuries and risk perception on the studied vessels. Analyses indicate that lower manning levels induce higher work pressure, which negatively influences safety culture. Respondents on vessels with lower manning levels (3–4 people) score lower on many of the key variables of the study: they experience more personal injuries, experience more stress, and rate the safety culture as lower than respondents on other vessels. It is not examined whether manning levels are too low. The safety challenges of vessels with lower manning levels are probably due to framework conditions (e.g. economy, competition). Future research should examine how to improve working conditions and safety culture on these vessels, given the current manning levels and framework conditions.

1. Introduction

1.1. Background and aims

Sea transport is central to world trade, as it carries about 90% of internationally traded produce [1]. Sea transport dominates long distance goods transport in Norway, where it constitutes about 81% of the import, measured in tonnes, including passenger ferries, and about 73% of the export measured in tonnes, including ferries and excluding crude oil and natural gas [42].

According to Ek et al. [7], seafaring is still among the most hazardous of occupations, although mortality rates for seafaring have declined substantially over the course of the 20th century. Merchant shipping is known to have a high rate of fatalities caused by both occupational accidents on board vessels and shipping accidents, involving e.g. foundering, grounding [7]. According to Nævestad et al. [32] there were on average 15 killed and 424 injured annually on Norwegian ships, i.e. Norwegian Ordinary Ship Register (NOR) and Norwegian International Ship Register (NIS) in the period 2004–2013.

The present study focuses on occupational safety on vessels sailing along the coast of Norway. The Norwegian Maritime Authority (NMA) has previously identified challenges in the coastal cargo sector that may potentially affect safety, e.g. an ageing fleet, negative framework conditions, and sought more knowledge on manning levels, safety culture on board and working conditions (cf [43]). In their study, Størkersen et al. [43] especially point to the negative safety effects of fatigue, heavy workload and alienation, stressing that these factors may cause operational errors. Other studies have also underlined the importance of working conditions for occupational safety in the maritime sector, e.g. manning level, work load, fatigue and stress [2,21,22,36,45].

Studies have also highlighted the importance of organisational safety culture for maritime safety, (cf [16,20,24,46, 53, 58]). In spite of this, there are few studies of maritime safety culture compared to other sectors. In 2005, Håvold reported literature searches indicating that only a couple of studies about safety culture and climate recently had been done in shipping [15]. A review conducted eight years later still found relatively few studies of safety culture at sea [49]. Organisational safety culture can be defined as "safety relevant aspects of culture in organisations" [12,3]. In this study safety culture is specified as shared and safety relevant ways of thinking or acting that are (re)created through the joint negotiation of people in social settings ([28], see also: [55]). It may be useful to think of organisational safety culture as the informal aspects (“how things are actually done”) of safety in organisations to distinguish it from the formal aspects (“how things should be done”), as described in procedures, routines and organisational charts etc ([3], see also: [54]). The latter is also referred to as safety management system (SMS), which typically include management policy,

http://dx.doi.org/10.1016/j.marpol.2017.07.019
Received 17 February 2017; Received in revised form 21 July 2017; Accepted 21 July 2017
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appointment of key safety personnel, reporting systems, hazard identification and risk mitigation, safety performance monitoring etc. [41].

The main safety prevention focus in the maritime sector is on safety management systems (SMS). This is due to the SMS requirement of the International Safety Management (ISM) code of the International Maritime Organization (IMO). IMO is the United Nations’ specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution from ships. IMO made the ISM code statutory in 1998. The ISM code was developed after several severe maritime accidents were found to be caused by human error and insufficient safety management systems [19]. IMO’s primary goal with the ISM code was to gradually create a new safety culture in the maritime industry [18].

The regulations on manning levels (IMO 1047) is another key maritime safety regulation. The safety manning defines the minimum crew size and minimum qualifications required for sailing from A to B, not taking into consideration the operational tasks which also must be done on board ships while sailing, for instance related to preparing for loading/unloading, maintenance, administrative tasks and so forth. If vessels choose to only have a safety manning, it is likely that they will be understaffed when it comes to safety critical functions. The “operational manning” is the manning level chosen by the shipping companies, based on their considerations of the needs of their vessels, additional to sailing.

The aim of the present study is to examine the influence of safety culture and working conditions on personal injuries and risk perception on vessels sailing along the coast of Norway. Obtaining knowledge on the relationships between these factors is a prerequisite of implementing preventive measures to improve occupational safety on board vessels. In this study, occupational safety refers to personal injuries and risk perception. Working conditions refer to factors like manning level on board, work pressure, and demanding working conditions.

The data used in the present report was originally collected in another project, which is reported in Nævestad [33]. The aims of the previous study were to study the relationship between organisational safety culture and safety on board vessels and to compare nationallyflagged (NOR) vessels with vessels flying flags of convenience (POC) when it comes to national safety culture, communication, working conditions, fatigue and implementation and enforcement of international rules [33]. The present study looks closer at the sample of largely Norwegian respondents from NOR-registered vessels only (N = 180), to be able to consider the effects of organisational factors on occupational safety without the confounding effects of flag or nationality (results are also reported in: [34,51]).

1.2. Previous research

1.2.1. Personal injuries and risk perception in maritime transport

Personal safety generally refers to two categories of incidents: personal injuries due to work accidents on board (or ship accidents), and ship accidents (i.e. fire/explosion, grounding, severe weather damage, capsizing, collision, contact damage, leakage, breakdown of machinery, environmental damage/pollution, stability failure (without capsizing), missing/disappeared vessel and “other accident”) [27]. Norwegian statistics shows that most personal injuries (96%) are due to work accidents on board, and that only four per cent are related to ship accidents in the period 1981–2013 [32]. The number of personal injuries on Norwegian flagged cargo vessels have been reduced in recent years (Fig. 1).

Fig. 1 indicates that the number of injuries per 1000 vessels have been reduced substantially for both injury severities in the period. The risk for the most severe injuries has been reduced by 63% in the period. In the same period, the number of NIS/NOR cargo vessels increased with 34%, to 3470 ships in 2013 [32]. In a questionnaire study including 6461 participants in 11 countries, Jensen et al. [17] found that during the latest tour of duty, 9.1% of all seafarers were injured and 4.3% had an injury with at least 1 day of incapacity. Hansen et al. [13] studied 1993 occupational accidents among crew aboard Danish merchant ships in the period 1993–1997. This study found that the mean risk of having an occupational accident was 6.4/100 persons at sea and the risk of an accident causing a permanent disability of 5% or more was .67/100 persons aboard. Comparing the risk of occupational accidents on different vessel types, Hansen et al.’s [13] study reports that Roll-on-roll-off vessels (2.85 per 10,000 persons) and passenger vessels (2.63) have the highest risk of occupational injuries of all severities, while gas tankers (;86) have the lowest risk. Looking at the accidents causing permanent injuries or fatal accidents on the other hand, coastal cargo vessels are among those vessels with the highest risk, while passenger vessels have the lowest risk [13].

1.2.2. Factors influencing personal injuries and risk perception

1.2.2.1. Demographic factors. Hansen et al. [13] also found that foreigners have a considerably lower accident risk than Danish citizens, and that age was a major risk factor for accidents causing permanent disability, but younger seafarers had a higher risk. Jensen et al. [17] also found seafarers’ age (<35 years) and nationality to predict occupational accidents. Nævestad et al. [48] also found seafarers age (<26 years) to predict occupational accidents in a questionnaire study including crewmembers on passenger vessels registered in the Norwegian Ship Register (NOR) (N = 84) and NOR registered coastal cargo vessels (N = 73).

1.2.2.2. Position/work activities. Jensen et al. [17] also found that position (i.e. rating) and work in engine room to be related to personal accident involvement. Hansen et al.’s [13] study found that the most serious accidents happened on deck.

1.2.2.3. Situational factors. Other key findings from the study of Hansen et al. [13] is that change of ship and the first period aboard a ship were identified as risk factors. Walking from one place to another aboard the ship caused serious accidents. Jensen et al. [17] also found tour lengths (<117 days) to be related to personal accident involvement.

1.2.2.4. Safety behaviour. Jensen et al. [17] found lacking use of protective equipment to be related to personal accident involvement. Nævestad et al. [48] found that an index made up of four safety behaviour items predicted personal injuries. These were: “I violate
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